JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY;

CONTAINING ITS TRANSACTIONS AND PROCEEDINGS,

AND A SUMMARY OF CURRENT RESEARCHES RELATING TO

ZOOLOGY AND BOTANY

(principally Invertebrata and Cryptogamia),

MICROSCOPY, &c.

Edited by

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and Professor of Comparative Anatomy and Zoology in King's College;

WITH THE ASSISTANCE OF THE PUBLICATION COMMITTEE AND

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FOR THE YEAR

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Part 1.

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THE

Royal Microscopical Society.

(Established in 1839. Incorporated by Royal Charter in 1866.)

The Society was established for the promotion of Microscopical and Biological Science by the communication, discussion and publication of observations and discoveries relating to (1) improvements in the construction and mode of application of the Microscope, or (2) Biological or other subjects of Microscopical Research.

It consists of Ordinary, Honorary, and Ex-officio Fellows, without distinction of sex.

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The Admission Fee is £2 2*s*., and the Annual Subscription £2 2*s*., payable on election, and subsequently in advance on 1st January annually, but future payments may be compounded for at any time for £31 10*s*. Fellows elected at a meeting subsequent to that in February are only called upon for a proportionate part of the first year's subscription, and Fellows permanently residing abroad, are exempt from one-fourth of the annual subscription.

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The Journal, containing the Transactions and Proceedings of the Society, and a Summary of Current Researches relating to Zoology and Botany (principally Invertebrata and Cryptogamia), Microscopy, &c., is published bi-monthly, and is forwarded post-free to all Ordinary and Ex-officio Fellows residing in countries within the Postal Union.

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CONTENTS.

ZOOLOGY.

A.—Vertebrata :—Embryology, Histology, and General.

a. Embryology.

* In order to make the classification complete, (1) the papers printed in the 'Transactions,' (2) the abstracts of the 'Bibliography,' and (3) the notes printed in the 'Proceedings' are included here.

β. Histology.

γ. General.

B.—INVERTEBRATA.

Mollusca.

α. Cephalopoda.

β. Pteropoda.

γ. Gastropoda.

δ. Lamellibranchiata.

β. Myriopoda.

γ. Prototracheata.

δ. Arachnida.

ε. Crustacea.

Vermes.

a. Annelida.

β. Nemathelminthes.

γ. Platyhelminthes.

δ. Incertæ Sedis.

Echinodermata.

Porifera.

Protozoa.

BOTANY.

A.—GENERAL, including the Anatomy and Physiology of the Phanerogamia.

a. Anatomy.

(1) Cell-structure and Protoplasm.

(2) Other Cell-contents (including Secretions).

(3) Structure of Tissues.

(4) Structure of Organs.

β. Physiology.

(1) Reproduction and Germination.

(2) Nutrition and Growth (including Movements of Fluids).

(3) Irritability.

(4) Chemical Changes (including Respiration and Fermentation).

γ. General.

B.—CRYPTOGAMIA.

Cryptogamia Vascularia.

Muscineæ.

Characeæ.

Algæ.

Fungi.

Mycetozoa.

Protophyta.

α. Schizophyceæ.

β. Schizomycetes.

MICROSCOPY.

α. Instruments, Accessories, &c.

(1) Stands.

(2) Eye-pieces and Objectives.

(5) Microscopical Optics and Manipulation.

(6) Miscellaneous.

β. Technique.

(1) Collecting Objects, including Culture Processes.

(2) Preparing Objects.

(3) Cutting, including Imbedding and Microtomes.

(4) Staining and Injecting.

(5) Mounting, including Slides, Preservative Fluids, &c.

(6) Miscellaneous.

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B. CRYPTOGAMIA.

Cryptogamia Vascularia.

Muscineæ.

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β. Schizomycetes.

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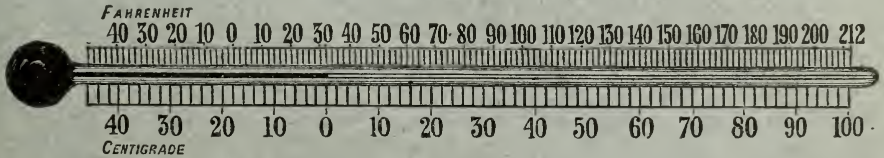
(6) Miscellaneous.

APERTURE TABLE.

Numerical Aperture. ($n \sin u = a$.)	Corresponding Angle ($2u$) for			Limit of Resolving Power, in Lines to an Inch.			Illuminating Power. (a^2.)	Penetrating Power. $\left(\frac{1}{a}\right)$
	Air ($n = 1·00$).	*Water* ($n = 1·33$).	*Homogeneous Immersion* ($n = 1·52$).	White Light. ($\lambda = 0·5269\ \mu$, Line E.)	Monochromatic (Blue) Light. ($\lambda = 0·4861\ \mu$, Line F.)	Photography. ($\lambda = 0·4000\ \mu$, near Line h.)		
1·52	..	..	180° 0′	146,543	158,845	193,037	2·310	·658
1·51	..	..	166° 51′	145,579	157,800	191,767	2·280	·662
1·50	..	..	161° 23′	144,615	156,755	190,497	2·250	·667
1·49	..	..	157° 12′	143,651	155,710	189,227	2·220	·671
1·48	..	..	153° 39′	142,687	154,665	187,957	2·190	·676
1·47	..	..	150° 32′	141,723	153,620	186,687	2·161	·680
1·46	..	..	147° 42′	140,759	152,575	185,417	2·132	·685
1·45	..	..	145° 6′	139,795	151,530	184,147	2·103	·690
1·44	..	..	142° 39′	138,830	150,485	182,877	2·074	·694
1·43	..	..	140° 22′	137,866	149,440	181,607	2·045	·699
1·42	..	..	138° 12′	136,902	148,395	180,337	2·016	·704
1·41	..	..	136° 8′	135,938	147,350	179,067	1·988	·709
1·40	..	..	134° 10′	134,974	146,305	177,797	1·960	·714
1·39	..	..	132° 16′	134,010	145,260	176,527	1·932	·719
1·38	..	..	130° 26′	133,046	144,215	175,257	1·904	·725
1·37	..	..	128° 40′	132,082	143,170	173,987	1·877	·729
1·36	..	..	126° 58′	131,118	142,125	172,717	1·850	·735
1·35	..	..	125° 18′	130,154	141,080	171,447	1·823	·741
1·34	..	..	123° 40′	129,189	140,035	170,177	1·796	·746
1·33	..	180° 0′	122° 6′	128,225	138,989	168,907	1·769	·752
1·32	..	165° 56′	120° 33′	127,261	137,944	167,637	1·742	·758
1·30	..	155° 38′	117° 35′	125,333	135,854	165,097	1·690	·769
1·28	..	148° 42′	114° 44′	123,405	133,764	162,557	1·638	·781
1·26	..	142° 39′	111° 59′	121,477	131,674	160,017	1·588	·794
1·24	..	137° 36′	109° 20′	119,548	129,584	157,477	1·538	·806
1·22	..	133° 4′	106° 45′	117,620	127,494	154,937	1·488	·820
1·20	..	128° 55′	104° 15′	115,692	125,404	152,397	1·440	·833
1·18	..	125° 3′	101° 50′	113,764	123,314	149,857	1·392	·847
1·16	..	121° 26′	99° 29′	111,835	121,224	147,317	1·346	·862
1·14	..	118° 0′	97° 11′	109,907	119,134	144,777	1·300	·877
1·12	..	114° 44′	94° 55′	107,979	117,044	142,237	1·254	·893
1·10	..	111° 36′	92° 43′	106,051	114,954	139,698	1·210	·909
1·08	..	108° 36′	90° 34′	104,123	112,864	137,158	1·166	·926
1·06	..	105° 42′	88° 27′	102,195	110,774	134,618	1·124	·943
1·04	..	102° 53′	86° 21′	100,266	108,684	132,078	1·082	·962
1·02	..	100° 10′	84° 18′	98,338	106,593	129,538	1·040	·980
1·00	180° 0′	97° 31′	82° 17′	96,410	104,503	126,998	1·000	1·000
0·98	157° 2′	94° 56′	80° 17′	94,482	102,413	124,458	·960	1·020
0·96	147° 29′	92° 24′	78° 20′	92,554	100,323	121,918	·922	1·042
0·94	140° 6′	89° 56′	76° 24′	90,625	98,233	119,378	·884	1·064
0·92	133° 51′	87° 32′	74° 30′	88,697	96,143	116,838	·846	1·087
0·90	128° 19′	85° 10′	72° 36′	86,769	94,053	114,298	·810	1·111
0·88	123° 17′	82° 51′	70° 44′	84,841	91,963	111,758	·774	1·136
0·86	118° 38′	80° 34′	68° 54′	82,913	89,873	109,218	·740	1·163
0·84	114° 17′	78° 20′	67° 6′	80,984	87,783	106,678	·706	1·190
0·82	110° 10′	76° 8′	65° 18′	79,056	85,693	104,138	·672	1·220
0·80	106° 16′	73° 58′	63° 31′	77,128	83,603	101,598	·640	1·250
0·78	102° 31′	71° 49′	61° 45′	75,200	81,513	99,058	·608	1·282
0·76	98° 56′	69° 42′	60° 0′	73,272	79,423	96,518	·578	1·316
0·74	95° 28′	67° 37′	58° 16′	71,343	77,333	93,979	·548	1·351
0·72	92° 6′	65° 32′	56° 32′	69,415	75,242	91,439	·518	1·389
0·70	88° 51′	63° 31′	54° 50′	67,487	73,152	88,899	·490	1·429
0·68	85° 41′	61° 30′	53° 9′	65,559	71,062	86,359	·462	1·471
0·66	82° 36′	59° 30′	51° 28′	63,631	68,972	83,819	·436	1·515
0·64	79° 36′	57° 31′	49° 48′	61,702	66,882	81,279	·410	1·562
0·62	76° 38′	55° 34′	48° 9′	59,774	64,792	78,739	·384	1·613
0·60	73° 44′	53° 38′	46° 30′	57,846	62,702	76,199	·360	1·667
0·58	70° 54′	51° 42′	44° 51′	55,918	60,612	73,659	·336	1·724
0·56	68° 6′	49° 48′	43° 14′	53,990	58,522	71,119	·314	1·786
0·54	65° 22′	47° 54′	41° 37′	52,061	56,432	68,579	·292	1·852
0·52	62° 40′	46° 2′	40° 0′	50,133	54,342	66,039	·270	1·923
0·50	60° 0′	44° 10′	38° 24′	48,205	52,252	63,499	·250	2·000
0·45	53° 30′	39° 33′	34° 27′	43,385	47,026	57,149	·203	2·222
0·40	47° 9′	35° 0′	30° 31′	38,564	41,801	50,799	·160	2·500
0·35	40° 58′	30° 30′	26° 38′	33,744	36,576	44,449	·123	2·857
0·30	34° 56′	26° 4′	22° 46′	28,923	31,351	38,099	·090	3·333
0·25	28° 58′	21° 40′	18° 56′	24,103	26,126	31,749	·063	4·000
0·20	23° 4′	17° 18′	15° 7′	19,282	20,901	25,400	·040	5·000
0·15	17° 14′	12° 58′	11° 19′	14,462	15,676	19,050	·023	6·667
0·10	11° 29′	8° 38′	7° 34′	9,641	10,450	12,700	·010	10·000
0·05	5° 44′	4° 18′	3° 46′	4,821	5,225	6,350	·003	20·000

COMPARISON OF THE FAHRENHEIT AND CENTIGRADE THERMOMETERS.

Fahr.	Centigr.	Fahr.	Centigr.	Fahr.	Centigr.	Fahr.	Centigr.	Fahr.	Centigr.
°	°	°	°	°	°	°	°	°	°
212	100	158	70	104	40	50	10	- 4	- 20
210·2	99	156·2	69	102·2	39	48·2	9	- 5·8	- 21
210	98·89	156	68·89	102	38·89	48	8·89	- 6	- 21·11
208·4	98	154·4	68	100·4	38	46·4	8	- 7·6	- 22
208	97·78	154	67·78	100	37·78	46	7·78	- 8	- 22·22
206·6	97	152·6	67	98·6	37	44·6	7	- 9·4	- 23
206	96·67	152	66·67	98	36·67	44	6·67	- 10	- 23·33
204·8	96	150·8	66	96·8	36	42·8	6	- 11·2	- 24
204	95·56	150	65·56	96	35·56	42	5·56	- 12	- 24·44
203	95	149	65	95	35	41	5	- 13	- 25
202	94·44	148	64·44	94	34·44	40	4·44	- 14	- 25·56
201·2	94	147·2	64	93·2	34	39·2	4	- 14·8	- 26
200	93·33	146	63·33	92	33·33	38	3·33	- 16	- 26·67
199·4	93	145·4	63	91·4	33	37·4	3	- 16·6	- 27
198	92·22	144	62·22	90	32·22	36	2·22	- 18	- 27·78
197·6	92	143·6	62	89·6	32	35·6	2	- 18·4	- 28
196	91·11	142	61·11	88	31·11	34	1·11	- 20	- 28·89
195·8	91	141·8	61	87·8	31	33·8	1	- 20·2	- 29
194	90	140	60	86	30	32	0	- 22	- 30
192·2	89	138·2	59	84·2	29	30·2	- 1	- 23·8	- 31
192	88·89	138	58·89	84	28·89	30	- 1·11	- 24	- 31·11
190·4	88	136·4	58	82·4	28	28·4	- 2	- 25·6	- 32
190	87·78	136	57·78	82	27·78	28	- 2·22	- 26	- 32·22
188·6	87	134·6	57	80·6	27	26·6	- 3	- 27·4	- 33
188	86·67	134	56·67	80	26·67	26	- 3·33	- 28	- 33·33
186·8	86	132·8	56	78·8	26	24·8	- 4	- 29·2	- 34
186	85·56	132	55·56	78	25·56	24	- 4·44	- 30	- 34·44
185	85	131	55	77	25	23	- 5	- 31	- 35
184	84·44	130	54·44	76	24·44	22	- 5·56	- 32	- 35·56
183·2	84	129·2	54	75·2	24	21·2	- 6	- 32·8	- 36
182	83·33	128	53·33	74	23·33	20	- 6·67	- 34	- 36·67
181·4	83	127·4	53	73·4	23	19·4	- 7	- 34·6	- 37
180	82·22	126	52·22	72	22·22	18	- 7·78	- 36	- 37·78
179·6	82	125·6	52	71·6	22	17·6	- 8	- 36·4	- 38
178	81·11	124	51·11	70	21·11	16	- 8·89	- 38	- 38·89
177·8	81	123·8	51	69·8	21	15·8	- 9	- 38·2	- 39
176	80	122	50	68·2	20	14	- 10	- 40	- 40
174·2	79	120·2	49	66	19	12·2	- 11	- 41·80	- 41
174	78·89	120	48·89	66·4	18·89	12	- 11·11	- 42	- 41·11
172·4	78	118·4	48	64	18	10·4	- 12	- 43·60	- 42
172	77·78	118	47·78	64·6	17·78	10	- 12·22	- 44	- 42·22
170·6	77	116·6	47	62	17	8·6	- 13	- 45·40	- 43
170	76·67	116	46·67	62·8	16·67	8	- 13·33	- 46	- 43·33
168·8	76	114·8	46	60	16	6·8	- 14	- 47·20	- 44
168	75·56	114	45·56	60	15·56	6	- 14·44	- 48	- 44·44
167	75	113	45	59	15	5	- 15	- 49	- 45
166	74·44	112	44·44	58	14·44	4	- 15·56	- 50	- 45·56
165·2	74	111·2	44	57·2	14	3·2	- 16	- 50·80	- 46
164	73·33	110	43·33	56	13·33	2	- 16·67	- 52	- 46·67
163·4	73	109·4	43	55·4	13	1·4	- 17	- 52·60	- 47
162	72·22	108	42·22	54	12·22	0	- 17·78	- 54	- 47·78
161·6	72	107·6	42	53·6	12	- 0·4	- 18	- 54·40	- 48
160	71·11	106	41·11	52	11·11	- 2	- 18·89	- 56	- 48·89
159·8	71	105·8	41	51·8	11	- 2·2	- 19	- 56·20	- 49
								- 58	- 50



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104	2 inches	17	2 10 0					
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106	$\frac{2}{3}$ inch	25	2 0 0	70	112	210	280	350
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108	$\frac{1}{2}$ inch	45	2 10 0	100	160	300	400	500
109	$\frac{4}{10}$ inch	65	4 0 0	125	200	375	500	625
110	$\frac{4}{10}$ inch	95	5 0 0	150	240	450	600	750
111	$\frac{1}{4}$ inch	75	3 10 0	200	320	600	800	1000
112	$\frac{1}{5}$ inch	120	4 10 0	250	400	750	1000	1250
113	$\frac{1}{8}$ inch	130	5 0 0	400	640	1200	1600	2000
114	$\frac{1}{10}$ imm.	180	5 5 0	500	800	1500	2000	2500
115	$\frac{1}{15}$ imm.	180	8 0 0	750	1200	2250	3000	3750
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„	April	16
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„	October	15
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„	December	17

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JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

FEBRUARY 1890.

TRANSACTIONS OF THE SOCIETY.

I.—*Freshwater Algæ and Schizophyceæ of Hampshire and Devonshire.*

By Alfred W. Bennett, M.A., B.Sc., F.L.S., F.R.M.S., Lecturer on Botany at St. Thomas's Hospital.

(*Read* 11*th December*, 1889.)

Plate I.

The gatherings of which the results are given in this paper were made in August 1888 and August 1889; the species observed in Hampshire are indicated by the letter H, those in Devonshire by D. Unless otherwise stated, the locality for the former is bogs and streams in the New Forest, in the neighbourhood of Lyndhurst; for the latter the south-eastern corner of Dartmoor and its outskirts, in the neighbourhood of Bovey Tracey and Buckfastleigh. Both in Desmids and in other families of Algæ the Hampshire localities were decidedly the richer, and I am unable to account for the comparative poverty of the Dartmoor gatherings, both in individuals and in species. The most

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EXPLANATION OF PLATE I.

(All multiplied 200 diameters unless otherwise stated.)

Fig. 1.—*Glochiococcus insignis* (De Ton.) Reinsch.
„ 2.—*Schizothrix anglica* n. sp. (× 400).
„ 3.—*Scytonema figuratum* Ag. (× 300); *a*, hormogone.
„ 4.— „ „ (× 400); *b*, heterocyst.
„ 5.—*Staurogeneis rectangularis* A. Br.
„ 6.—*Rhizoclonium geminatum* n. sp. (× 100).
„ 7.— „ „ (× 600).
„ 8.—*Micrasterias denticulata* Bréb. var. *intermedia* n. var.
„ 9.— „ *rotata* Ralfs var. *urnigera* n. var.
„ 10.— „ *truncata* Bréb. var.
„ 11.— „ *crenata* Bréb. var.
„ 12.— „ „ Bréb. var.
„ 13.— „ *crux-melitensis* Men.
„ 14.—*Euastrum crasso-humerosum* n. var.
„ 15.—*Cosmarium homalodermum* Nordst.

fruitful locality in the New Forest was the bog between Lyndhurst and Christchurch, so well known to botanists as the habitat of the rare *Spiranthes æstivalis.*

Very little work has been done with the Freshwater Algæ of the South-west of England since the time of Hassall, Ralfs, and Jenner. The only recent papers of importance with which I am acquainted are by Mr. E. D. Marquand, on "The Desmids and Diatoms of West Cornwall," and on "The Freshwater Algæ of the Land's End District," in the 'Transactions of the Penzance Natural History and Antiquarian Society' for 1882–3 and 1885–6; and by Mr. E. Parfitt on "Devon Freshwater Algæ," in the 'Transactions of the Devonshire Association for the Advancement of Science, Literature, and Art' for 1886. As in previous papers, I have excluded diatoms from the list. Species for which I could find no previously recorded locality in these islands are printed in italics; and new species or new varieties in small capitals. To the names of those desmids not previously recorded from the southern counties of England an * is prefixed.

PROTOCOCCACEÆ.

Eremosphæra viridis DBy., H, D.
Glœocystis vesiculosa Näg., D.
„ rupestris Rbh., D.
Botryococcus Braunii Ktz., H.
Rhaphidium falcatum Cke., H.
Chlorococcum gigas Grün., H.
Schizochlamys gelatinosa A. Br., D.
Scenedesmus acutus Mey., H.
„ obtusus, Mey., H, D.
Glochiococcus insignis (De Ton.) Reinsch (Acanthococcus insignis Reinsch, Ber. Deutsch. Bot. Gesell., iv. 1886, pl. xii. f. 22), H. Fig. 1.

This interesting organism was observed very rarely in bog-pools near Lyndhurst. It corresponds very closely with Reinsch's description and figure. The total diameter of the cell is about 67·5 μ. The cell-wall is exceedingly thick, as much as one-fourth the diameter of the cell, and consists of a large number of plicated layers, the cell-cavity filled with granular protoplasm and containing large chromatophores. I have already recorded (Journ. R. Micr. Soc., 1888, p. 2, pl. i. f. 4) the occurrence in this country of a spiny species of this genus, which I have described as a new species under the name *Acanthocladus anglicus* mihi,* which may, however, be but a form of this.

CHARACIACEÆ.

Nephrocytium Nägelii Grün., Beaulieu, H.

* See Note at the end of this paper.

Chroococcaceæ.

Chroococcus turgidus Näg., H.
Aphanocapsa virescens Rbh., H.
Merismopedia glauca Näg., H, D.

Oscillariaceæ.

Oscillaria tenerrima Ktz., H.
„ princeps Vauch., H.
Schizothrix anglica n. sp., H. Fig. 2.

Trichomes very long and slender, unbranched, about 5 μ in diameter; two or more inclosed in a common mucilaginous sheath. Sheath 6–10 times as broad as the trichomes, pale yellow, diffluent (ultimately brown?), somewhat lamellose. This interesting genus of Oscillariaceæ is new to Britain; the submarine species, *Schizothrix Creswellii*, described by Harvey, and found by him, and again recently by Parfitt, at Sidmouth, being referred by Thuret, no doubt correctly, to *Inactis*. The organism was found sparingly in a bog-pool near Lyndhurst. It does not seem to me to agree fully with any species hitherto described, differing from them in the extreme fineness of the trichomes. It comes nearest to *S. Mülleri* Näg., apparently known only from the neighbourhood of Zürich; but may very probably be identical with *Dasygloia amorpha* Thw., found in England by Berkeley, the descriptions of which are very imperfect. Bornet (*in litt.*) is inclined to sink both *Schizothrix* and *Dasygloia* in *Microcoleus*, characterized by the inclusion of a number of trichomes in the same general sheath. They present the peculiarity of the narrowing of the common sheath at the lower end into a kind of tube, from which portions of the trichomes escape in the form of hormogones.

Scytonemaceæ.

Stigonema minutum Hass., H, D.
Scytonema figuratum Ag. (S. calothrichoides Ktz.), H. Figs. 3, 4.

Sheath translucent, pale yellow throughout, about 25 μ in diameter. Trichomes green, composed of pseudocysts, about 4 μ broad, and about as long as broad, or longer in the lower part of the trichome; heterocysts elliptical, about twice as long as broad, 20 × 10 μ. Branches always geminate, usually short, and of somewhat less diameter than the main filament. A slenderer species than *S. myochrous* Ag., which has been recorded from Cornwall by Marquand. Bogs, Lyndhurst. A widely distributed species, not mentioned in Cooke's 'British Freshwater Algæ,' stated to have occurred in England by Bornet and Flahault on the authority of Berkeley, but without any locality.

Tolypothrix lanata Wartm., H.

Trichome very slender, single, or sometimes two more or less parallel included in a sheath; not more than 10 μ in diameter; pseudocysts about as long as broad; heterocysts few and distant. Sheath varying greatly in width, pale yellow, ultimately brown. Trichome often projecting a long way beyond the sheath. Floating on moor-pools, or attached to aquatic vegetation. Under this species Bornet and Flahault include *T. flaccida* Ktz., *T. muscicola* Ktz., *T. coactilis* Ktz., *T. pulchra* Ktz., *T. ægagropila* Rbh., and others.

NOSTOCACEÆ.

Aphazinomenon flos-aquæ Ralfs, H.
Cylindrospermum macrospermum Ktz., H.
Nodularia sp., H.

A species of this chiefly brackish-water genus was seen occasionally in bog-pools in the New Forest; but, as neither spores nor heterocysts were observed, specific determination was impossible.

PEDIASTREÆ.

Pediastrum Boryanum Turp., H.
,, rotula A. Br., H.
Staurogeneis rectangularis A. Br., H. Fig. 5.

This rare organism was only very seldom seen in a gathering from a pool near Beaulieu. Of its systematic position I am very doubtful. It seems to me not improbable that it may be an early stage of a *Pediastrum*, and it is placed near this genus by Braun, but his description (Alg. Unicell., p. 70) is very imperfect. It bears some resemblance to *Merismopedia*, but the colour of the endochrome is chlorophyll-green, not blue-green. It agrees fairly well with Cooke's description ('Freshwater Algæ,' i. p. 46, pl. xviii. f. 3); but the cœnobe is certainly not "cubical." The colony is tabular, like that of *Pediastrum*, about 110 × 75 μ, elliptical with truncated ends, and contains, in the specimens observed, sixteen pseudocysts, arranged in four subfamilies of four each, the whole inclosed in hyaline jelly. The pseudocysts are oblong and somewhat curved, or bean-shaped, about 20–22·5 × 10 μ. It was first observed in these islands by Archer, but he gives no locality; the only British habitat yet recorded of which I am aware is by Marquand, near the Land's End, Cornwall.

PANDORINEÆ.

Eudorina elegans Ehrb., H.
Gonium pectorale Müll., H, D.

ULOTRICHACEÆ.

Ulothrix zonata Ktz., H, D.

CONFERVACEÆ.

Draparnaldia glomerata Ag., H.
Stigeoclonium protensum Ktz., H.

Filament somewhat moniliform, about 12·5 μ broad in its broadest part; cells rather longer than broad, and slightly constricted at the septa in the lower part of the filament; those towards the apex of the branches much longer. Each branch terminating in a hyaline filament of very great length, as much as 380 μ, septated at long intervals; the branches themselves sometimes again branching. Small stream near Lyndhurst.

RHIZOCLONIUM GEMINATUM n. sp., H. Figs. 6, 7.

Filaments long, slender, curving and interlaced; cells about 20 × 12·5 μ, with very thin cell-walls. From the filaments are put out here and there short root-like processes filled with green endochrome; these are sometimes solitary, but more often two proceed from adjacent cells, or even two from the same cell; and these are then curved and interlace with those of an adjoining filament, but without any actual conjugation. A ball of flocculent matter commonly collects round these protuberances, firmly welding the filaments together. Forming, with the preceding, a flocculent scum on a small slow stream near Lyndhurst. Most of the species of the genus grow in brackish water.

DESMIDIACEÆ.

Hyalotheca dissiliens Sm., H.
,, mucosa Ehrb., H.
Desmidium Swartzii Ralfs, H.
Docidium Ehrenbergii Ralfs, H.
Cylindrocystis diplospora Lund., H, D.
* ,, crassa DBy., H.
Penium cylindrus Ehrb., H.
,, digitus Ehrb., H, D.
,, closterioides Ralfs, H, D.
,, Brebissonii Ralfs, H, D.
,, didymocarpum Lund., D.
Tetmemorus Brebissonii Men., H, D.
,, granulatus Bréb., H.
,, lævis Ralfs, H, D.
Spirotænia condensata Bréb., H, D.

Closterium didymotocum Cord., H, D.
„ lunula Ehrb., H.
„ turgidum Ehrb., H.
„ Ehrenbergii Men., D.
„ Dianæ Ehrb., H, D.
„ angustatum Ktz., H, D.
„ rostratum Ehrb., H.
„ setaceum Ehrb., H, D.
* „ *Kützingii* Bréb., H.

Although given in Cooke's 'British Desmids,' no locality is recorded for this species.

Closterium intermedium Ralfs, D.
„ cornu Ehrb., H.
„ acutum Bréb., H.
„ aciculare West, D.
„ linea Pert., H.
Micrasterias denticulata Bréb., H, D.
„ „ var. INTERMEDIA n. var., D. Fig. 8.

Length of frond about 200 μ, breadth about 180 μ. This variety appears to be intermediate between *M. denticulata* Bréb. and *M. Thomasiana* Arch. The size and the segmenting correspond closely to those of the typical form, the dentation of the edge being decidedly more apiculate, resembling that of *M. Thomasiana;* but it is destitute of the "apiculate elevations" and remarkable "divergent projections" in the centre described as characteristic of this species. It is, however, very doubtful whether *M. Thomasiana* should be retained as a distinct species. Its extreme form appears to have been seen by no one but its discoverer. Jacobsen (Desm. Denm., in Bot. Tidskr., 1874, p. 186) regards it as a variety of *M. denticulata,* and describes a series of intermediate forms with the projections more or less developed. The present variety occurred in bog-pools on Dartmoor.

Micrasterias rotata Ralfs, H, D.
„ „ var. URNIGERA n. var., H. Fig. 9.

This beautiful desmid differs from the typical form in its larger size, and in the urn-like form of its central lobe, which projects as much as 25 μ beyond the lateral ones. In this respect it resembles Ralfs's draw ng more nearly than Cooke's. Wolle (Desmids U.S., pl. xxiv. f. 1) also depicts the central lobe as projecting considerably. The surface of the frond is covered with inflated protuberances. The extreme length, including the projection, is 325 μ, the greatest breadth 250 μ; but in the specimens observed the two halves were of very unequal size. Bog near Lyndhurst.

Micrasterias papillifera Bréb., H.
„ truncata Bréb., H.
„ „ Bréb. var. TRIDENTATA n. var., H. Fig. 10.

A variety with the lateral lobes tridentate instead of bidentate.

Micrasterias crenata Bréb., H, D. Figs. 11, 12.

Two forms of this variable species. De Wildeman has shown (Bull. Roy. Soc. Belg., 1888; Obs. sur quelques Desm., p. 2) how closely this species is linked with the preceding by intermediate forms.

Micrasterias crux-melitensis Men., H. Fig. 13.

The form observed (but only very rarely) of this rare and beautiful desmid in the New Forest bears a much closer resemblance to that which occurs in America (Wolle, Desm. U.S., t. xxxv. f. 3) than to any hitherto recorded from Great Britain, the lobing not being nearly so deep. The outline of the frond is very nearly circular, about 140 μ in length and breadth; its surface is covered with small protuberances. The species has been gathered hitherto, in the south of England, as far as I am aware, only by Jenner.

Euastrum oblongum Grev., H.
„ crassum Ktz., H, D.
„ CRASSO-HUMEROSUM n. var., D. Fig. 14.

This interesting variety or possible hybrid is described at length elsewhere ('Annals of Botany,' vol. iv. p. 171).

*Euastrum pinnatum Ralfs, H.
„ humerosum Ralfs, H, D.
* „ ventricosum Lund., D.
„ affine Ralfs, D.
„ ampullaceum Ralfs, D.
„ insigne Hass., D.
„ didelta Ralfs, H, D.
„ cuneatum Jenn., H.
„ ansatum Ralfs, H, D.
„ circulare Hass., H, D.
„ pectinatum Bréb,, H, D.
„ rostratum Ralfs, H.
„ binale Ralfs, H.
* „ erosum Lund., H, D.
* „ ornithocephalum Benn., H.
Cosmarium quadratum Ralfs, D.
* „ homalodermum Nordst., D. Fig. 15.

Nearly circular in outline; length and greatest breadth about 70 μ; two conspicuous protuberances on each half-cell. Bog-pools, Dartmoor. No locality is given in Cooke's 'Brit. Fresh-water Algæ,' but Mr. West has gathered it in Yorkshire.

Cosmarium cucumis Cord., H, D.
" Ralfsii Bréb., H, D.
* " pachydermum Lund., D.
" pyramidatum Bréb., H, D.
" pseudo-pyramidatum Lund., H.
" Brebissonii Men., H, D.
" margaritiferum Men., H.
" botrytis Men., H, D.
* " præmorsum Bréb., H.
* " ochthodes Nordst., H.
" ornatum Ralfs, H.
" Broomei Thw., H.

This is certainly a true freshwater species.

Cosmarium speciosum Lund., H.
* " *prægrande* Lund., H.

See Note at the end of this paper.

*Cosmarium globosum Buln., H, D.
" cucurbita Bréb., H.
" attenuatum Bréb., D.
" turgidum Bréb., H.
Xanthidium armatum Bréb., H, D.
" aculeatum Ehrb., H.
Arthrodesmus incus Hass., H.
Staurastrum cuspidatum Bréb., D.
" avicula, Bréb., H.
" Reinschii Roy, D.
" hirsutum Bréb., H.
" teliferum Ralfs, H, D.
" Pringsheimii Reinsch, H, D.

This appears to be a widely distributed species.

Staurastrum spongiosum Bréb., H.
" muticum Bréb., H, D.
" alternans Bréb., H.
" polymorphum Bréb., H.
" proboscideum Arch., H.

ZYGNEMACEÆ.

Spirogyra longata Vauch., H.

Seen in lateral conjugation.

Spirogyra porticalis Vauch., H.

MESOCARPACEÆ.

Mesocarpus pleurocarpus DBy., H.
Staurospermum gracillimum Hass., Beaulieu, H.

SIPHONEÆ.

Vaucheria sessilis Vauch. Wet rock, Buckfastleigh, D.

NOTE.

I have to add a few words in reference to my previous papers of this series.

Nostoc hyalinum mihi (Journ. R. Micr. Soc., 1886, p. 4, pl. i. figs. 2, 3). Bornet and Flahault point out that this specific name has already been appropriated by Rœmer. I propose, therefore, that it shall in future be known as *N. opalinum* Benn. Those eminent algologists think that my species, if distinct, is most nearly allied to *N. microscopicum* Carm.

Xanthidium spinulosum mihi, tom. cit., p. 10, pl. ii. f. 17. I am now convinced that the peculiarities on which I founded this species are due merely to a peculiar condition of the gelatinous envelope, and that it is simply a form of *X. fasciculatum* Ehrb. The name should therefore be abolished.

Oscillaria princeps Vauch., op. cit., 1887, p. 11, pl. iv. f. 4. On the (negative) authority of Cooke's 'British Freshwater Algæ,' this species was recorded as new to Britain. Marquand had, however, previously observed it in Cornwall (Trans. Penzance Nat. Hist. Soc., 1885–6); and Mr. Roy informs me that he had gathered it earlier than that in three or four places on Deeside, Scotland. It is probably not uncommon, at all events in the southern counties.

Apiocystis Brauniana Näg., tom. cit., p. 9, pl. iii. f. 1. This has been long known in Aberdeen, according to Roy (*in litt.*). Mr. S. Le M. Moore has also found it in this country, and has been more successful than previous observers in detecting its mode of reproduction (Journ. Linn. Soc., vol. xxv. p. 362). Mr. West also records it from Yorkshire.

Aphanothece microscopica Näg., tom. cit., p. 10, pl. iii. f. 3. Has been familiar to Mr. Roy for many years in the neighbourhood of Aberdeen.

Pediastrum integrum Näg., tom. cit., p. 12, pl. iv. figs. 11–13. Occurs in the neighbourhood of Aberdeen, according to Mr. Roy, but is rather uncommon.

Cœlastrum cubicum Näg., tom. cit., p. 13, pl. iv. f. 14. Has been gathered repeatedly by Mr. Roy in the neighbourhood of Aberdeen. He records also *C. microsporum* Näg. from the same locality, and Mr. West adds a Yorkshire habitat.

Cosmarium sphericum mihi, tom. cit., p. 17, pl. iv. f. 22. This appears to be identical with *C. prægrande* Lund., Desm. Suec., p. 54, pl. iii. f. 21. I have observed it in Cumberland, Cornwall, and Hampshire.

Zygnema peliosporum Wittr. was omitted from my list of species from North Cornwall, where it is not uncommon in bog-pools. I am not aware of its having before been gathered in these islands, except by Marquand in West Cornwall. It is not given in Cooke.

Homospora mutabilis Bréb., op. cit., 1888, p. 2, pl. i. f. 1. Has also been observed by Marquand in Cornwall.

Acanthococcus anglicus mihi, tom. cit., p. 2, pl. i. f. 4. De Toni having pointed out that the name *Acanthococcus*, given to this genus by Reinsch, had been previously appropriated to a genus of Florideæ, and proposed the substitute *Glochiococcus*, this species must now be known as *Glochiococcus anglicus* (De Ton.) Benn.

II.—*On an Objective with an Aperture of* 1·60 *N.A.* (*Monobromide of Naphthaline Immersion*) *made according to the Formulæ of Prof. Abbe in the Optical Factory of Carl Zeiss.*

By Dr. S. Czapski (Jena).

(*Read* 11*th December*, 1889.)

An advance in the increase of the capabilities of an optical instrument is always possible in two directions—the *qualitative* and the *quantitative*. The first point Prof. Abbe has kept in view, as far as the Microscope is concerned, in the construction of the apochromatic objectives. The quality of the objective was here augmented by a complete union of the rays, without that element on which the capacity of the objective primarily depends, viz. the aperture, being sensibly increased. In the terminology of optics it was properly only the "definition" of the objective which was improved. That by this means its resolving power was also increased was an indirect consequence of the first condition. For it is natural that an objective of given aperture should only have the resolving power prescribed by theory, if the assumption of this theory—perfect union of rays—is fulfilled. The earlier known achromatic objectives did not therefore reach the limit of the resolving power which the aperture allowed them; the apochromatics approach extraordinarily near to this limit. This aperture itself, however, in the case of the strongest apochromatics, was not essentially greater than that which had been already obtained by Zeiss, as well as by other opticians, in their earlier objectives (1·40 against 1·30 of the earlier).

An advance upon that attainable with the apochromatics of 1886 is only possible if the aperture is increased in a marked degree. To this advance a special difficulty opposes itself. In order to reach a given aperture a, for instance 1·60, it is necessary that all media between the object and the front lens of the objective, as well as this lens itself, should have a higher refractive index than a, therefore higher than 1·60 in the case we are supposing. For since the angle of aperture of the rays entering into the objective can practically scarcely exceed 150° (as cover-glass and focus necessitate a certain distance of the object from the front lens), therefore, since $a = n \sin u$, must $n > a$, because $\sin u$ is necessarily < 1; and between the object and front lens there must be no layer of a medium, however thin, whose index n' is $< a$. For at such a layer the part of the incident pencil whose aperture is n' would, according to the laws of geometrical optics, be lost by total reflection, and there would remain only the part whose aperture a' is $< n'$.

At the present time, however, not only do the front lenses of objectives consist for the most part of crown glass with a maximum index

1·56, but the cover-glasses are made of a crown-glass (blown) whose index is about 1·52, and the index of the immersion liquid is equally about 1·52. If, then, we are confined to the use of these materials, no higher aperture is attainable than 1·45 N.A. as a maximum, as is also proved practically. If it is desired to go beyond this limit, then, as shown above, care must be taken that the substances used for cover-glass, front lens, and immersion liquid have indices higher than the desired aperture.

The aperture which was first decided upon, and which was completely realized, was 1·60. An immersion liquid which satisfied the required conditions was found in monobromide of naphthaline, whose index is about 1·66. For the cover-glass and the front lens was selected for reasons of construction (removal of spherical and chromatic aberration) a flint-glass of index 1·72, so that the objective was no longer, in the strict sense of the term, a homogeneous-immersion objective. None of the existing kinds of flint glass appeared to be suitable for the front lens. Special fusions had to be undertaken (by Dr. Schott) in order to obtain a satisfactory glass.

The work of calculation for establishing a suitable formula had been going on for a year previously, but was not brought to an end until August of this year. In the course of the calculation the favourable result was obtained, that in spite of the very difficult conditions, not only could the removal of the chromatic and spherical aberration in the ordinary sense be obtained, but in addition a correction of almost the same perfection as with the apochromatics.

In the beginning of September the first objectives were completed. One was exhibited by the author to the Naturforscherversammlung in Heidelberg, from September 18–24, in the exhibition of newly constructed scientific instruments, as well as in the section for pathological anatomy. The other was placed at the disposal of Dr. van Heurck, of Antwerp, who had done excellent service for the perfecting of the objectives, in preparing new test-objects indispensable for their testing and final adjustment. As already mentioned, the objects must have special cover-glasses of flint glass. There must not be between cover-glass and object any medium whose index $< 1 \cdot 66$. Thus, the preparation must either be melted on the cover-glass (which does not succeed with flint-glass) or it must be imbedded in a medium whose index is at least $= 1 \cdot 66$.

For the visibility of microscopic objects it is, however, well known to be advantageous if they are placed in a medium whose index differs as much as possible from that of the object itself. In the present case it is important that that index should be as *high* as possible, since the index of the diatom valve is scarcely higher than 1·55. How Dr. van Heurck in numerous readily arranged experiments overcame this double difficulty, and how he has been successful in finding a practical medium of index 2·4, I must leave to him to explain.

A third and fourth difficulty for certain purposes also lie in the following:—If it is desired to use the most oblique illumination which the objective will allow, the same remarks are equally applicable to the incident pencils as to those proceeding from the object; its aperture will not have its full value, if between object and condenser there is a medium whose index is less than the figure which represents the aperture, and the condenser itself must be so constructed that it also shall have the full aperture desired. In other words, the slide must also consist of flint glass of $n > 1·65$, and between it and the condenser must be interposed a medium of $n > 1·65$, and the front lens of the condenser must in all cases be made of flint glass of at least the same n.

A condenser of this character was constructed at the same time as the objective; also slides of flint-glass, and between them and the condenser monobromide of naphthaline was used, just as between cover-glass and objective. This arrangement, as above said, is only necessary with preparations for which the most oblique illumination possible is required—as, for example, *Amphipleura pellucida*, or those which are to be observed with *completely* open illuminating cone. In all other cases, including axial illumination, ordinary slides of crown glass and the ordinary condensers suffice. According to the aperture of the latter, and according as a stratum of air is left between it and the stage, or water or oil is added, we obtain even in these cases an illuminating cone of an obliquity representing an aperture of 1·0–1·4. For most purposes the latter is quite sufficient.

The type of construction of the objective is the same as that of the other apochromatic objectives of large aperture. To the more than hemispherical front lens of flint glass (index 1·72) succeeds a binary achromatic lens. Over this lower part is the (for apochromatics) characteristic upper part of the objective, on the peculiar composition of which depends the removal of the chromatic difference of the spherical aberration, i. e. first a single lens of crown and following on this two more achromatic lenses, the one composed of two and the other of three lenses. The focal length of the objective is 2·5 mm. (1/10 in.).

Since the objective, as already pointed out, is not really a homogeneous-immersion one (cover-glass and front lens having an index of 1·72, whilst the immersion liquid has an index of 1·66) and also because of the extraordinarily large aperture of the image-forming rays, it is exceedingly sensitive to changes of the cover-glass thickness, and also to every change in the index of the immersion liquid—almost as sensitive as a high-power dry system. It must therefore be used only with pure monobromide of naphthaline and with cover-glasses of the same thickness for which it is corrected, if the image is to be perfect. The cover-glasses themselves moreover must be made with great care and of the right glass.

The production of these cover-glasses in the usual way—by blowing in a furnace—was forbidden by their substance. The condition mentioned above, however, made it necessary to bring the cover-glasses to the required thickness by carefully grinding down somewhat thicker plates to 0·01 to 0·02 mm., and to polish them with care (like lenses of medium quality), which naturally makes such cover-glasses very expensive.

This is not the place to dilate on what can be done with objectives of this kind. The results which Dr. van Heurck has already obtained in the use of them lead in any case to the hope that, in spite of the great difficulty of their use, they will afford valuable aid for certain problems of microscopy. It will be a question for connoisseurs to decide, whether in other branches of microscopical research besides that of diatoms (more especially cultivated by him) an equally marked advance on that previously reached can be obtained.

The inquiry may be made whether and how far a further increase of the aperture beyond that of 1·60 here attained can be expected. The difficulty of such a construction consists (as was the special hindrance before) in the *want of a suitable immersion liquid.* This liquid must have an index of at least 1·8–1·9 (in order to make an essential advance on the present objective), and it must besides possess those general properties which qualify it as an immersion liquid: i. e. not to attack the glass of either the cover or the front lens; sufficiently transparent; not too viscous; not inflammable (like the phosphorus solutions), &c. If such a liquid were found, Professor Abbe would be at once prepared to undertake the calculation of an objective of an aperture of 1·8 or 1·9, since glass of sufficiently high index for the front lens and the cover-glass could be provided without difficulty.

SUMMARY

OF CURRENT RESEARCHES RELATING TO

ZOOLOGY AND BOTANY

(*principally Invertebrata and Cryptogamia*),

MICROSCOPY, &c.,

INCLUDING ORIGINAL COMMUNICATIONS FROM FELLOWS AND OTHERS.*

ZOOLOGY.

A. VERTEBRATA:—Embryology, Histology, and General.

a. Embryology.†

Theories of Heredity.‡—Mr. E. B. Poulton gives a sketch of the theories of heredity propounded by Mr. Darwin and Prof. Weismann. He points out that the direct evidence in favour of the transmission of acquired characters seems to fail to stand the ordeal of a thorough investigation, and he urges reasons against the chief lines of indirect evidence. These lines are the fact of individual variation, the effects of use and disuse of parts, and the facts presented by the phenomena of instinct. The consideration of twins and monstrosities leads to the conclusion that individual variation is predetermined in the fertilized ovum. Weismann contends that the object of sexual reproduction is to supply variations upon which natural selection can operate. The apparent effects of increased use are more probably due to the operation of natural selection upon a part which is, *ex hypothesi*, of especial importance, combined with the admitted increase which follows increased use during the life of the individual. The apparent effects of disuse are more probably due to the cessation of natural selection, which can no longer maintain the efficiency of a useless part. The phenomena of instinct seem capable of explanation by the operation of natural selection upon blastogenic variations of the nervous system rather than by the supposed transmission of acquired habit.

Intracellular Pangenesis.§—Herr H. de Vries seeks to rehabilitate the theory of pangenesis, so far as that credits the germ-cell with an accumulation of minute elements corresponding to the characteristics of the organism. The author's "pangenes" are not so small as Haeckel's

* The Society are not intended to be denoted by the editorial "we," and they do not hold themselves responsible for the views of the authors of the papers noted, nor for any claim to novelty or otherwise made by them. The object of this part of the Journal is to present a summary of the papers *as actually published*, and to describe and illustrate Instruments, Apparatus, &c., which are either new or have not been previously described in this country.

† This section includes not only papers relating to Embryology properly so called, but also those dealing with Evolution, Development, and Reproduction, and allied subjects.

‡ Midland Natural., xii. (1889) pp. 245–58.

§ 'Intrazellulare Pangenesis,' Jena, 1889. Biol. Centralbl., ix. (1889) pp. 545–50 "plastidules," nor so large and like one another as Spencer supposed his "physiological units" to be; in size they are nearer to the smallest known organisms than to molecules, and they are as diverse as the characteristics of the organism are numerous. De Vries recognizes regular successions of cells "from the fertilized egg-cell through the individual to the following generation," and distinguishes primary and secondary courses or tracks, of which the former run direct from germ-cell to germ-cell, while the latter are circuitous, giving the organism in many cases the power of asexual multiplication. The products of cell-division may be both on the germinal track (phylotic), or both in the body proper (somatic), or one may be germinal while the other is somatic (somatarchic). The author does not allow the legitimacy of a hard and fast distinction between somatic and germinal cells.

According to the theory of "intracellular pangenesis," the entire protoplasm is made up of "pangenes." Each characteristic of the organism has its special "pangene." Representatives of all are found in the nuclei, while the body of the cell contains for the most part only those which are essential to that cell's activity. So many remain within the nucleus, and are active, for instance, in nuclear division; so many must pass out into the protoplasm of the cell to unite with other "pangenes," to multiply, and become active. The theory seeks to combine one of the fundamental ideas of Darwin's pangenesis with the more modern conception of germinal continuity.

Theory of the Mesoderm.*—Prof. C. Rabl has been led by his investigations on the segments of the Vertebrate head to consider the great problem of the formation and differentiation of the mesoderm. His researches refer chiefly to embryos of *Pristiurus*, fowl and pigeon, and rabbit.

I. *The Formation of the Mesoderm.*—(*a*) Rabl's investigation of Selachian development leads to results essentially the same as Rückert's. That portion of the mesoderm which has its origin beside the chordal endoderm Rabl distinguishes as *gastral*, while that which arises from the endoderm of the invagination-margin is distinguished as *peristomial*, corresponding respectively to Rückert's axial and peripheral mesoblast. The two portions pass into one another at the posterior end of the embryonic rudiment. It is noteworthy that the peristomial mesoderm retains its connection with the endoderm longer than the gastral does. (*b*) In the mesoderm of the chick-embryo at the end of the first day two portions are to be distinguished, that which arises from the head-process and that from the primitive streak. The two pass into one another at the anterior end of the streak. Except in the head-process and in the primitive streak there is never any connection between the mesoderm and the primary layers; at the periphery the mesoderm stops with a sharp margin between ectoderm and endoderm. Rabl's results are for the most part in accord with the well-known study of the germinal layers of the chick by Balfour and Deighton. (*c*) The author's investigation of the blastoderm of the rabbit was less satisfactory, but his results seem to corroborate van Beneden's conclusion that one portion of the mesoderm arises in the form of two symmetrical rudiments—

* Morphol. Jahrb., xv. (1889) pp. 113-252 (4 pls.).

right and left—from the margins of the head-process, while the other and principal portion originates from the posterior end and from the margins of the primitive streak.

The memoir becomes more interesting as the author proceeds to discuss how the formation of mesoderm in Amniota is to be derived from that of Anamnia, and that again from such a mode as *Amphioxus* exhibits. Rabl has a good deal to say about the yolk, and expounds most lucidly his theory of its repeated acquisition and loss throughout the history of Vertebrates. The eggs of *Amphioxus* and the Cyclostomata are primarily poor in yolk; the poverty is also true of Ganoids and Amphibians, but here it is secondary; while in placental mammals it is tertiary. Similarly the eggs of Elasmobranchs are primarily rich in yolk, while those of Teleosteans, Sauropsida, and Monotremes are only secondarily so. Having discussed the yolk, the author seeks to connect the various forms of gastrulation, and points out in so doing that the yolk of the Protamniota ought naturally to be situated where the principal mass lay in their amphibian ancestors, viz. in front of and ventral to the blastopore. He is led to the opinion so often expressed that the primitive groove of Amniota represents the blastopore, and the primitive streak its coalesced margins. The dorsal margin of the blastopore in *Amphioxus*, Cyclostomata, and Amphibia, the posterior margin of the blastopore in Elasmobranchs, Ganoids, and Teleosteans, and the anterior end of the primitive groove of Amniota are all homologous. The same is true of the ventral margin of the blastopore in *Amphioxus*, Cyclostomata, and Amphibians, the anterior margin in Elasmobranchs, Ganoids, and Teleosteans, and the posterior end of the primitive groove of Amniota. Rabl supports this conclusion by arguments drawn from the nature of the segmentation, the formation of the mesoderm, the origin of the neurenteric canal, and the formation of the blood. In the course of his argument he urges that the metamerism of the Vertebrate body has its origin always from the gastral, never from the peristomial mesoderm, and also that a vertebral segment always arises *behind* a vertebral segment, the first one appearing without exception behind the position at which the auditory vesicle is formed.

Rabl then passes to consider the homology of the mesoderm in the Bilateralia. His general conclusion is that in all Invertebrate Bilateralia the mesoderm has its origin from two rudiments separated in the median line and derived from the endoderm of the blastopore margin. He makes an exception, however, on behalf of the Chætognatha. Having gained the above general result, Rabl proceeds to show that a perfect homology obtains between the mesoderm of the Invertebrate Bilateralia and that of Vertebrates. On questions of detail, he inclines to believe that the mesoderm had its phylogenetic origin in two endoderm cells symmetrically situated by the margin of the blastopore, and along with Hatschek still suggests that the primary function of these cells was reproductive.

II. *The Differentiation of the Mesoderm.* One general conclusion stands out among the rest. The head of Vertebrates is regarded as consisting of two portions—an anterior, larger, unsegmented region, and a posterior, smaller, segmented part. This is true both ontogenetically and phylogenetically. The boundary between the two regions is marked by the auditory vesicle, which is reckoned, however, with the anterior portion. The mesoderm of the anterior head may be divided into several portions, but these are not comparable to vertebral segments (*Urwirbel*) either in origin or in differentiation. In the anterior head there are (apart from olfactory and optic) two primary nerves, the Trigeminus and the Acusticofacialis. The nerves of the eye-muscles are perhaps to be derived from the Trigeminus, and the muscles themselves perhaps from the visceral musculature associated with the first arch. The primary nerves of the posterior head are the Glossopharyngeus and the Vagus; the Hypoglossus also arises from the ventral roots of this region. A portion of the Vagus may also attain independence as the Accessorius. Homologues of dorsal branches are not to be sought for, since they arise in the trunk at a late stage, apparently in connection with the splitting of the originally single lateral muscular mass into dorsal and ventral regions. The unsegmented mesoderm of the anterior head of Craniota is compared to the process of the first vertebral segment in *Amphioxus*, as described by Hatschek.

Placenta of Rodentia.*—M. M. Duval commences his account of his own observations with a description of the placenta of the Rabbit. For the terms plasmodiblast or cytoblast, suggested by Van Beneden for the part formed from the ectoderm of the egg, he proposes the *vox hybrida* ectoplacenta. On the seventh day of gestation, that is just before the fixation of the ovum to the mucous membrane, the latter exhibits the modifications by which the maternal placenta is distinguished; these are, macroscopically, the formation of the two cotyledonary projections, which are separated by a wide and deep intercotyledonary groove; the histological appearances are the conversion of the uterine epithelium into a homogeneous layer, and the development of the capillaries of the mucous membrane.

The development of the fœtal part of the placenta commences at the end of the seventh day with an ectodermal thickening in the form of ectoplacental crosses. In these there are a number of layers, the superficial of which form the plasmodial layer of the ectoplacenta, while the deeper remain formed of distinct cells. In the former the nuclei multiply by direct division, in the latter by karyokinesis. The former increases by outgrowths which make their way into the mucous membrane of the cotyledonary projections of the uterus; at the end of the ninth day they more or less completely surround the superficial capillaries of this mucous membrane. At the same time every trace of the epithelium of the uterus disappears at the level of the ectoplacental formation, and there only remain glandular cæca.

After the ninth day the elements of the plasmodial layer of the ectoplacenta surround the superficial capillaries of the uterine cotyledons, and, owing to the disappearance of the endothelial wall which alone limited these vessels, they become reduced to mere sinuses hollowed out in the substance of the ectoplacenta, that is to say, to sinuses bounded by the ectodermal elements of the embryo and filled with maternal blood.

* Journ. Anat. et Physiol., xxv. (1889) pp. 309–42 (2 pls.).

Nomenclature of Sexual Organs in Plants and Animals.*—Prof. T. Jeffery Parker offers some criticisms on Mr. R. J. Harvey Gibson's essay "On the Terminology of the Reproductive Organs of Plants." He would retain the terms gonad (= reproductive organ), gamete (= conjugating body), and zygote (= product of conjugation), and use the terms spermary and ovary for the differentiated male and female gonads, sperm and ovum for male and female gametes, zygospore for a resting cell or non-motile zygote formed by the conjugation of equal and similar gametes; zygoöospore for a similarly formed motile zygote and oosperm for a zygote formed by the union of ovum and sperm.

Prof. Parker gives a useful table in which are classified the chief methods of sexual reproduction, but of which we have only space for the larger divisions.

A. Union temporary, probably accompanied by an exchange of nuclear material, and followed by increased activity in fissive multiplication; gametes equal and similar and coextensive with the conjugating organisms.

e. g. *Paramæcium.*

B. Union permanent, resulting in the formation of a zygote, the nucleus of which is (? always) formed by the fusion of the nuclei of the two gametes.

I. Gametes equal and similar.

e. g. *Dallingeria*, *Protococcus*, et al.

II. Gametes equal in size, but one (ovum or egg-cell) is either altogether non-motile or becomes so before conjugation, while the other (sperm or sperm-cell) is motile.

e. g. *Spirogyra*, *Ectocarpus.*

III. Gametes dissimilar both in form and size, one, the microgamete, being relatively small and active; the other, a macrogamete, relatively large and passive.

e. g. *Vorticella*, *Volvox*, *Fucus*, *Metazoa*, *Phanerogams.*

Egg-capsule of Chimæra monstrosa.†—Dr. A. Günther gives a description of the egg-capsule of *Chimæra monstrosa;* it was dredged by the Rev. W. S. Green last July in 315 fathoms off the south-west coast of Ireland, and is of especial interest since the egg-capsule described by J. Müller and by Duméril as that of *Chimæra* is that of *Callorhynchus.* It is 6½ in. long, broad anteriorly, and gradually tapers into a styliform posterior portion for the tail of the embryo; this styliform process is provided with four narrow ridges of which the strongest is that on the right side; the dorsal and ventral ridges are thinner, fragile, and show a rayed structure. Dr. Günther has already suggested that *Chimæra* most probably propagates in deep water; the capsule has no filaments for adhesion, and these would be useless at a depth where the water is perfectly quiet.

γ. General.

Index to the 'Zoologischer Anzeiger.'‡—Prof. J. V. Carus has issued a very elaborate, and apparently complete, though by no means

* Proc. Australasian Assoc. Adv. Sci., 1888, pp. 338–43.
† Ann. and Mag. Nat. Hist., iv. (1889) pp. 415–7.
‡ Leipzig (Engelmann), 8vo, 1889, iv. and 444 pp.

faultlessly printed, index to the first ten volumes of his 'Zoologischer Anzeiger.' This volume will be of great service not only to the possessors of these volumes, but to all students of zoology, for it is a guide to the literature of the science during an important decade.

Zoology of Mergui Archipelago.—The descriptions of the collections made by Dr. John Anderson in the Mergui Archipelago are now complete; their publication has extended over three years, and they occupy volumes xxi. and xxii. of the Journal of the Linnean Society.

B. INVERTEBRATA.

Medullated Nerve-fibres and Neurochord in Crustacea and Annelids.*—Herr B. Friedlaender has made a special examination of the neurochord of *Mastobranchus;* he finds that its sheath consists at least largely of a substance which is very like the medulla of vertebrate nerve-fibres. Within the neurochord there is a substance which is coagulated by alcohol, sublimate, heating and so on, which appears to be of a plasmatic nature, but does not seem to have any definite structure. This substance is the direct continuation of the processes of the neurochord-cells, and appears to agree with them completely.

The neurochords of *Mastobranchus* are three in number, are tubular in form and divisible into sheath and contents; the former consists largely of (in Pertik's nomenclature) myelinogenous or nerve-medulla-like substance; it is probable that there is also a supporting substance, but this cannot be definitely affirmed.

A comparison of a number of apparently similar structures seems to show that the so-called neurochords of *Mastobranchus*, *Lumbricus*, and probably of other Annelids, the nerve-tubes of *Palæmon*, *Squilla*, and very probably of other Crustacea and perhaps of Arthropods in general, and the medullated fibres of Vertebrates are, fundamentally, the same structures. They are all tubular and consist of wall and contents; when the former is of considerable thickness it appears in optical section to have a double contour. The wall of these tubes appears in many (? all) cases to consist at least partially of myelinogenous substances which exhibit certain differences in some cases. Many authors have erroneously regarded the "myelin formations" to which they give rise as part of the contents of the tubes. The contents of the tubes is a protoplasmic substance, rich in water, and directly continuous with the processes of the ganglionic tubes. Among Vertebrates these contents are called axis-cylinders, a name which may be given a wider and more general extension. On the whole, we may conclude that the so-called neurochords are medullated nerve-fibres, and deny the truth of the general proposition that medullated nerve-fibres are found in Vertebrates only.

In conclusion, the author considers the function of the neurochords; he is inclined to doubt that of their being an organ of support. With some diffidence he is inclined to associate them with the power possessed by a number of Annelids and Crustacea of making sudden contractions of the body; in such movements there is an almost simultaneous contraction of the homodynamous muscles of all or nearly all the segments of the body.

* MT. Zool. Stat. Neapel, ix. (1889) pp. 205–65 (1 pl.).

Mollusca.

Mollusca of Canary Islands.*—Prof. C. Chun gives an account of some of the Mollusca collected during a visit to the Canary Islands; as may be supposed he treats mostly of Pteropoda. He gives an account of *Desmopterus papilio* g. et sp. n., Prof. Pelseneer's critical observations on which we have already reported.† *Phyllirhoë trematoides* sp. n. seems to be a well-marked form, of a reddish colour, not so transparent as *P. bucephala*, and smaller than it or *P. atlantica*.

Census of the Molluscan Fauna of Australia.‡—Prof. R. Tate points out that the marine molluscan fauna of Australia admits of division into two sections, one occupying the tropical shores and consisting largely of migrants from the oriental marine province, the other belonging to the temperate waters and consisting largely of endemic species and possessing several restricted genera. The southerly termination of the Great Barrier Reef seems to be a definite point of separation on the east coast. On the west the tropical fauna prevails as far south as Shark Bay, while at Freemantle the Australian species are in the ascendency. The Australian province has yielded 1672 species, of which 72 per cent. are restricted. Others belong to New Zealand or the South Polynesian area, and 13 link temperate Australia with South Africa. The Indo-Australian province has yielded 1495 species, of which rather less than half are endemic in Australia. The author sums up his results in a convenient and easily comprehended table. One genus of Cephalopoda, nine of Gastropoda, and six of Conchifera, are peculiar to Australia. The terrestrial Mollusca are in their species locally distributed, but the genera are nearly all widely dispersed over warm and temperate regions. Of a total of 461 species only two are extra-Australian.

γ. Gastropoda.

Some Species of Vaginula.§—Dr. H. Simroth has a preliminary notice of his studies on some species of *Vaginula*, all of which are new and are called *V. Leydigi* (from Queensland), *V. Hedleyi* (from Queensland), and *V. Hennigi* (from Cambodja). In the first of these the most anterior lobes of the liver lie in front of the intestine, in the others behind. The salivary glands of *V. Hedleyi* consist of a number of separate, flat, whitish saccules, in *Leydigi* they are compact and brownish. The differences in the generative organs are next described. The pedal gland of all is a loose tube, which agrees generally with that of *Testacella* and *Amalia*, but exhibits very great differences in details. The differences are much less marked in the case of the heart, kidney, and lungs. The last differ considerably from the ordinary respiratory organ of the Pulmonata; the respiratory surface is not provided for by vascular trunks which branch more or less finely, but by sinuous longitudinal folds, which partly break up the pulmonary space into chambers, and by other finer folds and coils which provide the necessary extensive surface.

* SB. K. Preuss. Akad. Wiss. Berlin, 1889, pp. 539–47 (4 figs.).
† See this Journal, 1889, p. 734.
‡ Trans. Roy. Soc. South Australia, xi. (1889) pp. 70–81.
§ Zool. Anzeig., xii. (1889) pp. 551–6, 574–8.

The nervous system is remarkable for the fact that the two strong cords which pass backwards contain the intestinal as well as the pedal nerves; the course taken by them is not the same in *V. Leydigi* and *V. Hedleyi*, but this is on account of the difference in the cephalic aorta and is of no importance. The distribution of the branches seems to the author to show that the whole of the dorsal thickening—the notœum—is equivalent to the mantle, and that the pulmonary and anal orifices primitively lay much further forwards.

The tentacles are solid and cannot be invaginated, and the ommatophores are capable of a considerable amount of forward and backward movement. The smooth knob at the end which carries the eye is enormously supplied with nerves; the stalk is quite different to the ordinary pulmonate type, being extremely fine, with sharply-marked transverse rings; it recalls in a striking way the tentacles of some Auriculaceæ. The surface of the lower antennæ is irregularly papillose, and they have a smooth terminal knob, well supplied with nerves. This knob contains an orifice which leads into a rounded cavity, from the wall of which springs an epithelial cone very rich in nerves. At its base there opens a large multicamerate gland which fills up almost the whole of the tentacle. This organ may be safely regarded as having an olfactory function.

The mucous glands of the skin are no less remarkable, for they are not, as is ordinarily the case, unicellular, but are tubular invaginations of the epithelium, which are lined by pavement-cells, and into which the mucus is emptied from all directions. Differences in arrangement are presented by the different species.

The foot, finally, has its own remarkable characters; the arrangement of the cavernous brain is such that every one of the small solid transverse ridges can be swollen out from behind; the primary vessel has not a constant lumen, but has a number of exceedingly powerful sphincters, which follow one another as closely as the transverse divisions of the foot.

It is clear that the Vaginulidæ are a very remarkable family of the Pulmonata, with a large number of characteristic special adaptations. How these arose we cannot yet say; their affinities to the Helicidæ and their allies are not at all close, nor do they seem to have much to do with the Athoracophoridæ of the Oriental-Australian province. It is most probable that they have a certain though distant affinity with the Auriculaceæ.

Neomenia, Proneomenia, and Chætoderma.*—Mr. G. A. Hansen has some notes on these interesting archaic Molluscs. It was stated by Hubrecht that *Proneomenia Sluiteri* had no penis and no gills, but *P. Sarsii* and *margaritacea* have a penis on either side; this organ appears to be merely a round, hollow tube. As to gills, no such well-developed filamentar branchiæ are seen as in *Neomenia*, but there are true folds with a lumen, in which blood-corpuscles may be detected. The author gives figures of the hinder end of *Neomenia*, which he hopes are more satisfactory than those of Tullberg, and he gives of these a detailed description.

* Bergens Museums Aarsberetning for 1888 (1889) 12 pp. (1 pl.).

In *Proneomenia*, as in *Chætoderma*, the ova pass through the pericardium, whence a canal passes backwards on either side, and opens into the anterior end of the albumen-gland. *Neomenia* is clearly the most highly developed of these three genera in the structure of its generative apparatus.

The various organs of the three forms are briefly compared with one another. The skin of *Chætoderma* is very simple, that of *Proneomenia* gives rise to a thick chitinous cuticle, in which there are spicules, and *Neomenia* has a thick cutis, which is traversed by muscular fibres, nerves, and blood-vessels. The gonad of *Chætoderma* is simple, and the sexes separate; in the others, which are hermaphrodite, the gonad is double. In all three the circulatory organs are arranged in the same way, but the diaphragm is best developed in *Chætoderma;* the blood is red, and the corpuscles oval or rounded cells, with a central nucleus. The author has nothing new to add to the earlier descriptions of the nervous system. The musculature is best developed in *Chætoderma*, which has four strong longitudinal muscles; in that genus also the digestive canal is more highly organized than in the other two.

While *Chætoderma* is by its musculature and skin (saving the calcareous spicules) most like an annelid, in other points of its organization it is more closely allied to the Mollusca. Its large tooth, which must be regarded as a modified radula, its gills and gonads are those of a Mollusc. *Proneomenia* is more distinctly a Mollusc; it has a well-developed radula, is hermaphrodite, and in some species (at any rate) has a penis. In *Neomenia* the molluscan character of the gonads is still more marked, for there is a receptaculum seminis on the efferent duct of the gonad, while the duct appears to be divided. The circulatory system is molluscan, for the blood filters through the tissues; there are distinct blood-vessels in the skin of *Neomenia* only, but these do not seem to have a proper wall.

δ. Lamellibranchiata.

Variability of Tasmanian Unio.*—Mr. R. M. Johnston has made a close study of a number of specimens of the genus *Unio*. He finds that, if specimens marking seven successive stages of growth be compared together, the variations in form from youth to the adult stage embrace characteristics which cover most of the distinctions upon which many of the Australian forms mainly depend for the recognition of distinct specific rank. He thinks it probable that the several forms erected into distinct species in various parts of Australia may ultimately prove to be local varieties or particular stages of growth of one widely distributed species.

Molluscoida.

α. Tunicata.

Development of Pyrosoma.†—Dr. O. Seeliger confirms Chun's opinion that the young colonies of four *Pyrosoma*-individuals usually pass from the cloaca of the mother animal to considerable depths,

* Proc. Roy. Soc. Tasmania, 1888 (1889) pp. 95–6 (2 pls.).
† Jenaische Zeitschr. f. Naturwiss., xxiii. (1889) pp. 595–658 (8 pls.).

there multiply asexually, and gradually ascend to the surface. He has been able to work out the life-history with some degree of completeness.

I. The formation of the *stolo prolifer*. The posterior ventral end of a young *Pyrosoma* from an older colony shows three distinct portions which form the bud-generation. There is an ectodermic portion, an endodermic tube or process of the endostyle, and a mesodermic germinal strand, along with a number of mesenchyme cells. In an early stage, the author describes the thickening of the ectoderm, and the origin of the peribranchial tubes from the mesoderm. A further step involves the differentiation of the endodermic tube, and of the mesodermic masses filling the cavity of the stolon. In connection with the mesodermic strand, the peribranchial tubes, the reproductive strand, liberated mesenchyme cells, and the neural canal are described. Seeliger shows the essential agreement between *Pyrosoma* and *Salpa*, as regards the formation of buds, and contrasts this with the very variable processes in other Tunicates. He has previously maintained the phylogenetic independence of the process in the two series.

II. The modification of the *stolo prolifer* into the *Pyrosoma* chain. The stolon grows in length, and divides into distinct regions. In a chain of four or five thus formed, the individuals are still in communication through their pharyngeal and (primary) body-cavities, but as in *Salpæ* the connection is readily broken. The plane of the stolon marked by the primary neural canal and the genital strand corresponds to the median plane of the adult animals. The neural-hæmal axis of each stolon-segment corresponds to the subsequent longitudinal axis, while the longitudinal axis of the stolon and its several segments is the future dorso-ventral axis. This is the result of a marked inequality of growth and consequent displacement in the segments. The ectoderm is of least importance in the differentiation; it produces the cellulose tunic, is pierced by the inhalant and exhalant apertures, and forms long tubular outgrowths which penetrate the mantle as blood-courses. The endoderm divides very early into a proximal and a distal portion, of which the first remains for a while without any essential change, but the second developes into the pharynx and digestive canal of the *Pyrosoma*. This change is described at length. The discussion of the mesoderm begins with an account of the peribranchial tubes. These are at first continuous along the whole of the young stolon, but soon divide into segments corresponding to the buds. They grow especially towards the hæmal surface where their median margins meet below the intestine, and are obliterated to form the cloaca. The appearance of the gill-slits and their relation to the peribranchial chamber are then noticed. The history of the primary neural canal is traced. The persistent ganglion appears far forward on the original neural vesicle from which it soon becomes distinct. The ciliated groove, a sac-like expansion homologous with the "hypophysis-gland" of Ascidians, the first hints of an eye, the disposition of the nerve-strands are discussed in order. Seeliger compares the development of the central nervous system with the very similar process in *Pyrosoma*, and with the development of the true embryos. Some of the free mesoderm cells form blood, while others are fixed as true connective-tissue elements, and form a homogeneous matrix which in old animals fills up the primary body-cavity. Furthermore, in young animals every muscular rudiment consists of a strand of mesenchyme cells, and the author notes that though the muscle round the inhalant aperture has a purely mesenchymatous origin, it exhibits histological characters which the Hertwigs describe as belonging to epithelial or mesoblastic musculature. Finally, heart and pericardium also arise from the mesenchyme. In his account of the history of the genital strand, Seeliger emphasizes the fact that the hermaphrodite apparatus of the organism and the mesoderm of the buds arise from the same rudiment. The memoir concludes with some notes on the formation of the *Pyrosoma* colony.

Heterotrema Sarasinorum.*—Dr. K. Fiedler gives an account of a new genus of Synascidians, which was discovered by the Doctors Sarasin during their visit to Ceylon. It belongs to the family Distomidæ, as defined by Herdman, and stands nearest to *Distoma* itself, but it differs from it in having the efferent orifice merely surrounded by a smooth layer of circular muscles, the teeth being absent; it has also a trifid anal languette, which is wanting in *Distoma*. The author gives a technical account of the new genus and species, as well as numerous details regarding its anatomy.

Arthropoda.

Peculiar Swimming Movements of Blood-corpuscles of Arthropods.†—Dr. H. Dewitz has noticed in certain Arthropods phenomena which led him to believe that the blood-corpuscles are able to swim freely in the blood-fluid. In the hinder wings of a still uncoloured *Tenebrio molitor*, which has just passed the pupal stage, the matrix-tissue of the wings begins to disappear. Processes radiate out from the protoplasm of the cell-body around the nuclei, and pass into the adjoining matrix-cells. This meshwork is filled with blood. The corpuscles are generally narrowed at either end, and sail with one tip directed forward through the meshwork. The author enters into a good deal of detail as to his observations. As to the cause of the movements there is considerable difficulty. No cilia could be detected, nor any regular undulations of the surface, such as Brock has observed in the spermatozoa of a Mollusc; it is possible that they take up and again drive out blood-fluid, and in this way effect their movements. It is clear that the blood-corpuscles of Arthropods have a greater power of movement than those of Vertebrates, for they do not move in a closed vascular system, and can only regain their paths by depending on their own activity. It is not quite certain whether the active movement seen by Max Schultze in the red blood-corpuscles of quite young chicks was a swimming or an amœboid-creeping movement.

Vision of Arthropods.‡—Dr. D. Sharp, after giving an account of Prof. Plateau's valuable experiments on the vision of Arthropods, summarizes his impressions. Insects in motion are guided largely by the direction of light, and the existence of light and shade. When walking they are guided by a combination of light-impressions and tactile-

* Zool. Jahrb., iv. (1889) pp. 857–78 (1 pl.).
† Zool. Anzeig., xii. (1889) pp. 457–64.
‡ Trans. Entomol. Soc. Lond., 1889, pp. 393–408 (1 pl.).

impressions; the latter do not act when the insect is flying. There is not yet any evidence that the light-perceptions are sufficiently complex to be entitled to be called seeing, but, as the large development of the compound eye permits the simultaneous perception of movement, its direction, and of lights and shades over a given area, a dragon-fly may pursue and capture another insect without seeing it in our sense of the word seeing. Dr. Sharp suggests that a set of observations should be made to test to what extent covering the optic organs with pigment is effectual in excluding light from them. It is, further, necessary to observe and delineate the actual tracks made by particular species when escaping from Plateau's labyrinth, the tracks as yet given being only diagrammatic.

α. Insecta.

Distasteful Insects.*—Mr. E. B. Poulton has a somewhat sharp reply to Mr. Butler's observations,† and his only object is to enlighten "readers who may mistake the expression of Mr. Butler's conviction that his notes occupy an altogether unique position for a comprehensive guide to the literature of the subject." To this Mr. A. G. Butler replies ‡ by quoting the observations he communicated to Mr. Poulton some time since. He considers it noteworthy that no insect in any stage excepting the red-tailed humble-bee (which was only offered to the Missel-Thrush) was rejected by all his birds; those insects which were refused by certain species were eagerly devoured by others, so that it was impossible to conclude that any of them enjoyed perfect immunity from destruction. His birds did not learn by experience to reject with scorn that which they had proved to be unpalatable, and in some instances they seemed to acquire a taste for larvæ previously refused. "Birds are very intelligent, but their memories are ridiculously short." As to Mr. Poulton's remark that birds are afraid of large spiders, Mr. Butler points out that the larva of *Stauropus fagi* does not leave the egg full-grown.

Abdominal Appendages of Insects.§—Dr. E. Haase has investigated the abdominal appendages of Insects, and especially of the Thysanura, with especial reference to the affinities of the Myriopoda. He finds it necessary to distinguish between the soft ventral saccules, which can be evaginated, and which are generally known as segmental or crural glands, and the stump-like appendages which he calls "Bauchgriffel."

The ventral saccules of *Scolopendrella* are developed from the third to the eleventh segment of the trunk; it is pointed out that they may be filled with blood, and are drawn in by a special muscle; their cuticle is smooth, has no distinct pores, and the nuclei of their matrix are very large. Among the Diplopoda we find saccules of similar structure, but with a simpler matrix and better developed retractors; they lie in the third pair of legs of both sexes of *Lysiopetalum*, *Polygonium*, and *Siphonophora*. In the Chordeumidæ a few are found between the copulatory feet of the male, where they serve as receptacula seminis. In *Campodea*,

* Ann. and Mag. Nat. Hist., iv. (1889) pp. 358–60.
† See this Journal, 1889, p. 633.
‡ Ann. and Mag. Nat. Hist., iv. (1889) pp. 463–73.
§ Morphol. Jahrb., xv. (1889) pp. 331–435 (2 pls.).

paired ventral saccules, very like those of *Scolopendrella*, are found at the hinder margin of the second to the seventh ventral plate of the abdomen; they are traversed by muscles and a cord of connective tissue. No distinct pores can be made out in the cuticle, and the matrix-layer is provided with a few gigantic nuclei. In *Japyx solifugus*, saccules beset with glandular hairs are to be seen on the hinder margin of the first ventral plate of the abdomen; in *J. gigas* these break up into several parts. In *Machilis* there are seven pairs of abdominal saccules with well-developed muscles and an apparently non-porous cuticle. The ventral tube of *Collembola* on the first abdominal segment has well-developed retractor muscles, a cord of connective tissue, and glandular cells with distinct pores. Living examples of *Machilis* and *Podura* show that the abdominal sacs are only protruded when the animal is completely at rest and in warm damp air. *Poduræ* creeping on a glass surface keep their ventral tube generally inactive, and the same is always the case with the abdominal saccules of *Machilis*.

The relation between the development of the tracheal system and the ventral saccules shows that the latter have a respiratory function, and are to be regarded as blood-gills; the air-tubes are absent in most of the Poduridæ, are short and open by a single pair of stigmata in *Smynthurus* and *Scolopendrella*, and by three in *Campodea;* when the common longitudinal trunks are developed the ventral saccules are reduced.

No urinary products can be detected in the abdominal saccules; the development of the saccules is affected not only by the tracheæ but also by the amount of metabolism which goes on.

It is probable that the coxal sacs found in both sexes of Diplopods have a subsidiary function as organs of attachment during copulation. The temporary vesicular appendages of *Gryllotalpa*, *Melolontha*, and others, the structure of which completely resembles that of the abdominal saccules, are to be regarded as secondary blood-gills.

The stump-like ventral appendages of *Scolopendrella* (coxal styles) are found on the second to the twelfth segments of the trunk; they are movable and are traversed by a nerve. The spinning styles of *Scolopendrella* are quite immovable, and correspond to the cerci of Insects. The pair of appendages on the first abdominal segment of *Campodea* is to be regarded as a rudimentary pair of legs; this genus has no gonapophyses in either sex. The jointed anal cerci of *Campodea* are quite like antennæ in structure, but they have no muscles. The abdominal styles of *Machilis* have flexor muscles in the anterior segments; the mid-tail of this genus corresponds to a supra-anal prolongation of the anal piece.

The abdominal styles serve especially as tactile organs and for the support of the body in locomotion or in springing, while the anal cerci have a function similar to, though less well developed than that of the antennæ.

The author concludes that the Myriopoda and Insects have a common origin; the Symphyla stand nearest to the Diplopoda, but the Pauropoda are to be regarded as degraded from the latter. The common ancestors of the Chilopoda and Insecta stand equally near to the former and to the Symphyla, but they possessed a posterior genital orifice.

The higher Insects (Pterygota) have ancestors in common with the Thysanura, with which they were closely connected. The abdominal styles are not remains of legs but secondary, paired, hairy structures which were at first purely sensory. The Collembola appear to be a direct side-branch of the Thysanura. All the Pterygota had the same origin. The ventral plates of the hind-body of the Hexapoda were derived from the fusion of the abdominal legs, developed in the embryo, with the whole ventral membrane, or with a median shield, which corresponds to the sternal shield of Myriopods.

Luminous Organ of Insects.*—Dr. H. v. Wielowiejski has continued his investigations on the luminous organs of insects, and commences with a criticism of the work of other observers. In *Pyrophorus* he finds that the ventral luminous plates consist of two layers. The upper, which is generally filled with crystalline concretions, agrees exactly in structure and relations with the "urate layer" of the Lampyridæ. But the special luminous plate is of a very different form to that which is typical of the just-named family; the cells appear to be closely connected with one another; their protoplasm is close and highly refractive; on the surface there is a thickening which is not so well developed as in *Lampyris italica*. The rows of cells do not appear to be invested by a membrane of connective tissue, as Dubois supposes; the small nuclei seen by the French observer belong to the tracheal capillaries which Dubois failed to see. The author cannot accept M. Dubois's views as to the physiology of the luminous organs.

Development of Insects.†—Prof. C. Emery reviews V. Graber's researches ‡ on the development of Insects. The abdominal appendages which occur in representatives of most of the orders were studied by Graber in *Melolontha*, *Hydrophilus*, *Mantis*, &c., and are regarded as normal but rudimentary structures, the interpretation of which depends on the conclusions arrived at as to the ancestral forms. Both Graber and Emery incline to the opinion that the direct ancestors of insects were "heteropodous," and not "homopodous." Graber's observations on the origin of segments in *Stenobothrus variabilis* show that the segmenting is not superficial, but that the hypoblast divides first into four "macrosomites," and subsequently into "microsomites" or metameres, which agrees with what has been described in *Œcanthus niveus* by Ayers. Graber observes that the three thoracic segments in the hypoblast are differentiated while the three segments of the mouth-appendages are still included in an undivided macrosomite. By hypoblast, Graber means the result of the invagination of the blastoderm, to the entire exclusion of the yolk-cells or "centroblast," to which he denies all share in forming the rudiments of the embryo. In reference to the enveloping blastodermic fold (or "gastroptyche") Graber distinguishes the inner amniotic sheath as "entoptygma," the outer serous sheath as "ectoptygma." Most of the insects investigated (e. g. Hymenoptera) show the typical process of folding, the yolk lying wholly on the dorsal surface

* Zool. Anzeig., xii. (1889) pp. 594–600.

† Biol. Centralbl., ix. (1889) pp. 396–405.

‡ Morphol. Jahrb., xiii. pp. 586–615 (2 pls.); xiv. pp. 345–67 (2 pls. and 4 figs.). Denkschr. K. Akad. Wiss. Wien, liv. pp. 109–62 (8 pls. and 2 figs.).

of the embryo (*ectoblastic*), but in Rhynchota and Libellulidæ the embryonic rudiment is invaginated into the yolk, and the embryo with the ventral amnion is separated from the ectoptygma by a layer of yolk (*entoblastic*), while in Lepidoptera an intermediate mode of development occurs. Emery protests against the conclusions suggested by Graber's application of the above differences to the classification of Insects, and insists on the necessity for more extended embryological investigations.

Morphology of Lepidoptera.*—Mr. W. Hatchett Jackson, in his paper under this title, deals with two points in the anatomy of the Macrolepidoptera—the external anatomical indications of sex in the chrysalis, and the mode in which the azygous portion of the oviduct with its accessory organ developes in the female. It seems to have escaped the notice of all observers that it is perfectly easy to determine the sex of a given chrysalis; the distinctive characters are to be found in the sternal region of the ninth abdominal segment in the male, and in the corresponding region of both the eighth and ninth abdominal somites in the females. The male has a fine short line corresponding to the aperture of the ductus ejaculatorius, and this line has two small oval lips. The female has typically two fine linear depressions which correspond to the paired vesicles invaginated from the larval hypodermis, and to the apertures of the bursa copulatrix and oviduct in the adult.

One of the greatest peculiarities of the Lepidoptera is the existence, in connection with the female reproductive organs, of two separate external apertures, that of the bursa copulatrix, and that of the oviduct. Mr. Jackson has made an investigation of the development of these parts in *Vanessa Io*, and comes to the conclusion that the aperture of the bursa copulatrix belongs to the eighth somite, and is, strictly speaking, the homologue of the single genital aperture of other Insecta; the Lepidoptera have really two post-genital somites intervening between the genital aperture and the anus, and the oviducal aperture is an acquired peculiarity. While these statements are true of most Lepidoptera, it is recognized that variations may occur, as in *Nematois metallicus*, described by Cholodkowsky.

Three distinct stages appear to be indicated in the phylogenetic history of the female reproductive organs. In the first stage paired larval oviducts opened at the posterior border of the seventh abdominal somite, as in existing Ephemeridæ. If accessory organs were present they opened independently on the two succeeding somites. In the second stage a short vagina or azygous oviduct, derived from the hypodermis of the eighth somite, made its appearance. The bursa copulatrix and receptaculum seminis opened close behind its aperture or into it on its dorsal aspect, while the sebaceous glands retained a separate aperture. Very similar arrangements obtain in many living Orthoptera. Finally, in the third stage, the sebaceous glands open into a continuation of the vagina which possesses a second terminal aperture—a disposition of the parts which is specialized in the Lepidoptera.

* Zool. Anzeig., xii. (1889) pp. 622–6.

Alimentary Canal of Lamellicorn Larvæ.*—Dr. P. Mingazzini describes the alimentary tract in the larvæ of *Oryctes*, *Phyllognathus*, *Cetonia*, *Tropinota* and *Anomala*—phytophagous Lamellicorns. The histology and physiology of each of the three regions of the gut are discussed at great length; among the many special points worked out we may notice the dimorphism of the epithelial cells in the posterior part of the œsophagus, the disposition of the muscular fibres on the mesenteron, the nuclear crystalloids of the midgut-epithelium, the chitinous structures of the proctodæum, and the nuclear degeneration in the epithelium of the hindgut-sac.

The alimentary canal of Insects exhibits two extreme types:—one in which the stomodæum is very slightly developed (as in the above larvæ), while the proctodæum is long and complicated; another is seen in Orthoptera where the stomodæum is greatly developed, but the proctodæum relatively reduced. In the primitive Thysanura both types occur, the gut of *Machilis* resembling that of Lamellicorns, while in *Nicoletia* or *Lepisma* the other type is approached. The author associates the extreme types of alimentary apparatus with the different habits of the members of the two orders referred to above, and finds another factor of variability in the degree of digestive power possessed by the mesenteron in different insects. He also emphasizes the differentiation consequent on the proctodæum acquiring a distinct absorbent function as in Lamellicorn larvæ.

The chitinous structures in the stomodæum and proctodæum are physiologically of three kinds:—those which serve for trituration, e. g. teeth and spines; those which retain the food, such as the tree-like structures in the hindgut of Lamellicorn larvæ; and those which are directive. Foremost among the peculiarities of the two regions derived from the ectoderm, Mingazzini notices the chitinous cuticle, which must be chemically as well as microscopically determined. Another character, which in the higher insects is only seen in the proctodæum, is the folding, best seen in the rectum. The author notes the possibly primitive hexamerous symmetry of the intestine: thus, the mesenteron of Lamellicorns exhibits double dorsal and double ventral muscular bundles, which with the two laterals make six divisions. He derives some support for this theory from the researches of Miall and Denny on the cockroach. He discusses Eisig's comparison of the chitin in Capitellidæ with that of insects, but sought for the fibrillar structure which Eisig described without finding any trace of it. The chitin is regarded simply as a cuticle with peculiar chemical properties. The cæca of the mesenteron are portions specialized for regular secretion, in virtue of being out of contact with the food. The presence of unstriped muscular fibres in the tunic of the mesenteron leads the author to discuss the distribution of these elements, to protest against certain generalizations on this subject, and to note the intermediate forms between the striped and unstriped types. It is interesting to find that in no region of the gut did Mingazzini discover karyokinetic division of the nucleus. The unique crystalloids in the degenerating nuclei of midgut cells are probably waste products.

* MT. Zool. Stat. Neapel, ix (1889) pp. 1–112 (4 pls.).

Parasitic Bees.*—Prof. E. Hoffer gives an account of the genus *Psithyrus*, the members of which are parasitic in the nests of humble-bees, which they very closely resemble. The female may be distinguished from a humble-bee by the less curved tip of the abdomen, by the raised ventral ridges which converge from the sides to the tip, by the absence of collecting apparatus, by the somewhat naked and shining back, and by certain differences in labrum and mandibles. The males, which are much smaller than the females, may be distinguished from species of *Bombus* by the relatively short head, by the externally convex and uniformly hairy tibia of the posterior legs, by the almost membranous and light-coloured genital appendages, and by several other characteristics. There are only male and female forms of *Psithyrus*,—the latter appearing in spring, the former decidedly later. After describing the structure of the body, the author gives a very interesting account of the mode of life of both sexes. He describes the slow flight of the females in early spring, their sluggishness except in bright sunshine, their deliberate and thorough robbery of a few flowers, and their determined search for *Bombus* nests. An entrance is effected by force, but apparently only into those nests which contain either a solitary queen *Bombus*, or only a few workers. The egg-laying of the *Psithyrus* was not observed. Only the stored pollen and honey of the hosts are devoured by the adult parasites at least, but the consequence is always that the humble-bee colony ceases to flourish. It is possible, or even probable, that the larvæ of the *Psithyrus* devour those of their hosts, but the mother probably superintends the nutrition of her larvæ, and also forbids the entrance of other claimants. The lives of the males in the two genera are as similar as those of the females are different; and, as in the case of *Bombus*, the males of *Psithyrus* all die in the cold and scarcity of food associated with the advent of autumn. Professor Hoffer describes six species of *Psithyrus* from the Steiermark district.

Parasitic Castration of Typhlocybæ.†—M. A. Giard gives an account of his observations on the parasitic castration of *Typhlocyba* by the hymenopterous larva *Aphelopus melaleucus* and the dipterous larva *Atelenevra spuria*. Like their hosts, these insects have two generations in the year. The researches of Mr. James Edwards show that what, in a previous note, M. Giard called *T. rosæ* L. should be distinguished into *T. hippocastani* J. Edw. and *T. Douglasi* J. Edw. *Aphelopus* usually attacks the former and *Atelenevra* the latter. Parasitism by *Aphelopus* generally causes the ovipositor to be much reduced and incapable of penetration, but *Atelenevra* seems to have much less influence. The penis, on parasitic castration, undergoes considerable reductions, and the specific character is greatly modified.

Certain singular organs, hitherto overlooked in the males of *Typhlocyba*, have the form of two invaginations of the ectoderm, which start from the ventral surface of the first abdominal segment, and extend, like the fingers of a glove, to the extremity of the fourth segment; these the author regards as homologous with the stridulating organs of the male Cicadas. When the males are parasitically infested the ventral invagi-

* MT. Nat. Verein Steiermark, xxv. (1889) pp. 82–158 (1 pl.).
† Comptes Rendus, cix. (1889) pp. 708–10.

nations are much reduced, and may form only two little pockets on the first segment.

Aphelopus melaleucus appears to be pretty common; in Wimereux and at Meudon the sac which contains the larva is of a blackish colour, and not yellow, as in the Luxembourg Garden. This colour is evidently protective of the more numerous individuals living on *T. ulmi*, the abdomen of which is black, and is probably due to heredity in the others. It is possible that *Aphelopus* presents varieties in the different species of *Typhlocyba* which it infests.

Phytophagous Habits of the Larva of Friganea.*—Dr. D. Levi-Morenos finds that the larvæ of different species of *Friganea* (Neuroptera), usually stated to live on aquatic flowering plants, comparatively seldom feed on the green parts of the plant, though occasionally on the root and epiderm. He finds, on the other hand, the alimentary canal loaded with diatoms of many different species. From some of these the endochrome is entirely removed in the process of digestion, while others remain comparatively intact.

Embryology of Blatta Germanica and Doryphora decemlineata.†—Mr. W. M. Wheeler gives a detailed account of his observations on the development of the cockroach and the potato-beetle. In all the details of their history the two forms differ strikingly, but their main ontogenetic features are as strikingly similar.

After an account of the ovaries and modes of oviposition the development of the egg is described as far as the formation of the blastoderm; though the author adds something more to our knowledge of the copulation of the pronuclei than Blochmann, he considers that the process must be studied in Arthropod eggs with more evenly compact yolk than those of the Orthoptera, the numerous cracks and fissures in which render the observation of delicate internal processes exceedingly difficult, if not impossible. The nuclei, at one time in the yolk, all appear to rise to the surface to form the blastema and reinforce it in its formation of the blastoderm.

The author maintains that a portion of the chromatin of the insect-egg visibly survives in the decomposition of the germinal vesicle, and can be traced through the divisions resulting in the formation of the two polar globules into the cleavage-nucleus and its descendants. In other words, there is no moment when the nucleus ceases to exist as nucleus. Particular attention was paid to the determination of the paths of the pronuclei and cleavage-nucleus in *Blatta*, and experiments were made on the possible effects of gravitation. The conclusion arrived at is that the force of gravitation has no perceptible effect on the development of the eggs of *Blatta*; their highly differentiated eggs, utterly unable to revolve in their envelopes like the eggs of birds and frogs, have their constituents prearranged, and the paths of their nuclei predetermined with reference to the parts of the embryo. The spherical form of the crustacean egg, as opposed to the oval shape of the great majority of insect-eggs, will be a great obstacle in the way of extending this generalization to the lower group.

* Notarisia, iv. (1889) pp. 775–80.
† Journ. of Morphology, iii. (1889) pp. 291–372 (7 pls.).

The formation of the germ-layer, and embryonic envelopes is next discussed. The method of germ-layer-formation in *Blatta* is, at first sight, very different from that observed in *Doryphora;* but a study of the latter helps to explain the conditions which obtain in the former, and makes it probable that the endoderm of *Blatta* originates in the mass of cells found under the area of proliferation, the more superficial cells of which form the mesoderm.

The embryonic envelopes and the dorsal organ which are formed soon after their rupture, offer a good deal of difficulty. In considering the meaning of the amnion and serosa of Hexapoda, we must postulate that (1) there are no sufficient reasons for homologizing the embryonic envelopes of insects with the homonymous but dissimilar structures in Myriopods, Scorpions, and *Peripatus;* (2) there is no more than a superficial resemblance to speak for a homology between the dorsal organs of the Crustacea and the embryonic envelopes of Insects, and between the dorsal organs of the former and the homonymous structures in the latter; (3) the dorsal organ of insects may be regarded as the necessary result of the rupture and absorption of the embryonic envelopes, and, consequently, as in no way related to such structures as the dorsal organs of *Cymothoa*, *Limulus*, and others. There is a complete series of finely graduated forms of envelope-formation from that seen in *Calopteryx* to that which obtains in *Blatta*, *Aphis* representing the first step in the transition of an entoblastic into an ectoblastic embryo. The author concludes that the typical ectoblastic originated from the typical entoblastic embryo, not by an extrusion of the yolk from between the amnion and serosa, but by a gradual weakening of the invaginative process. This weakening results in more and more of the anterior portion of the ventral plate remaining inert, though the growth of the membranes to shut off the amniotic cavity continues.

The term "dorsal organ" is applied to the peculiar thick lump of cells which results from the concentration on the dorsal yolk of the remains of either the amnion or serosa or of both, preparatory to their absorption in the yolk. Its presence in Insects is probably due to the fact that the embryonic envelopes are to be absorbed. These membranes might either undergo dissolution *in situ*, or they might be brought together in a mass, and swallowed up by the yolk somewhere in the median dorsal line. The latter method is obviously the more advantageous as the body-walls, which are continually growing towards this dorsal line, might be impeded in their advance, if the membranes were absorbed at all points on the surface of the yolk.

In conclusion, Mr. Wheeler gives an account of the fate of the different germ-layers. We have only space to note that the frontal ganglion is formed as an unpaired thickening of the dorsal wall of the œsophageal ectoderm near the base of the labrum; the outer neurilemma is of ectodermal and not of mesodermal origin, for shortly after the separation of the nerve-cord from the integumentary ectoderm, it sheds from its surface a delicate chitinous cuticle, simultaneously with the shedding of the first integumentary cuticle.

β. Myriopoda.

Anatomy of Chilopoda.*—Herr B. Schaufler gives an account of the generative organs of *Lithobius*, *Cryptops*, and *Geophilus;* the author differs in a number of important points from Fabre. Glands which have a certain relation to the receptacula seminis are always well developed; they are inferior to another pair of glands which vary in the extent to which they are developed, and which may have the function of providing protective envelopes for the ova against external influences. The feeble development of the glands in *Cryptops* and *Geophilus* may perhaps be made up for by the care of the young which the members of these genera exhibit. It is difficult to speak with any certainty as to the habits of these shy and nocturnal animals, but it is very probable that copulation does obtain among the Chilopoda.

Structure of Gizzard in Scolopendridæ.†—Dr. V. Willem finds that in *Scolopendra*, *Scolopocryptops*, *Cryptops*, and, probably, in other genera of the Scolopendridæ there is a gizzard which has the same fundamental constitution as that of Insects. In *Scolopendra* it has a thick muscular wall, the interior of which is grooved by projecting longitudinal folds ; on these there is a crown of protuberances directed forward, and formed by the chitinogenous layer and the cuticle of the anterior intestine. The form of the protuberances varies in different species. In *Scolopocryptops* and *Cryptops* the gizzard is an ovoid swelling of the buccal intestine, provided internally with chitinous processes which are directed towards the œsophagus. The armature of the organ is most complicated in *Cryptops*, with which nothing among Insects but that of *Corethra plumicornis* can be compared.

δ. Arachnida.

Parasite of the Slug.‡—M. P. Mégnin describes an Acarid which appears to have been known for a long time as parasitic on the grey slug (*Limax*). It is identified as *Ereynetes limacium*, is included in the family Trombidiidæ beside the genus *Tydeus*, and has a near relative in the orange-coloured *Ereynetes velox* which infests dung-eating insects. The parasite of the slug is blind, of a white colour, and moves with rapidity on its host. The females, males, nymphs, and hexapod larvæ are described. They seem to live on the mucus of the slug, and ought, perhaps, to be called commensals.

Anatomy of Pentastomida.§—Herr E. Lohrmann gives an account of the anatomy of the Pentastomida. Contrary to Leuckart, he finds that the outer soft chitinous investment is distinctly striated, for sections show an alternation of lighter and darker bands, of which, in some parts there may (in *P. tænioides*) be as many as twenty. In the harder parts of the cuticle, such as the hooks and their supporting plates, there is no striation, but there are a number of small irregular spaces which are sometimes arranged in rows or layers. The author does not alto-

* Abh. Zool.-Bot. Gesell. Wien, xxxix. (1889) pp. 465–77.
† Bull. Soc. Acad. Roy. de Belgique, lix. (1889) pp. 532–46 (1 pl.).
‡ Journ. Anat. et Physiol. (Robin), xxv. (1889) pp. 570–2 (1 fig.).
§ Arch. f. Naturgesch., lv. (1889) pp. 303–37 (1 pl.).

gether agree with Leuckart as to the disposition of the musculature, and he points out that, to completely understand that of *P. tænioides*, it is well to examine young forms; these have not the flattened form of older examples, but are rounded, and the oblique system of muscles is limited to the sides. The species exhibit some differences among themselves as to the arrangement of the muscles.

Sensation does not appear to be confined to the two so-called tactile papillæ at the anterior end of the body. There are a number of small warty-like bodies, which are generally paired, in the anterior region; their cuticle is broken through at one point and the cleft is filled by a closely packed tissue, the elements of which are arranged in parallel rows and are directed outwards. At their inner ends they are connected with undoubted nerve-fibres. The functions of these organs would appear to be to give information to the larva when it has acquired a suitable resting-place and perhaps also to allow the male to discover the female. Herr Lohrmann is not inclined to agree with Leuckart in regarding the so-called tactile papillæ as rudimentary antennæ. The differences exhibited by different species are pointed out.

It seems to be impossible to understand clearly the relations of the mouth without the aid of sections; this method was first used by Hoyle, and to his account the author makes some corrections and additions; to Leuckart's description of the œsophagus the author has only to add that there are longitudinal as well as circular muscles; the cells of the mid-gut have not the special fringe noticed by Frenzel and others in many other Arthropods.

The author enters at some length into an account of the secretory organs, and gives reasons for regarding them as belonging to two, and not as did Hoyle to three distinct groups. In his account of the male generative organs his most important points are some remarks on their more minute structure; on the whole, they have already been fully described by Leuckart. And, similarly, he has but little to add to what is generally known as to the characters of the female organs.

Dr. Lohrmann cannot agree with Hoyle in regarding Leuckart's subgenera *Linguatula* and *Pentastomum* as having generic value. The only sharp distinction is the double testis of *P. tænioides* and the form of the body; but the latter is clearly due to the characters of the region inhabited. Adults with rounded bodies are found in the round spaces in the meshwork of the lungs, while the flat forms live in the flat spaces of the nasal cavities. Some of the described species are apparently only stages of growth, and *P. polyzonum* would appear to have had six names. Finally, there are descriptions of two new species—*P. platycephalum*, the host of which is unknown, but is probably an Alligator, and *P. clavatum* from the lungs of *Monitor niloticus*.

ε. Crustacea.

Crustacea of Canary Islands.*—Prof. C. Chun confines himself to an account of the Amphipoda, Schizopoda, and Decapoda collected by him on his visit to the Canaries. Although he allows that all the names as yet given to forms of *Phronima* are synonyms of *P. sedentaria*, he finds

* SB. K. Preuss. Akad. Wiss. Berlin, 1889, pp. 527–39 (10 figs.).

himself justified in naming a new species which he calls *P. Diogenes;* it lives in depths of from 350 to 1500 metres; the characters by which it differs from the well-known species are carefully pointed out in detail. Three specimens were found of the rare *Rhabdosoma armatum. Oxycephalus piscator* and *O. typhoides* were found to be commensals of *Eucharis multicornis.*

A description is given of a remarkable new Amphipod, called *Fortunata lepisma*, which it is somewhat difficult to associate with any of the known families. It agrees with the Gammaridæ in the small size of the eye and of the cephalic segment, while the want of a lateral compression of the body and the form of the segmental appendages calls to mind some of the Hyperina. Milne-Edwards rightly insisted on the value of the form of the antenna as a characteristic of the latter group; of these, the Phronimida, like *Fortunata*, have the anterior antennæ two-jointed, while the hinder antennæ are absent in the female. On the whole, however, the characters of this new form are sufficiently peculiar to justify the formation of a new family—that of the Fortunatæ—for its reception. The author adds a diagnosis of the family.

In the Atlantic, as in the Mediterranean, the Schizopoda form a very characteristic part of the pelagic fauna. The remarkable *Euchætomera typica*, described by G. O. Sars in the 'Challenger' Report, is now for the first time definitely stated to inhabit the Atlantic. By the astounding length of its upper antennæ, which were broken off in the Pacific Ocean specimens obtained by the 'Challenger,' by the size of its endopodites, the remarkable shortening of the carapace and telson, this form is characteristically intermediate between *Mysis* and the *Arachnomysis Leuckartii* which the author has described from the depths of the Mediterranean. *Stylocheiron mastigophorum*, first found in the Mediterranean, was found at all depths. *S chelifer* sp. n. is so called on account of the size of its chelæ; its antennæ are as long as its body.

Sergestes sanguineus sp. n. is so called on account of the blood-red coloration of its astonishingly long lower antennæ, which are more than four times as long as the body; it is distinguished from all the Sergestidæ yet described by the extraordinary development of its penultimate thoracic legs.

Differences in Developmental History of Marine and Freshwater Forms of Palæmonetes varians.*—Dr. J. E. V. Boas points out that the species hitherto known as *Palæmonetes varians* contains two forms; one, northern and marine or brackish in habitat, the other more southerly in distribution and a dweller in fresh water. The adults are so like one another that there could be no reason for separating them specifically, but their developmental history is very different. The egg of the freshwater form has eight times the volume of the marine; the latter leaves the egg as a gill-less zoea, passes through a normal Mysis-stage, and takes food from its birth. The freshwater form appears as a much better developed zoea, and has gills; the exopodites of the thoracic feet are only slightly developed, so that there is only an indication of the Mysis-stage—i. e. there is an abbreviation of the metamorphosis; and in consequence of the large quantity of the nutrient

* Zool. Jahrb., iv. (1889) pp. 793-805 (1 pl.).

yolk with which it leaves the egg, and which is only gradually absorbed, the young animal does not take food from outside till very late, and the maxillary palps are, consequently, for a long time without setæ. The freshwater form is to be regarded as having been derived from the marine; and its peculiarities are analogous to those which we often find in other freshwater animals which have allies in the sea. The peculiarity of the case lies in the fact that the adults of the two forms have remained almost exactly alike, while the development has become so very different.

Vermes.

α. Annelida.

Development of Annelids.*—M. L. Roule has a lengthy memoir on the development of Annelida, based chiefly on a study of *Enchytræoides marioni*. The embryos pass through the early stages of their development in cocoons, and escape when they have from fourteen to fifteen rings. Segmentation is complete and somewhat unequal; as a rule there is no cavity comparable to a blastocœl; a planula is formed by tangential division of the cells, and the interior is at first a mesoendoblast, and is extensive. As an archenteron appears the endoblast becomes distinct as a single layer of cells from the five or six rows that form the mesoblast. We have already noted † the author's description of the formation of the cœlom. As the embryo elongates and becomes cylindrical the archenteron and cœlom increase in size; the ectoblast of the anterior end of the body thickens to form the cephalic plate, and a similar medullary plate appears on the ventral surface. As the embryo elongates it becomes narrower, and four or five rings appear in the anterior region of the body; septa begin to extend from the somatopleure to the splanchnopleure, and the cephalic lobe becomes marked off as the most anterior segment of the body. The ectoblast becomes depressed in relation to the septa, so that an external annulation corresponds to the internal segmentation of the mesoblast and cœlom. The dorsal and ventral portion of the central nervous system next become united. Behind the last ring there is a large mass of mesoblast in which closed cavities are hollowed out by pairs, on either side of the digestive tract. The setæ are formed at the expense of the ectoblast, and the muscles which move them from the somatopleure. The external and sub-ectoblastic cells of the somatopleure begin to be differentiated into smooth muscular fibres by the formation of contractile substance at their periphery; they thus become fibre-cells, comparable to those of Molluscs.

The nephridia appear in the form of a continuous cord, which becomes differentiated in the deep region of the somatopleure; this cord divides into groups of four or five cells, which become connected with the septa. The cells of the group fuse, and vibratile canals become hollowed out in the mass. After expulsion from the cocoon the body of the embryos continues to elongate, and two blood-vessels begin to appear; these trunks join and fuse; at first each trunk is represented

* Ann. Sci. Nat., vii. (1889) pp. 107–442 (15 pls.).
† See this Journal, 1889, p. 387.

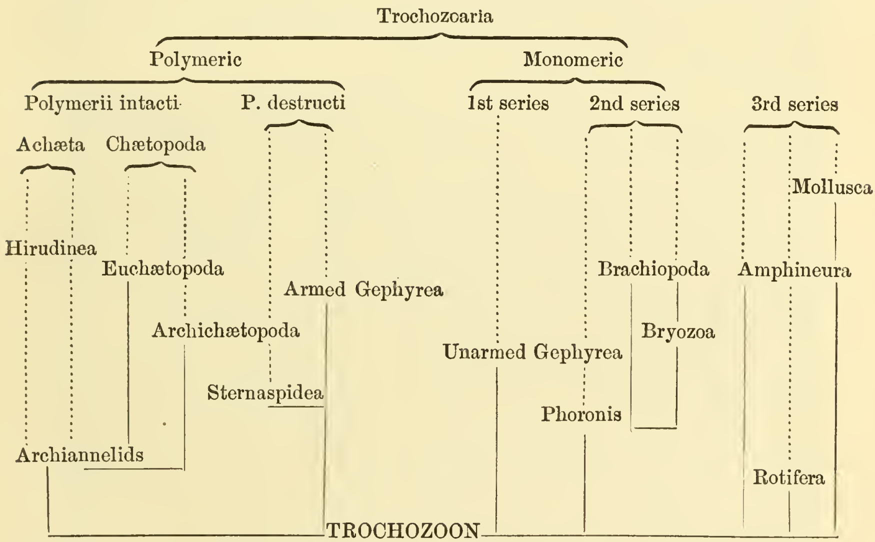
by an empty space without proper walls, placed between the splanchnopleure and the endoblast; this may be considered as a blastocœl-space, which does not and never will communicate with the cœlom. Later on, the splanchnopleure furnishes the vessel with a complete wall. When the two vessels are continuous along the whole of their course they give rise to anastomosing loops which unite the two.

The seventh stage, in which the worm has thirty rings, is characterized by the appearance of the gonads and sperm-ducts. To begin with, the pair of nephridia in the eleventh ring is absorbed and disappears; the rudiments of the testicle and ovary then appear in the eleventh and twelfth rings respectively; they are altogether derived from the peritoneal endothelium of the septum, which forms the anterior boundary to the ring in which they appear. The rudiments of the testicle grow rapidly, and divide into lobes, while the cells which form them become fused into a symplasm, in which a number of small nuclei are scattered. The rudiments of the ovaries remain undivided, and their cells, though closely packed, do not fuse. The two sperm-ducts appear in the twelfth ring in the place of the segmental organs, which are not there developed; their origin and mode of development resemble in all points those of true nephridia; so that the homology of the two sets of organs cannot be doubted. They are put into relation with the ectoblast of the wall of the twelfth ring to form the penis. In the adult stage the body of the worm measures 12 to 15 mm. in length, and has about fifty rings; the clitellar region is a little wider than the rest of the body, owing to the thickening of the ectoderm, in which there are numerous mucous cells, and to the distension of the walls by the contained gonads. The author describes the phenomena of spermatogenesis and oogenesis. When the adult has discharged its gonads the tissues of the organs undergo degeneration, and the individual dies. The act of reproduction appears, therefore, to be the term of life in this species.

The absence of initial mesoblasts does not appear to be peculiar to the embryos of *Enchytræoides;* it seems, on the contrary, to be the rule in all condensed developmental histories of Annelids. Similar facts have been noted in other groups of animals, for, e. g. the enterocœle of *Amphioxus* appears to be wanting in most other Vertebrates, where the mesoblast is separated by a simple cleavage of a primordial layer, which corresponds to the meso-endoblast of Annelids. When a mesoblast is formed in *Enchytræoides* it is homologous with the mesoblastic bands of the larval trochosphere. The differences between the embryo now described and the trochosphere are due to the condensation of development in the former. The difference between the descriptions now given and those of the development of other Oligochæta are considerable, but are probably largely due to the want of technical appliances which obtained when these latter were drawn up.

With regard to the systematic position of Annelids, M. Roule agrees with Hatschek in allying them to the Mollusca; it is very probable that both Annelids and Platyhelminths were derived from a group of Cœlomata which had a very simple structure, similar to that of the trochosphere-larva. The whole group may be called the Trochozoaria, and divided into those that are polymeric or segmented and those that are monomeric or not metamerically segmented. Of the former there are two series; in some the segmental cavities of the larva persist in the adult, while in others the septa are destroyed in such a way that the definite cœlom resembles that of the monomeric Trochozoaria. The former may be said to have persistent segments, the latter to have the segments destroyed; to the former belong the Archiannelids, Hirudinea, Archichætopoda, and Euchætopoda, and to the latter *Sternaspis* and the armed Gephyrea.

The monomeric Trochozoaria contain a certain number of classes, of which it is difficult to estimate the relations; three series are, however, well marked. In the first are the unarmed Gephyrea, in the second the Bryozoa, Brachiopoda, and *Phoronis*, and in the third the Rotifers, Amphineura, and Mollusca. The relations of these are shown in the table.



Earthworms from Western Himalayas and Dehra Dun.*—Prof. A. G. Bourne records the presence of *Perichæta houlleti*, immature examples of what is perhaps a new species of *Perionyx*, and *Typhæus Masoni* sp. n. from Dehra Dun, which lies at the foot of the Western Himalayas. From Masouri, which is at an elevation of between 5000 and 6000 feet, he has received three species of *Lumbricus* or of some allied genus or genera, and two species of *Perionyx;* the latter were immature, and the author refrains from naming the former as he could only give an incomplete description, and the literature with regard to the genera and species of Lumbricidæ is already in great confusion. Fletcher has recorded the presence of the same species of Australian earthworm at very various altitudes, but in India all the species from hill stations seem to differ from those of the plains. Among other

* Journ. Anat. Soc. Bengal, lviii. (1889) pp. 110–17 (1 pl.).

points, *T. Masoni* is remarkable for the mode of arrangement of the setæ in the posterior third of the body; they are not arranged in couples as in the anterior two-thirds, but are equidistant from one another; and this disposition gives the worm a striking appearance.

β. Nemathelminthes.

Development and Anatomy of Gordius tolosanus.*—Dr. O. v. Linstow gives an account of the anatomy and development of *Gordius tolosanus* Duj. It is probable that the small embryonic larvæ are encapsuled in the aquatic larvæ of *Ephemera*, *Corethra*, *Chironomus*, and *Tanypus*, and that the large forms live freely in the body-cavity of terrestrial beetles, which fall into the water in spring, whence the Gordii again reach their proper element. The passage from one host to the other can only be effected in late summer when pools and ponds begin to dry up, and the beetles are able to get at and eat the dipterous aquatic larvæ. The larvæ return to the water in April, and at the end of June sexually mature examples are found in the water.

In the cutis of the larva Dr. v. Linstow was unable to find the four layers described by Camerano, the external cuticular and the fibrillar layers being alone present. The muscles are all longitudinal and the long muscle-cells have an elongated, rod-like nucleus; the differences in the arrangement of the muscles at the hinder end of the body in the larval males and females are pointed out. The cell-body serves partly as a support for the internal organs, partly as packing, and partly as a formative body for the testes and ovaries which are as yet undeveloped; the segmented arrangement of the cells is remarkable. Both male and female larvæ present, in transverse sections, two lateral, symmetrical, and one asymmetrical cavity; in the latter lies the enteron and at its ventral surface the nerve-cord, and the author regards it as the cœlom. It differs in form in the two sexes. The anterior part of the digestive tract becomes closed in the larger larvæ; the thick commencement of the œsophagus is made up of two lateral and symmetrical halves. The intestine has a distinct lumen; in the male the efferent ducts of the genital tubes open into the terminal part of the intestine, and in both sexes the end of the gut has a very wide lumen and very thick walls. The central nervous system commences just behind the mouth with two partly-developed swellings which are connected with a large nervous mass which entirely surrounds the œsophagus; a little further back the organ consists of three distinctly differentiated cords which lie close to one another, and are supported at their base by a nucleated mass. The author's account of this part of the nervous system differs altogether from that of M. Villot. With Camerano, the author denies the existence of an intermuscular or interparenchymatous water-vascular system, which has been described by Villot.

In sexually mature forms, ocelli, which have been hitherto overlooked, were observed; they are two small lenses surrounded by black pigment spheres and separated from one another by 0·082 mm. The walls of the two spaces which lie symmetrically on the dorsal side of the cœlom and extend through the whole length of the male, are converted into the

* Arch. f. Mikr. Anat., xxxiv. (1889) pp. 248–68 (3 pls.).

testes; the spermatozoa are short thick rods, one-half of which is thinner than the other. The ovaries of young females are organs filled with cells, which begin just behind the head, and soon become so large that they nearly fill up the space in the body. The structure of the gonads of both sexes is described in some detail. The external copulatory organs described by Vejdovsky do not seem to exist in *G. tolosanus;* the "bursa" would appear to be a hardened mass of sperm, and the cirrus an artifact.

Dr. Linstow thinks that the *Gordii* are allied to the Annulata by the segmentation of the cell-body and of the ovaries, by the double nature of the male organs, and the ventral position of the nerve-cord; while, on the other hand, their developmental history, as lately described by Camerano, allies them to the Nematodes.

Notes on Mermis.*—As a continuation to the above, Dr. v. Linstow offers some notes on *Mermis.* He gives descriptions of the new aquatic forms which he calls *M. contorta* and *M. crassa.* The former is very elongated and thin, the male being 14·8 mm. long, and 0·17 broad, while females were found which measured 24·1, 42, 44·8, and 49 mm. with the respective breadths of 0·23, 0·28, 0·26, and 0·28 mm. In the median axis of the œsophagus there is a strong chitinous tube. *M. crassa* is much more robust then *M. contorta*, and offers some important anatomical differences from *M. albicans* and *M. nigrescens.* The cuticular stratum consists of four layers—a fine, homogeneous epidermis, a superficial corium in which two systems of fibres cross one another, a somewhat thicker corium-layer which consists of circular fibres, and a fine hypodermis. Six very well-developed longitudinal ridges extend through the whole length of the body; they are due to thickenings of the hypodermis, and are best developed in the region of the head. The musculature breaks up into six nearly equal longitudinal areas; in the anterior part of the body the muscles are very powerful, but posteriorly they become much thinner. The nervous system consists of a large brain, and a ventral nerve-cord which, alternately to right and left, gives off at right angles to the cord nerve-trunks which inclose ganglionic cells; these nerves are inserted into the muscles, and extend over the lateral areas. Between the musculature and the internal organs there is a finely granulated layer, which is well developed at either end of the body, where the cell-body is wanting. This body has an investing membrane within which are hyaline spheres; these are feebly stained by borax-carmine, and are dissolved by xylol; it must not, therefore, be called a fat-body.

Mermis appears to form a link between *Gordius* and the Nematodes; with the former it has in common the mode of life, the annellation of the body in quite young larvæ, the presence of a cell-body, and a ventral nerve-trunk. The generative organs of *Mermis*, which have the form of a flat, broad band very rich in nuclei and placed asymmetrically on one side of the body, are quite similar to those of Nematodes.

Sexual Elements of Ascaris of Dog.†—Herr S. M. Lukjanow has made a series of sections of the sexual tubes of the *Ascaris* of the Dog.

* Arch. f. Mikr. Anat., xxxiv. (1889) pp. 390–6 (1 pl.).
† T. c., pp. 398–408 (2 pls.).

In the deepest portions of the ovary the spherical nuclei of the egg-cells are regularly provided with a centrally-placed nucleolus, which possesses the characters of a plasmosoma. Karyokinetic figures appear in some numbers notwithstanding the small size of the cell. Within the ovaries the egg-cells have a delicate plexiform structure, which is barely noticeable, and paraplasmatic contents are not to be seen. As they pass to the oviducts the spherical form is more and more replaced by the pyramidal, and the dimensions of all the parts increase, though not regularly. As maturation proceeds, yolk-spherules appear in the body of the egg-cell and lie in the rounded meshes of the protoplasmic network; the nuclei of these cells become stellate, and no distinct membrane can be demonstrated; the nuclear substance appears to be almost homogeneous, and karyokinetic figures are only rarely seen.

The structure of the nuclei of the egg-cells does not long remain simple; very many of the stellate nuclei give off new elements, which are of great importance in the formation of the chromatin elements which pass into the polar corpuscles.

In the parts of the oviduct which lie nearer the uterus the egg-cells take on a more or less spherical form, and further changes go on in their nuclei. The formation of polar bodies is cotemporaneous with the entry of the spermatozoa into the egg-cell; ordinarily only one sperm-cell enters the egg-cell; it then soon undergoes a peculiar disintegration; the head becomes rounded, and instead of having the form of a horn, is more or less spherical; it separates from the other parts of the spermatozoon. It now either lies freely in the body of the egg-cell, or is surrounded by a small quantity of a peculiar substance which appears to have the characters of protoplasm.

The male and female pronuclei appear to be exactly similar, save that one is ordinarily larger than the other; their karyokinetic metamorphoses exhibit some remarkable peculiarities, the loops becoming well stained with safranin, which is not the case when the polar bodies are being formed, and each loop is made up of granules arranged in the fashion of a rosary. The blastomeres have nuclei which are similar to the pronuclei.

The author concludes by pointing out the great value of the method of combined staining in distinguishing the various processes which go on in developing and fertilized ova.

γ. Platyhelminthes.

Development of Distomum macrostomum.*—Dr. G. A. Heckert gives a monographic account of *Leucochloridium paradoxum* and its adult form *Distomum macrostomum*. The larvæ have long been known as brightly coloured vesicles in the horns of the snail *Succinea amphibia*, but Zeller was the first to demonstrate (in 1874) the connection between these and the adult *Distomum* parasitic in singing birds. What Zeller did in outline, Heckert has completed in detail. He starts from the sporocyst threads which penetrate the liver of the snail in all directions, and describes how parts of this meshwork acquire with the growth of the germs a very different structure, becoming brightly coloured pulsating

* Bibliotheca Zoologica (Leuckart and Chun). Heft iv. (1889) pp. 66 (4 pls.).

vesicles superficially like the segmented larvæ of Diptera. After describing the histology of *Leucochloridium*, Heckert gives an account of his experiments in infecting songsters with this parasite. The results enabled him to trace the transition from larva to adult. In four days after infection the change is complete, and in fourteen days the eggs are liberated. The *Distomum* inhabits the cloaca of the bird, and the eggs were frequently observed in the fæces and urinary products. The most characteristic peculiarities of the adult are the nature of the head end and the position of the genital aperture. The dorsal wall of the mouth-sucker is much longer than the ventral, and the aperture is sharply inclined to the ventral surface; both suckers can thus be used at once for attachment, which is probably important in such a situation as the cloaca. The genital aperture is not ventral, as is usually the case, but terminal, or even turned towards the dorsal surface.

So far as Heckert was able to follow the first stages in the development of the egg, Schauinsland's account of the embryology of Trematodes holds true. After describing various steps in the development, the author passes to the ciliated free-swimming embryo. He was able to demonstrate that the chemical stimulus of the snail's digestive secretion was of itself sufficient to bring the embryo out of the egg-shell. By sections he detected the embryos in process of boring through the wall of the gut, and believes that the cilia are lost at this stage. The sporocysts found in the adjacent organs of the snail begin as small, almost spherical bodies, within which a rapid multiplication of cells takes place with direct nuclear divisions. The appearance of an internal cavity and a distinct germinal epithelium, the liberation of egg-like cells into the cavity of the sporocyst, and the curious root-like ramifications noticed at the outset are described in detail. It is important to note that it is always a single cell in the germinal epithelium of the sporocyst-wall which starts a "germ-ball" or a fresh individual, so that Leuckart's comparison of "germ-cell" and ovum is corroborated. The development of the "germ-balls" into larvæ, and the histological differentiation exhibited in the process are, finally, described.

Position of Excretory Pores in Ectoparasitic Trematoda.*—Dr. M. Braun who has been surprised at the variations in the statements affecting the position of the excretory pore in ectoparasitic Trematodes, some authors saying it is ventral and others dorsal, has made an investigation by the method of sections—the only safe one—and found in all forms examined that the pores were dorsal in position.

Larva of Tænia Grimaldii.†—M. R. Moniez gives a description of cysts collected from various dolphins in the Atlantic during the voyage of the 'Hirondelle.' The other host, or that which contains the adult, will probably prove to be *Orca* or a Dolphin, as these animals are cannibal in their habits. The youngest stage observed presents the appearance of an ordinary *Cysticercus;* in older individuals the rudiment of the body of the future *Tænia*, considerably elongated, was seen. It had the form of a tube hollow from end to end, and its cavity communicates with the exterior by the orifice of the cysticercus. In still older

* Zool. Anzeig., xii. (1889) pp. 620–2.
† Comptes Rendus, cix. (1889) pp. 825–7.

individuals the tube becomes longer, narrower, and rolled on itself, and the whole length is now about 65 cm., with a diameter of one-fifth of a millimetre. All this development appears to be pure loss, for it is impossible that the head of *Tænia* can be evaginated, nor can the long tube, which has all the characters of the vesicle of a cysticercus, pass into the adult.

These remarkable peculiarities are as yet unknown in Cestodes; at first sight the great development of the body of the larva of *T. Grimaldii* may be compared to that of *T. crassicollis* of the Cat; but the difference between the two species is radical; in the latter there is no rupture of the receptaculum capitis such as, in the former, allows of the development of the body within the interior of the vesicle.

Several encysted worms have already been observed in Dolphins; the very curious *Stœnotænia Delphini* of Gervais has some resemblance to the cysticercus of *T. Grimaldii;* others have reported on the presence of true cysticerci, but all these descriptions, with the exception of those of *Phyllobothrium*, are not sufficient for us to be able to recognize the animals meant.

Monstrous Specimen of Tænia saginata.*—Dr. L. Trabut gives an account of a *Tænia saginata* with six suckers and of a trihedral form, taken from an officer who had been in Tonkin. Owing to its form it ceases to be a flat worm: a section across a ring is well represented by a Y; all the sexual orifices are situated along the edge which corresponds to the lower limb. The author considers that he has had to do with two worms half united by their male surfaces. Similar anomalies have been described in the case of other species of *Tænia* by Küchenmeister and others, but never before has the head been seen.

Swedish Cestoda.†—Herr E. Lönnberg gives a systematic account of Swedish Cestodes, diagnosing forty species, of which eight are new. He establishes two new genera, *Tritaphros* and *Ptychobothrium*, and gives a valuable list of 128 hosts with the parasites he has found in or on them, including not only Cestodes, but Trematodes, Nematodes, Acanthocephala, Crustaceans, and others.

δ. Incertæ Sedis.

New and little-known Rotifers.‡—Dr. W. B. Burn gives an account of *Stephanops intermedius*, a new species, which appears to stand between *S. lamellaris* and *S. muticus*, although he thinks it would be better to unite the three species. He also has some notes on *Œcistes umbella*, which he has found in a shallow pool on Tooting Common.

Echinodermata.

Echinodermata of Deep Water off the S.W. Coast of Ireland.§—Prof. F. Jeffrey Bell gives an account of the echinoderms collected in July last by the Rev. W. S. Green. The most important capture was that of six specimens of *Phormosoma placenta.* The author has been able to

* Arch. Zool. Expér. et Gén., vii. (1889) pp. x. and xi.
† Bihang Handl. K. Svensk. Vet.-Akad., xiv. (1889) pp. 1–69 (2 pls.).
‡ Science-Gossip, 1889, pp. 179–81.
§ Ann. and Mag. Nat. Hist., iv. (1889) pp. 432–45 (2 pls.).

show that the Drs. P. and F. Sarasin were incorrect in regarding the great development of the organs of Stewart as a characteristic of the Echinothuriidæ,* for in *Phormosoma* these organs may be altogether absent, or small vestiges may be present in some only of the rays. The muscles, which were described as dividing the test into a number of compartments, and as causing the vermicular motions of *Asthenosoma urens*, are also absent from *Phormosoma*, and are poorly developed in *A. pellucidum*. *Astrogonium greeni* is a new species, as is *Holothuria aspera*, and both, like *Phormosoma*, come from 1000 fathoms. *Antedon bifida* was found 150 fathoms lower than the 100 fathoms, already recorded as its greatest depth. *Nymphaster protentus*, described by Sladen among the Starfishes of the 'Challenger,' is an addition to the British deep-water fauna. *Echinus microstoma*, which was incompletely described by Wyville Thomson, is refigured, and measurements of it are given; some of the characters of *E. elegans* are discussed. An account is given of the variations presented by a number of specimens of *Spatangus raschi*, and it is pointed out that in discussing the question of the utility of specific characters we must exercise the greatest caution in the selection of the points of structure which we use as such marks. To such a question, and to the allied one, how far are characters that vary within considerable limits to be so used as specific, the answers that may be given must be tentative, and not dogmatic.

Comatulæ of Mergui Archipelago.†—Dr. P. H. Carpenter describes the six species of Comatulæ collected by Dr. John Anderson in the Mergui Archipelago. Five belong to the genus *Antedon*, and of these *A. Andersoni* is alone new; it belongs to what Dr. Carpenter has called the *elegans*-group but differs from known representatives in being bidistichate and not tridistichate, and in not having a well-plated disc. It is remarkable for the rarity of the syzygies in the arms; were the species fossil and the lowest portions of the arms alone preserved, and that badly, it would be possible to miss these unions altogether. The author suspects, therefore, that Walther's attempt to establish the absence of syzygies as a diagnostic character of *Solanocrinus* is partly due to a generalization in imperfect material. *Actinometra notata* sp. n. is described as a fine species allied to *A. paucicirra*, but differing from it in always having palmars, and sometimes twice as many arms. There is a very remarkable, and at present inexplicable, distribution of the grooves, for though all the arms are grooved, the ambulacrum from the left posterior angle of the peristome comes to a sudden ending on the disc, immediately after its first bifurcation; all the ambulacral grooves of the corresponding ray are connected with the single groove-trunk which comes round the right side of the disc. This abnormal arrangement does not seem to be accidental, but it may be due to parasitic growths.

Echinoidea of Mergui Archipelago.‡—Prof. P. M. Duncan and Mr. W. Percy Sladen report on the six species of Echinoids collected by Dr. John Anderson. All are known; and the most remarkable points are that all the regular forms belong to the family Termopleuridæ, and there

* See this Journal, 1888, p. 956.

† Journ. Linn. Soc., xxi. (1889) pp. 304–16 (2 pls.). ‡ T. c., pp. 316–9.

is not one representative of the nine genera lately recorded by Prof. Jeffrey Bell from the Andaman Islands.

Asteroidea of Mergui Archipelago.*—Mr. W. Percy Sladen reports that the collection of Starfishes made by Dr. John Anderson contains several new as well as rare forms, while some of the known species show variations which are sufficient to impart a character to the collection as a whole. It is reasonable to expect that a number of new species may ultimately be found in the Mergui Archipelago. Of the twelve species lately enumerated by Bell from the Andamans, only one species occurs here, and of seven genera only two are represented. The new species described by the author are *Astropecten Andersoni*, *A. notograptus*, and *Nepanthia suffarcinata*.

New Formation of Disc in broken Arm of an Ophiurid.†—Dr. R. Semon gives a description of a specimen of *Ophiopsila aranea*, which appears to have many points of interest. At first it looks as though there was a small disc, and three small arms in continuity with the larger arms. The small arms and the disc give every sign of being quite young, while the two larger arms have the appearance of those of normal and older animals. Against the supposition that these two arms have had twice as intense a power of growth as the other three, we have to put the fact that the central disc is still immature. The author concludes that we have here a case of an arm which has been able to give rise to all the essential parts of an Ophiurid with the exception of the generative products. Were a case found in which these also were developed the creature would be an important element in the discussion of the problem of the continuity of germ-plasm.

Prof. H. Ludwig ‡ subjects this paper to severe scrutiny. He is not at all satisfied with the exactness of the figures given; he argues against almost all of Dr. Semon's points, one by one, and he concludes that the specimen described was a not quite adult *Ophiopsila aranea* which had lost its disc as far as the peristome, three of its arms, and the tips of the other two, and was now replacing all these parts by regeneration. By Dr. Semon's courtesy he had himself the opportunity of examining the specimen.

Holothurioidea of the 'Gazelle.'§—Dr. K. Lampert gives an account of the forty-one species collected during the voyage of the 'Gazelle'; among them seven species and one variety are new. Unfortunately this surveying vessel did not obtain any examples of the Elasipoda, as no very deep dredging was made.

Cœlenterata.

Cœlenterata of Canary Islands.‖—Prof. C. Chun gives a short account of a new species of *Perigonomus*, which he calls *P. sulfureus*. As a result of his dredging he is able to show that the most common Craspedote Medusa of the Atlantic, *Aglaura hemistoma*, is essentially a

* Journ. Linn. Soc., xxi. (1889) pp. 319–30 (1 pl.).
‡ Jenaisch. Zeitschr., xxiii. (1889) pp. 585–94 (1 pl.).
‡ Zool. Anzeig., xii. (1889) pp. 454–7.
§ Zool. Jahrb., iv. (1889) pp. 806–58 (1 pl.).
‖ SB. K. Preuss. Akad. Wiss. Berlin, 1889, pp. 524–6.

surface form. The complete absence of Rhizostomata from his collections is striking, though fishermen say that they abound in July and August. Two new Cydippids were found, one of which is the type of a new genus which it is proposed to call *Ute*, while the specific name is *cyanea*. Sexually mature examples are not more than three to four mm. across. Although not common, it is constantly found throughout the winter. Young examples are devoid of the blue pigment which gives the specific name to the adult. The other new form is called *Hormiphora palmata;* it appears to be allied to the Mediterranean species *H. plumosa.*

Alcyonaria of the 'Challenger.'*—Professors E. P. Wright and T. Studer have issued their report on the Alcyonaria, other than the Pennatulida, collected during the voyage of the 'Challenger.' The classificatory views of Prof. Studer have already been explained in this Journal.† In all 189 species are described, 133 of which were forms already known. As the record of deep-sea Alcyonaria is still very incomplete, the authors deem it premature to draw any conclusion from them. Some of the species described are of remarkable beauty; such, for example, are *Dasygorgia cupressa*, and the species of *Stenella* and *Primnoisis*; the largest number of new forms appears to be in the genus *Spongodes.*

Actiniaria of the Bahamas.‡—Dr. J. P. M'Murrich gives a systematic and anatomical account of the Actiniaria of the Bahamas. One of the most striking characters of *Aiptasia annulata* is the occurrence upon the tentacles of a number of elevated bands; these are due to the thickening of the ectoderm only, the mesoglœa taking no part in their formation; they contain a number of nematocysts. In *Discosoma anemone*, on the other hand, the elevations on the column are produced by solid conical outgrowths of the mesoglœa, while the ectoderm which covers them is quite undifferentiated, and resembles in structure that which covers the walls in the intervals between them. Several specimens of this species were obtained in various stages of division. In the endoderm of *Rhodactis Sancti Thomæ* numerous cysts were found imbedded, measuring about 68 μ in length by 27 μ in breadth, and looking almost like encysted nematode parasites; they were found on examination to be nematocysts. *Heteranthus floridus* was observed in the process of fission; in one case the only evidence of it was the presence of two distinct peristomial elevations, each with a mouth, upon the disc, and a crowding of the rows of disc tentacles on the portion of the disc common to the two mouths. Several new species are described in this memoir.

The author was much struck by the resemblance which the Actiniarian fauna of the Bahamas presents to that of the Pacific, and its decided difference from that of the eastern coast of America. The occurrence of *Lebrunea neglecta* in shallow water in the West Indies is of considerable interest in view of the fact that the other members of the Dendromelinæ occur, so far as is known, in deep water—1375 and 2160 fathoms—off the coast of Chili. The author thinks that it is not so much the absolute temperature which limits the distribution of animals as the exposure to great, or more or less sudden variations.

* 'Challenger' Reports, xxxi. (1889) No. lxiv., 314 pp. (43 pls.).
† 1888, p. 237. ‡ Journal of Morphology, iii. (1889) pp. 1-80 (4 pls.).

Cerianthus borealis.*—Dr. D. C. Danielssen first described this species in 1838, but in deference to the opinion of his colleague the late Dr. Koren, he has long considered it as synonymous with *C. Lloydii*. Now, however, having had the opportunities of further studying the true *C. Lloydii* he reverts to his original view as to the distinctness of the two species. He now gives a full description of *C. borealis*. The bilateral symmetry noticed in some other species of this genus is apparent also in the northern form, where the bilaterality is internal as well as external.

The ectoderm contains an extraordinarily large number of nematocysts; when many are extruded the surface of the body has quite a fungoid appearance. In addition to the nematocysts there are a large number of unicellular clubshaped mucous glands, the efferent ducts of which are of some length. The clear fibrillar area lying beneath the ectoderm has been rightly regarded by Profs. O. and R. Hertwig as a nervous structure; under high powers its median part is seen to consist of a large number of nerve-fibrils, from which, on one side, there are given off many nerve-fibres; these form plexuses, and become lost in the muscular layer; on the other side there are ganglionic cells which have their broad ends turned towards the layer of nerve-fibrils. The nerve-cells have a large nucleus which is surrounded by a rather dark, finely granular protoplasm, and they give off one or more processes which form anastomoses, and are lost in the cylinder-cells of the ectoderm.

Below the nervous apparatus there is a well-developed muscular layer, consisting of transverse and longitudinal muscles, the former of which are external to, and more delicate than the latter; the two layers cross one another. The layer of connective tissue is very thin and homogeneous, and on its inner face there is a thin layer of circular muscles which is lined by endothelium.

There are eight pairs of septa, which are all complete, and of which two may be regarded as directive; between the digestive tract and the body-wall there is a large, unpaired, ventral chamber. All the septa are formed of a pretty thick supporting membrane, and all have mesenterial filaments and gonads connected with them. The sexes are separate, and the gonads are quite special in character.

The female organs form one or more round capsules which are separate from, and may be some distance from one another. The capsule commences as a protoplasmic thickening, which becomes broader at its base; only one egg is developed in each capsule, and, when it becomes free by the bursting of the capsule, it remains between the lamellar prolongations thereof; in this position it is, probably, fertilized. The testicle is in the form of a snake, and consists of a large number of sausage-shaped cæca, which are attached in groups to a membrane of connective tissue. Connected with the testicles are many nematocysts, which may either have the form of those described by Heider, or may be more elongated and have a thicker capsule. The male would appear to be smaller than the female, and to have a smaller number of tentacles.

The digestive tube is cylindrical; its inner wall is produced into well-developed longitudinal folds and is marked by two grooves, the

* Bergens Museums Aarsberetning for 1888 (1889) No. 1, 10 pp. (1 pl.).

lower of which is alone visible to the naked eye. The epithelium consists of short ciliated cylindrical cells in the grooves, while the cylindrical cells of the side-walls are longer. The author concludes with a technical diagnosis of this interesting species.

Antipathidæ of Bay of Naples.*—Herr G. v. Koch finds five species in the Bay of Naples, all of which belong to the genus *Antipathes*, and exhibit in common a number of essential characters, which are briefly described. Very little is known of the biology of these colonies of polyps, owing to the difficulty of keeping them alive for any length of time in an aquarium; as to the mode of growth of the colonies, more has been made out by comparative methods than by direct observation. In all the species examined by the author, there are numerous branches and twigs on which smaller polyps often alternate with those of normal size; these smaller forms are younger. If they are followed through all the stages of their development it is seen that they commence as tubular prolongations of the larger polyps, and that they push out two, four, and then six tentacles; while this is being effected the larger septa and the œsophageal tube are laid down, and they gradually become normal polyps. The species described in the present paper are *A. glaberrima* Esper, *A. gracilis* sp. n., *A. subpinnata* Ellis, *A. larix* Esper, and *A. aenea* sp. n.

Method of Defence among Medusæ.†—Mr. J. W. Fewkes draws attention to a method of defence among Medusæ, which consists in discolouring the water by the emission of coloured pigment from certain chromatic cells on the bracts; these cells are related to, and are perhaps homologous with, the nematocysts in other genera of the groups in which they exist. Their presence has been observed in only one or two genera of Siphonophora. The known facts appear to be:—(1) Certain Agalmidæ, Forskaliidæ, and Apolemiidæ discharge a coloured fluid from their cystons, or hydrocysts with "mouths." This fluid is regarded as an excretion, and is supposed by Haeckel to be the means of protection, just like the sepia of the Cephalopoda. (2) *Agalma* itself has pigment-glands on the bracts, which discharge their contents when the covering-scales are broken from the stem; this discharge probably takes place on simple irritation. (3) Certain Hippopodiidæ and one Calycophore are known to change colour somewhat on irritation. (4) *Nanomia* has a prominent pigmented "oil-globule" at the base of the cyston, which has never been seen to discharge its contents. Our ignorance of the physiology of Jelly-fishes is so great, that we can at present hardly go further than this, though it is obvious that a number of interesting questions easily arise.

Porifera.

Fresh-water Sponges of Florida.‡—Mr. E. Potts gives an account of some fresh-water sponges which are of interest on account of the unusual situations and circumstances in which they were found. Most had grown on the stem of coarse grasses, where they formed spindle-

* MT. Zool. Stat. Neapel, ix. (1889) pp. 187–204.
† Ann. and Mag. Nat. Hist., iv. (1889) pp. 342–50.
‡ Trans. Wagner Free Inst. of Science, ii. 3 pp. (separate copy).

shaped masses one to four inches in length. They are temporarily submerged in salt water, and may afterwards have to undergo desiccation for weeks or months. They may be regarded as forms of *Meyenia fluviatilis*, of which species there may be a number of varieties; the specimens in question were remarkable for an unusual abundance of gemmules. Mr. Potts also gives an account of a new species of *Spongilla*—*S. Wagneri*—clearly allied to the cosmopolitan *S. lacustris*; it is to be distinguished on the grounds that it was found incrusting such marine organisms as barnacles and the calcareous tubes of *Serpulæ*, and from the "unprecedented multitudes of its dermal spicules." It has the singular habit of hiding away its gemmules within the barnacle or among the convoluted stems of the *Serpulæ*; the spicules of the gemmules are more like those of *S. fragilis* than those of *S. lacustris*.

Two New British Sponges.*—Mr. R. Hope describes two new species of British Sponges. *Microciona strepsitoxa* was found on the flat valve of a *Pecten*; of the microsclera the toxa is twisted in a manner quite unknown in other species of the genus. The other new form, which receives the specific name *echinata*, is referred with some doubt to the genus *Trachytedania* of Ridley.

Protozoa.

Fresh-water Heliozoa.†—The first part of Dr. E. Penard's memoir deals, as may be supposed, with *Actinophrys sol*. He does not believe that the contractile vacuole communicates with the exterior, and brings forward facts in support of his contention. The pseudopodia have a very different structure from those of Heliozoa with an external skeleton; in the latter they are formed by extremely long and delicate filaments of the same thickness throughout, and not provided with any rigid internal support, while in *Actinophrys* there is a rigid axial rod and a finely granular layer of protoplasm. This protoplasm is derived from that of the ectosarc, and varies in quantity from one moment to another; the axial filament is almost always invisible; it is remarkable for sometimes dissolving completely, and that by a process which is difficult to ascribe to anything else than the will of the animal.

As a rule, *Actinophrys* is immobile, or moves very slowly; if, however, it is stimulated by a bright light, it moves much more rapidly. Although it always surrounds its prey by a layer of protoplasm, the manner in which it captures it varies with the size of the animal. If it be very small, a piece of very clear and very delicate protoplasm is rapidly produced from the ectosarc and takes the form of a wide-necked urn; this curves round and then completely incloses the prey, which is gradually drawn into the ectosarc.

If the prey be larger, say a free *Vorticella* striking against the pseudopodia, the *Vorticella* contracts and the pseudopodia which are in contact with it become amœboid and draw it towards the ectosarc, while the *Actinophrys* begins to surround the prey with its own substance in the form of a spider's web. While this is going on, processes of the ectosarc mount around the *Vorticella*, using the base of the nearest pseudopodia

* Ann. and Mag. Nat. Hist., iv. (1889) pp. 333–42 (1 pl.).
† Arch. de Biol., ix. (1889) pp. 123–83 (2 pls.).

as a ladder along which they creep; the protoplasm advances on both sides of the prey, till at last it completely incloses it in its middle. In both cases the author observed what he calls a halo round the prey; in the former it is the surrounding liquid, imprisoned with the prey between the walls of the vacuole; in the latter it is, partly at any rate, due to a secretion of the animal. When the prey is about as large as *Actinophrys* itself there is no halo, and the mode of prehension is somewhat different.

This organism appears to have acquired in the struggle for existence a place quite as advantageous as that of Rhizopoda with solid coverings, for on occasion its pseudopodia function as true spines, and it is consequently left unmolested by Rhizopods, Infusoria, and Rotifers, while, on the other hand, it makes considerable ravages among the last two of these groups.

The nucleus is quite unlike that which one is in the habit of seeing in the lower animals, for it has a vesicular structure. There is an external enveloping membrane which bounds a clear and apparently liquid mass, which itself surrounds a nucleus that is either rounded or has a slightly irregular contour. The author discusses the reasons for and against the view that the nuclear capsule is not part of the true nucleus, and decides in favour of the view that it is not.

Discussing the phenomena of reproduction, M. Penard points out that young examples differ a good deal among themselves; some are exactly like the adult, others have no vacuoles, the ectosarc forms a definite border, and the pseudopodia are almost always very fine, and much elongated; others have a non-vacuolated ectosarc which is not distinguishable from the endosarc, very short pseudopodia, and a well-marked body-contour; others differ from these last in having the pseudopodia fine and very long. In others, lastly, there are large rounded vacuoles around the nucleus, and the pseudopodia are very fine and much elongated or wanting. The author differs from Gruber in stating that the young examples always have a distinct nucleus; the error of Gruber is explained by the supposition that he has mistaken specimens of *Ciliophrys*, which look like young *Actinophrys*, but have a very obscure nucleus.

The description given by Bütschli of the mode of formation of colonies would appear to be correct. A very interesting phenomenon is that which is called "gélification"; the whole of the colony becomes transparent, and the ectosarc forms a hyaline mucilage around the clarified endosarc. If the formation of colonies has nothing to do with the direct reproduction of the individual, it is at least useful as infusing new forces into the animal; the agglomerated individuals fuse so closely with one another, and their protoplasm anastomoses so completely, that when a specimen separates it must carry away with it part of the general mass, while leaving behind a little of its own.

Division certainly occurs, and is perhaps less rare than it appears, for it is effected very rapidly and in darkness. In conclusion, the author has some observations on zoospores, budding, and encystation. The author agrees with Brandt that certain *Saprolegniæ* parasitically infest *Actinophrys*, and he gives a short account of his own observations on them.

Foraminifera of Deep Water off the S.W. Coast of Ireland.*—Mr. Joseph Wright gives a list of the species of Foraminifera dredged in 1000 fathoms during Mr. Green's recent expedition. Among the forms noted as very rare are *Biloculina sphæra* and *B. elongata*, *Planispirina contraria*, *Cornuspira carinata*, *Astrorhiza arenaria*, several species of *Bulimina*, and others.

Cytoplasm and Nucleus in Noctilucæ.†—M. G. Pouchet, who has already shown that by abundantly feeding Noctilucæ one may produce in them in a few days cellular segmentation and, later, gemmation, has continued his observations. The plastic cytoplasm is not hyaline, but uniformly granular, the granulations being all of the same diameter and refractive power, and separated by equal distances from one another. It always lies near the nucleus, and the latter is somewhat different from that of forms already known. The chromatin seems to be formed of two substances, which, perhaps, correspond to the microsomes and hyaloplasm dissolved in one another. During gemmation, and as the nuclei multiply, the mass of chromatin increases absolutely, but it would seem that the proportion of chromatoplasm increases, from what is shown by the more and more vivid coloration of the segmented nuclei. In ends which have become free, the spherical nucleus is completely and uniformly coloured by methyl-green. At no time and in no stage do *Noctilucæ* appear to have nucleoli.

New Sporozoon in Vesiculæ seminales of Perichæta.‡—Mr. F. E. Beddard has observed a remarkable Gregarine in the vesiculæ seminales of a species of *Perichæta* from New Zealand, in which they were present in crowds. In the youngest stage this Gregarine has a spherical body with one or two long processes. If there are two, they are placed at opposite poles. There is a delicate cuticle, and ectoplasm and endoplasm can be distinguished. In the next stage they are, though larger, similar in form. The granules of the endoplasm are, for the most part, large and oval. The endoplasm is especially thick in the processes of the body. The cuticle is raised into fine ridges which run obliquely to the long axis. In this stage, and in the last, multiplication by fission occurs. A swelling at the extremity of one of the processes gradually grows, developes a process at its other free extremity, and becomes separated as a new individual. In the third stage the Gregarine is covered by a cyst-membrane consisting of a fibrous substance, in which numerous nuclei are imbedded. In this stage sporulation occurs, commencing by a rapid division of the at first single nucleus. Karyokinetic figures are formed during the division of the nucleus. The protoplasm also divides, but not so rapidly as the nucleus.

* Ann. and Mag. Nat. Hist., iv. (1889) pp. 447–9.
† Comptes Rendus, cix. (1889) pp. 706–7.
‡ Zool. Jahrb., iv. (1889) pp. 781–92 (1 pl.).

BOTANY.

A. GENERAL, including the Anatomy and Physiology of the Phanerogamia.

α. Anatomy.

(1) Cell-structure and Protoplasm.

Behaviour of Vegetable Cells to a very dilute Alkaline Silver-Solution.*—Returning to this subject, Herren O. Loew and T. Bokorny give the following as the general result of a number of fresh experiments, chiefly on *Spirogyra*.

The reduction of an extremely dilute alkaline silver-solution by vegetable cells does not depend on the presence of a reducing substance soluble in water, but on a reaction of the albumen of living cells. The failure of this reduction in dead cells, or in those killed by heat, acids, &c., is not the result of the exosmose of a reducing substance, but of a chemical change in the albumen. The albumen of living cells coagulates from the fluid parts by the action of many bases, in the form of globules, for which the authors propose the name *proteosomes;* they have an energetic reducing action on very dilute alkaline silver-solutions; and it is on their formation that the direct reaction of living cells with alkaline silver-solutions depends. Proteosomes cannot be produced in dead cells.

A silver-solution free from ammonia can be obtained by adding to a litre of distilled water 0·01 gr. of silver nitrate, and 5–10 ccm. of saturated lime-water. This reagent gives essentially the same results with algæ free from tannin and with those which contain it.

Doubly-refractive Power of Vegetable Objects.†—Prof. S. Schwendener replies to the objections of Ebner and C. Müller against his previously published views on this subject. The experiments of the first-named observer were, he states, made on fluids rather than on solids.

(2) Other Cell-contents (including Secretions).

Green Colouring-matter in Buried Leaves.‡—Mr. W. Thomson describes a bed of leaves still retaining a distinct green colour, found at a depth of 21 feet below the surface when digging for the Manchester ship-canal, which must have lain in the same position certainly for some centuries.

Dr. E. Schunck § has determined this colouring-matter to be modified chlorophyll resulting from the action of acids on true chlorophyll.

Localization of Tannin.‖—Herr M. Büsgen states that in some plants tannin is present even in the seed, although in most it is not found

* Bot. Centralbl., xxxix. (1889) pp. 369–73; xl. (1889) pp. 161–4, 193–7. Cf. this Journal, 1888, p. 244.

† SB. K. Preuss. Akad. Wiss., xviii. (1889) pp. 233–44. Cf. this Journal, 1887, p. 981.

‡ Mem. and Proc. Manchester Lit. and Phil. Soc., ii. (1889) pp. 216–9.

§ T. c., pp. 231–3 (1 fig.).

‖ Jenaisch. Zeitschr. Naturw., xvii. (1889). See Bot. Centralbl., xxxix. (1889) p. 318.

till after germination. It then occurs in the primary meristem and cambium, especially at the apices of the roots, and at the spots where the secondary roots are being formed; in the older parts it often disappears entirely. The primary tannin (in Kraus's sense) may be formed in the same cells and groups of cells as the secondary, as, for example, in the vascular-bundle-sheath and the epiderm. The young cork-cells often contain a rather large quantity of tannin, which disappears later, and without being transferred elsewhere. When vessels are formed, the tannin disappears with the living protoplasm. In the pith, the cortical parenchyme, and the collenchyme, the tannin often decreases in quantity, but without the protoplasm also disappearing. There appears to be some analogy between tannin-sacs and bundles of raphides, but none between the former and starch.

Colouring-matter of the Cones of the Scotch Fir.*—Sig. L. Macchiati finds the colouring-matter of the cones of *Abies excelsa* to consist of a mixture of at least three pigments—a beautiful orange-red substance, insoluble in alcohol, ether, or chloroform, but very soluble in water, out of which it crystallizes; an uncrystallizable substance of a resinous nature; and a golden-yellow uncrystallizable substance soluble in water, but insoluble in alcohol, ether, and chloroform. In addition to these there is a substance of a waxy nature.

Function of Calcium Oxalate in Leaves.†—According to Sig. A. Alberti, secondary calcium oxalate is formed only in the assimilating cells, under the action of light; its accumulation is not promoted by transpiration. The crystals of calcium oxalate can be redissolved, when they fulfil a physiological function through their lime, not through their acid. This consists in aiding the transport of the carbohydrates from the assimilating tissue towards the reservoirs of food-material, and that of the nitrates, phosphates, and sulphates to the assimilating tissue. The lime, abandoned by the respective acids, which have furnished the elements for the formation of the more important plastic substances, combines with oxalic acid, which is a product of regressive metamorphosis.

(3) Structure of Tissues.

Mechanical Tissue-system.‡—Herr H. Mertins has investigated the function of the pores commonly found in the walls of bast-cells which are supposed to have a mechanical function only, and where, therefore, they could not serve primarily for the transport of food-materials. He finds that, as regards the apparent relationship of the mechanical tissue to the transport of sap, two types may be distinguished:—(1) A distinct stereome-cylinder which completely separates the conducting from the assimilating tissue; and (2) a stereome-cylinder with ribs projecting to the epiderm, outside of which is the assimilating tissue. The first type occurs only in certain Caryophyllaceæ; and it is in them only that the mechanical cells have a direct function in connection with the transport of food-material. As compared with the second type, the pores in the

* Nuov. Giorn. Bot. Ital., xxi. (1889) pp. 423–7.
† Boll. Soc. Ital. Microsc., i. (1889) pp. 30–44. Cf. this Journal, 1889, p. 774.
‡ 'Beitr. z. Kenntniss d. mechanischen Gewebe-systems,' Berlin, 1889, 42 pp. See Bot. Centralbl., xl. (1889) p. 145.

bast-cells are more numerous and larger, especially on the tangential walls. In the other type, the transport is effected chiefly through mestom-bundles, sometimes through special cortical bundles, or by means of thin-walled parenchyme-cells; the bast-cells have but few and small pores.

Distribution of Laticiferous Tissue in the Leaf.*—Dr. D. H. Scott gives the result of observations on the course of the laticiferous tubes in a number of plants belonging to the Euphorbiaceæ, Artocarpaceæ, and some other natural orders. In the various species of *Ficus* no constant relation could be detected between assimilating and laticiferous tissue; but in some leaves the laticiferous cells appear to traverse all the tissues equally. It seems most probable that the laticiferous tubes are related functionally, as well as anatomically, to the secretory sacs of other plants.

Influence of the Symmetry of the Stem on the Fibro-vascular Bundles.†—Herr O. Lignier attempts to show that the course of the vascular bundles in the stem depends on the position of the leaves, because each bundle originates independently of the next at the base of the young rudiment of the leaf, and developes from above downwards as the internode increases in length. The lower end of the bundle then unites with the bundle-system of the internode next or next but one in age, applying itself laterally to an older bundle when the phyllotaxis is spiral, or forking when the phyllotaxis is verticillate, each fork uniting with a lateral bundle.

Anatomy of the Mulberry.‡—Prof. A. N. Berlese describes in detail the anatomical structure of the wood of *Morus nigra*, the present instalment being devoted to the root and the passage from root to stem. The root belongs to Janczewski's fourth group, in which the extremity of the central cylinder passes insensibly into the cortical zone, and the cortical zone into the cap, by means of a group of common initial cells. The peculiar excrescences of the root are described as being filled with a violet tissue which has been regarded by some writers as a mass of parasitic fungi, but which has been clearly shown to be the result of hypertrophy of the lenticels generated in the suberous tissue of the root.

Stem of Phytocrene macrophylla.§—Herr B. L. Robinson describes in detail the peculiarities of the anatomy of the stem of this tree from Java, and especially of the peculiar wedges between the bast-plates, characterized by their looser and softer texture, and by the presence of tracheïdes, and of the very large vessels composed of short cells.

Increase in thickness of the Stem of Abrus precatorius.‖—Herr J. H. Wakker describes the abnormal mode of increase in thickness of the stem in this plant, which he regards as belonging to Van Tieghem's group characterized by the possession of tertiary fibro-vascular bundles

* Ann. of Bot., iii. (1889) pp. 445–8. Cf. this Journal, 1888, p. 72.

† Bull. Soc. Linn. Normandie, ii. (1889) 15 pp. See Bot. Centralbl., xl. (1889) p. 114.

‡ Atti Soc. Veneto-Trentina Sci. Nat., x. (1889) pp. 256–73 (2 pls.).

§ Bot. Ztg., xlvii. (1889) pp. 645–57, 661–72, 677–86, 693–701 (1 pl. and 1 fig.).

‖ T. c., pp. 629–38 (1 pl.).

in the secondary cortex, and to the second half of this group. The course of the tertiary increase in thickness is, however, somewhat more simple than that described by Van Tieghem.

(4) Structure of Organs.

Structure of an Assimilating Parasite.*—Herr H. Hackenberg describes the vegetative structure of a phanerogamic parasite, *Cassytha americana*, belonging to the Lauraceæ. The slender stems are leafless, like those of *Cuscuta*, and attach themselves to the host by means of a somewhat similar structure, but contain abundance of stomates, and are distinguished by the remarkable peculiarity of the assimilating tissue of the cortex being very fully developed. In this respect it resembles the chlorophyllous parasites belonging to the Santalaceæ and Rhinanthaceæ, which are, however, mostly root-parasites. But its mode of life is that of *Cuscuta*. For when a haustorium has once been formed, all direct connection with the soil ceases; it lives on the sap of the host, which it gradually kills; the lower part of the parasite itself perishes, while the upper portion continues to develope.

Membrane of Pollen-grains.†—M. L. Mangin gives the following as the result of his investigations on the membrane of ripe pollen-grains:—(1) The membrane is differentiated into two layers: the one external and cutinized, the extine; the other internal and always present, the intine. (2) The intine, of which the structure is sometimes complex, is always formed of a combination of cellulose and pectic compounds; but the cellulose is limited to the internal face of the intine, and the pectic compounds form, nearly in a state of purity, the mass opposite the pores and hitherto considered as cellulose. In *Spartium junceum* the extine will be found to be composed of two layers: an internal cutinized zone, which is coloured yellow by alkalies; and this zone is clothed by a very thin colourless membrane, which is difficult to see. The intine also shows clearly two distinct layers. (3) When the membrane of the pollen-grain swells, it is the pectic compound which becomes soluble and absorbs water, and form a gelatinous mass, and later a viscid liquid. The cellulose does not take any part in this. (4) A callus which up to the present time was only known to exist in sieve-tubes has been found in a certain number of pollen-cells (Coniferæ, Cyperaceæ, and Juncaceæ), as an intercalary mass between the extine and the intine, and more or less mixed with substances composing this latter membrane. In *Carex riparia* the callus will be seen to be non-homogeneous; but it shows stratification, which is caused by cellulose and pectic substances forming bands parallel to the internal face of the mass.

Thickening-layers of Pollen-grains.‡—Herr A. Tomaschek has investigated the phenomena attending the growth of pollen-tubes, in the case of pollen-grains of *Colchicum autumnale* made to germinate on the cells of ripe fruits. He states that when the grains are made to germinate in nutrient solutions, the growth is so rapid that abnormal

* Verhandl. Natur. Ver. Preuss. Rheinl., xlvi. (1889) pp. 98–138 (2 figs.).
† Bull. Soc. Bot. France, xxxvi. (1889) pp. 274–83.
‡ Bot. Centralbl., xxxix. (1889) pp. 1–6 (11 figs.).

phenomena are frequently set up. In the course of its normal growth the membrane of the pollen-tube undergoes thickening of a very similar nature to that which has been observed in the bast-cells of the Apocynaceæ and Asclepiadeæ. This is effected neither by apposition nor by intussusception, but by the production of new masses of cellulose out of the protoplasm. The thickening is indicated by the silky refraction of the tube. It frequently takes the form of a number of caps formed successively within the apex of the tube. The separation of the protoplasm into distinct masses sometimes gives the appearance of a septated pollen-tube.

Morphology and Physiology of Pulpy Fruits.*—Mr. J. B. Farmer states that the morphology and physiology of the pulp of succulent fruits remains almost an untouched field. It is a fact worthy of notice that, while pulpy fruits are very common in certain natural orders, so much so as to constitute one of the ordinal characters, the morphological nature of the pulp itself may vary considerably within a very narrow limit of affinity. Amongst British plants the Caprifoliaceæ afford perhaps the best examples of this; thus, in *Lonicera Periclymenum* not only the pericarp and placenta become fleshy, but also the bracts and axis of the inflorescence; in the nearly allied *L. Caprifolium*, however, the succulent tissue is derived from the placenta and pericarp alone. Besides the extreme case of the honeysuckles and the more common forms of berries and drupes, there are some plants, as the rose and the strawberry, where the entire pulp is derived from the receptacle; in others the floral envelopes contribute the chief portion, as in *Hippophaë* and *Morus*. Another and more irregular source of pulp is the aril, as in the yew. Even in berries the relative parts played by the placenta and pericarp show great variety in different plants. Thus, in *Vitis* each furnishes about half, in *Solanum Dulcamara* the placenta, and in *Ligustrum vulgare* the pericarp provides almost the whole pulp.

The author then deals in detail with three forms of common occurrence which illustrate some of the varieties which are found in the nature and formation of pulp. In the ivy we have a plant where the pulp is mainly derived from the tissue of the carpels; and from the very first this tissue is clearly marked off from the peripheral cells which owe their presence to the activity of the meristem; since in the carpels the cell-divisions occur irregularly, and without definite order, except in the few layers destined to form the parchment-like endocarp. In the blackberry a portion of the pericarp only is devoted to the formation of pulp, the remainder undergoing modification to enable it to meet other and special requirements; while in *Solanum Dulcamara* we meet with a case in which the pulp owes its origin to two sources, being derived partly from the wall of the superior ovary, and partly from the tissue of the placenta. The author traces the formation of the pulp in all these three last cases.

Branching of Vegetative Axis and Inflorescence.†—Dr. J. Velonovsky describes the mode of branching of the axis of *Taxodium distichum* (sympodial), *Luzuriaga radicans* (Smilacineæ), and *Myrsiphyllum angus-*

* Ann. of Bot., iii. (1889) pp. 393–413 (2 pls.). Cf. this Journal, 1889, p. 244.
† SB. K. Böhm. Gesell. Wiss., 1888, pp. 365–76 (1 pl.).

tifolium (Asparageæ), of the cone of *Sequoia sempervirens*, and of the inflorescence of *Elvira biflora* (Compositæ). The axis of the male inflorescence of *Sequoia sempervirens* appears to present normally an example of dichotomous forking. The inflorescence of *Elvira* exhibits the remarkable singularity of being reduced to about three flowers, the receptacle being completely suppressed; the mode of development is cymose.

Comparative Anatomy of Bracts, Leaves, and Sheathing Leaves.*—M. L. Dufour shows that:—(1) The structure of the floral bracts is nearly always different from that of the ordinary leaves; (2) in the same leaf, or in leaves of various origin on the same plant, different types of structure may be found; (3) the structure of the sheath is nearly always different from that of the lamina; (4) there is not an invariable type of structure in leaves; the structure of the leaf depends essentially upon its mode of origin.

Laminar Enations from the Surfaces of Leaves.†—Dr. A. Ernst describes two cases of laminar enation. In the first it was found that on the dorsal surface of two of the leaves of a specimen of *Anthurium crassinervium* there were quite a number of curious enations midway between the primary nerves; and in the second, a leaf of *Mangifera indica* had on its under surface a secondary leaf growing from the midrib. The author states that we have here a case of fission; but as to its primary cause or causes, he does not offer any suggestions.

Apparatus to demonstrate the Mechanism of Turgidity and Movement in Stomates.‡—M. L. Errera describes a very simple apparatus illustrating the mechanism in stomates. It is composed of a ball of caoutchouc, which is surrounded by a network of silk, and terminates at each end in a small rigid tube. The branches of a metallic support bifurcate and receive the tubes in question. One of the tubes is closed, the other carries a cock, and this cock can be opened and air injected; the caoutchouc ball distends and presses against the silk network, the cock is then turned, and the ball remains rigid and turgid. The above is comparable to a turgid vegetable cell. The author concludes by describing a slight modification of this apparatus, consisting of two crescent-shaped balls of caoutchouc touching at their extremities but free in the middle, which may be compared to the two cells of a stomate.

Hairs of Labiatæ and Borragineæ.§—Herr C. Schmidt finds the hairs of the Borragineæ very uniform in character, stiff and sharp-pointed, with an elevated basal cushion formed from epidermal cells. Glandular hairs are comparatively rare; branched hairs or secreting glands do not occur in the order. The hairs of the Hydrophyllaceæ closely resemble those of the Borragineæ.

In the Labiatæ, on the other hand, a great variety occurs in the nature of the hairs, characteristic of the suborders, and even in some

* Bull. Soc. Bot. France, xxxvi. (1889) pp. 304–8.

† Ann. of Bot., iii. (1889) pp. 439–42.

‡ Bull. Acad. R. Sci. Belgique, xvi. (1888) pp. 458–72 (1 pl.).

§ 'Vergleich. Unters. üb. d. Behaarung d. Labiaten u. Borragineen,' Rybnik, 1888, 68 pp. See Bot. Centralbl., xxxix. (1889) p. 35.

cases of the genera and species. Glandular hairs are exceedingly common, often almost entirely replacing all other kinds; and they are very often accompanied also by oil-glands. Many species have branched hairs; in *Lavandula* they are stellate. The interior of the flower is very often provided with hairs of various kinds, which are concerned either with protection from the attacks of insects or with the carriage of pollen.

Hairs of Labiatæ, Scrophulariaceæ, and Solanaceæ.*—Herr F. A. Hoch describes the hairs characteristic of the different suborders of Labiatæ, which vary greatly. In the Scrophulariaceæ there is not the same amount of variation, the prevalent form being simple multicellular hairs with smooth or warty cell-wall. The Orobanchaceæ with their glandular hairs stand by themselves. In the Solanaceæ a great variety exists in the form of the hairs; the Atropaceæ are distinguished by the absence of sessile glands, and the occurrence of shortly stalked capitate hairs.

Underground Scales of Lathræa.†—M. M. Hovelacque describes the structure and development of the underground scaly leaves of *Lathræa*. When mature the margins and apex are recurved so as completely to cover the under side of the leaf with the exception of the basal region. From the latter a small opening leads to an anterior space into which posterior cavities open on all sides; all the chambers are clothed with the epiderm of the under side of the leaf, which is covered with numerous capitate hairs and peltate glands, but has no stomates. A single vein passes from the stem into the scale, where it branches.

Structure of Königia.‡—Herr O. Juel elucidates several obscure points in the structure of *Königia islandica* (Polygonaceæ). The phyllotaxis he describes as a modification of the decussate, in which the two leaves of some pairs are separated by an internode. All intermediate stages occur between this and the normal decussate phyllotaxis. In the development of the flowers the stamens originate earlier than the perianth-leaves. The inflorescence is cymo-botryoid, not differing in any essential point from that which occurs in typical Polygonaceæ.

Root-tubercles of Leguminosæ.§—Herr A. Prazmowski reviews the present state of our knowledge on this subject, and gives the results of a fresh series of experiments, chiefly on *Pisum*.

The tubercles are not normal structures, but are formed only as the results of infection, the infecting organisms being bacteria, as determined by Beyerinck; and the formation of tubercles takes place only when the root is young, the mature organs not being liable to infection. The bacteria perforate directly the young cell-wall, and thus enter the root-hairs and the epidermal cells of the root, where they multiply at

* 'Vergleich. Unters. üb. d. Behaarung unserer Labiaten, Scrophularineen u. Solaneen,' Freiburg-i.-B., 1888. See Bot. Centralbl., xxxix. (1889) p. 124.

† Bull. Soc. d'Etud. Scient. Paris, xi. (1888) 5 pp. See Bot. Centralbl., xxxix. (1889) p. 84. Cf. this Journal, 1889, p. 89.

‡ SB. Naturv. Studentsällsk. Upsala, April 19, 1888 (2 figs.). See Bot. Centralbl., xl. (1889) pp. 5 and 36.

§ SB. K.K. Akad. Wiss. Krakau, 1889. See Bot. Centralbl., xxxix. (1889) p. 356. Cf. this Journal, 1889, p. 246.

the expense of the protoplasmic contents of the cell. At the apex of the root-hairs they form botryoid colonies, which surround themselves with a refringent membrane, and coalesce with the cell-wall of the root-hair. From this period until the tubercle is fully formed, the growth of the bacterium-tube resembles that of a fungus-hypha, penetrating the epiderm and the cortex of the root even as far as the endoderm of the central cylinders. The neighbouring cells now begin to increase by division; while the bacterium-tubes branch abundantly, and form the "bacterioid tissue." The position of the tubercle is not a definite one, but may be opposite either the xylem of the central bundle, or the phloem, or between the two.

The relation between the root and the bacterioid organism is a true symbiotic one, each developing more vigorously at the expense of the other; though whether the additional supply of nitrogen is derived, as Hellriegel supposes, directly from the atmosphere or not, the author has been unable to determine. Finally, the contents of the bacterioid cells become gradually absorbed by the host-plant; this taking place with greater energy in inverse proportion to the amount of nitrogen supplied from the soil. The host-plant, therefore, is the stronger of the two symbiotic elements.

Tubers of Hydrocotyle americana.*—Mr. T. Holm describes in detail the vegetative structure of this American marsh-plant, especially of the little-known tubers attached to the underground stolons. The plant has two kinds of vegetative propagation,—by these stolons which end in tubers, and by runners which creep along the surface.

β. Physiology.

(1) Reproduction and Germination.

Heredity and Continuity of Germ-plasm.† — Herr G. Liebscher describes a series of experiments on hybrid barleys, especially between the 2-rowed and the 4-rowed forms, from which he draws conclusions favourable to Weismann's theory of the continuity of the germ-plasm, at least as far as its substance is concerned; though its structure may be independent of this; the structure not determining the properties themselves, but only their manifestation or latency.

Pollination by Insects.‡—M. J. M'Leod describes the mode of pollination of a number of flowers belonging to the Belgian flora; and gives many particulars with regard to the relative importance of the part played by different classes of insects in the fertilization of flowers. The following is given as the order of importance:—Coleoptera, hemitropous Diptera (Syrphidæ, Conopidæ, Bombylidæ), Apidæ with long proboscis, Lepidoptera.

Fertilization of Gladiolus.§—M. C. Musset describes certain curvatures of the styles and filaments of *Gladiolus segetum*, in consequence of which, notwithstanding the extrorse dehiscence of the anthers, self-

* Proc. U.S. National Museum, 1888, pp. 455–62 (2 pls.).
† Jenaisch. Zeitschr. Naturw., xxiii. (1889) pp. 216–32.
‡ Bot. Jaarb. (Gent), i. (1889) pp. 19–20 and 100–23 (3 pls.). See Biol. Centralbl., ix. (1889) p. 257.
§ Comptes Rendus, cviii. (1889) pp. 905–6.

pollination is not only rendered possible, but is, as he believes, the ordinary mode of fertilization.

Fertilization of Glossostigma.* — Mr. C. W. Lee describes the peculiar structure of the pistil in *Glossostigma elatinoides*, a native of New Zealand. It forms a kind of hood over the stamens; and, when irritated, rises up and falls back upon the petals, leaving the stamens exposed. In about fifteen minutes after being disturbed, it resumes its original position. The author believes that the object of this contrivance is to favour cross-fertilization.

Pollination of the Barberry.†—Prof. B. D. Halsted describes the mode of pollination of *Berberis vulgaris*, which is very rarely, if ever, self-fertilized. Surrounding the rim of the cup-shaped stigma is a narrow belt of long stiff hairs, secreting abundance of an adhesive substance; and it is on to these hairs that the pollen is thrown when the valves of the anther are thrown back, and not the upper surface of the discoid stigma, which is covered with papillæ, and which only can incite the emission of pollen-tubes. To this surface the pollen-grains can be carried only by insects.

Irritability of the Stamens of Portulaca.‡—Prof. B. D. Halsted calls attention to the remarkable irritability of the stamens of the purslane, *Portulaca oleracea*, and *P. grandiflora*, which promotes the scattering of the pollen over the bodies of insects visiting the flowers.

Cultivation of the Pollen-tubes of the Primrose.§—To ascertain the cause of the greater fertility of "legitimate" as compared to "illegitimate" unions in the heterostylous species of *Primula*, Herr C. Correns has cultivated the pollen-grains in a solution of 20 per cent. sugar and 3 per cent. gelatin. He finds the measurements of the pollen-grains to agree nearly with those given by Darwin; the diameters of the short and long-styled forms being in the proportion of 10 : 7, the volume being therefore about 3 : 1. Contrary, however, to what has hitherto been stated, he found that the larger grains do not put out longer tubes than the smaller grains, though they are somewhat thicker; nor is there any difference of form and size in the papillæ on the stigmas of the two forms. The author was unable to find in the pollen-grains themselves any explanation of the greater fertility of "legitimate" unions.

Distribution of Seeds by Birds.‖—According to Herr W. O. Focke, the seeds of berry-bearing plants are not distributed by birds to the extent generally supposed; since they are usually voided in close proximity to the parent-plant. The species which appears to be most widely distributed in this way is the juniper; also to a less extent the following:—*Pyrus Aucuparia*, *Sambucus nigra*, *Rubus Idæus*, *Solanum Dulcamara*, *Frangula Alnus*, *Viburnum Opulus*, and the black-fruited species of *Rubus*.

* Trans. New Zealand Inst., xxi. (1888) pp. 108–9.
† Bot. Gazette, xiv. (1889) p. 201.
‡ Bull. Bot. Departm. State Agricult. College Iowa, 1888, pp. 65–6.
§ Ber. Deutsch. Bot. Gesell., vii. (1889) pp. 265–72.
‖ Abhandl. Naturw. Ver. Bremen, x. (1889) p. 140. See Bot. Centralbl., xl. (1889) p. 148.

Dispersion of Seeds in Excrement.*—Herr E. Huth gives a list of 100 flowering plants, the seeds of which are disseminated through the agency of birds and other animals. In the Tropics monkeys and bats play an important part in this respect.

(2) **Nutrition and Growth (including Movements of Fluids).**

Importance of Potassium for the Growth of Plants.†—Herr R. Lübke finds, from experiments on *Phaseolus multiflorus*, that, when supplied with only a very small amount of potassium-salts, assimilation and metastasis still go on, although the vegetative processes are greatly reduced in energy. *P. vulgaris*, grown in a nutrient solution containing no potassium, showed much greater vigour than when grown in pure water, metastasis, cell-division, and the growth of the organs still proceeding. Even the formation of reproductive organs takes place, and the seeds, though small, are capable of germination. The energy of growth of *Polygonum Fagopyrum* exhibited, under similar circumstances, much greater deterioration. The author concludes that potassium is not absolutely essential for any one function of the plant; but that it plays in the vital processes a part similar to other elements, such as nitrogen, phosphorus, or sulphur.

Multiplication of Bryophyllum.‡—Mr. B. W. Barton describes the mode of production of buds on the margins of the leaves of *Bryophyllum calycinum.* A growing point is first formed from a group of embryo-cells situated at the base of the notches of the crenate leaves; and the first sign of activity of the new bud is the protrusion of usually two roots. The plantlet arising from the bud attains considerable size while still attached to the parent-leaf, which appears to carry on the work of assimilation for the benefit of the offspring.

Power of Transplantation of Organs.§—Herr H. Vöchting has conducted a series of experiments for the purpose of determining whether a part of a plant will continue to grow when planted on another organ of the same kind. He finds that this is almost always the case, and even when planted on an organ of a different kind. From this he draws the conclusion that every part of the stem and of the root is polarized like the parts of a magnet; and that every living cell of the root and of the stem has an upper and lower, an anterior and posterior, and a right and left half; the latter being apparently constructed symmetrically.

Climbing Shrubs.‖—Herr H. Schenck describes the mode of climbing of a number of Brazilian lianes belonging to the orders Polygalaceæ, Leguminosæ, Hippocrateaceæ, and others, which he calls "twig-climbers." The climbing is effected by the young leafy lateral branches being sensitive on the side in contact with the support. These then twine several times, continue to grow and increase in thickness,

* Samml. Naturw. Vorträge (Berlin), iii. (1889) 35 pp.; and Huth's Monatl. Mitteil., vii. (1889) 21 pp. See Biol. Centralbl., ix. (1889) p. 263.

† Landwirth. Jahrb., xvii., pp. 887-913 (1 pl.). See Bot. Centralbl., xxxix. (1889) p. 351.

‡ Johns-Hopkins Univ. Circ., viii. (1889) pp. 38-9.

§ Nachricht. K. Gesell. Wiss. Göttingen, 1889, pp. 389-403. See Bot. Centralbl., xl. (1889) p. 112.

‖ Verhandl. Naturw. Ver. Preuss. Rheinl., xlvi. 1889 (S.B.), pp. 9-10.

and then put out lateral branches of a higher order which display similar properties.

Epinasty and Hyponasty.*—From observations made on a number of plants growing either naturally in the soil or in a clinostat, Prof. S. H. Vines has arrived at the conclusion that the changes in the position of the leaves of growing plants are due entirely neither to the action of light nor to that of gravitation, but are epinastic and hyponastic, i. e. are the result of an inherent tendency of one or the other surface of dorsiventral organs to grow faster than the other surface. The tendency of epinasty, or the more rapid growth of the upper surface, in leaves, is to bring the lamina into the vertical plane, the apex being directed downwards; while the tendency of hyponasty, or the more rapid growth of the under surface, is to raise the member so that its long axis approaches the vertical. The changes in the position of the leaves of *Mimosa*, and that of the petals of flowers on variations in temperature, he attributes in the same way to the action of epinasty and hyponasty acting in conjunction with light.

Ascent of Sap in Woody Stems.†—Dr. F. Fankhauser gives fresh proof of the accepted theory that the ascent of sap takes place chiefly in the xylem of the vascular bundles, and principally in its vessels, from which it is distributed to the parenchyme; to a less extent through the epiderm and supporting tissue. He adopts Sachs's imbibition-theory, and considers that neither root-pressure nor transpiration is necessary to account for the elevation of the sap.

The same principles are further applied ‡ to explain the large quantity of water found in the endosperm of grasses, especially of barley.

Conduction of Water.§—After a *résumé* of the results of the most recent investigations by others, Herr T. Bokorny describes a fresh series of experiments with a view to determine the tissue through which the ascent of sap takes place in woody plants. The general conclusion arrived at is that this is by no means constant, though the conduction takes place chiefly through the vascular bundles, both in woody plants with a closed woody mass, and in those in which the vascular bundles are distributed over a transverse section. In certain plants the collenchyme and the sclerenchyme and even the epiderm, may take part in this function. In the bundles themselves, the chief part is played by the xylem, though the movement takes place also, to a certain extent, through the thin-walled bast. In plants which have no true vascular bundles, such as mosses, the ascent takes place through the central bundle of the stem.

Conduction of Water in Wood.‖—Replying to Hartig's criticisms,¶ Herr A. Wieler adduces fresh arguments in favour of his view that the conduction of water does not take place indifferently through the whole

* Ann. of Bot., iii. (1889) pp. 415–37 (2 figs.).

† 'Beitr. z. Erklärung d. Saftleitung,' 14 pp. and 1 pl., Bern, 1889. See Bot. Centralbl., xl. (1889) p. 114.

‡ Allg. Zeitschr. f. Bierbrauerei u. Malzfabrikation, 1889, 4 pp. and 2 pls. See t. c., p. 115.

§ Biol. Centralbl., ix. (1889) pp. 289–303, 321–7.

‖ Ber. Deutsch. Bot. Gesell., vii. (1889) pp. 204–12. Cf. this Journal, 1889, p. 251.

¶ Cf. this Journal, 1889, p. 90.

of the alburnum in the trunk of trees, but chiefly through the last annual ring, which is in direct connection with the appendicular organs of the same year.

Transpiration.*—Herr O. Eberdt sums up the results of recent researches on this subject, confirming some of the conclusions by independent observations. The work is divided into the following chapters:—(1) Influence of light on transpiration; (2) Influence of the moisture of the air on transpiration; (3) Influence of heat on transpiration; (4) Influence of concussion on transpiration; (5) Influence of wind on transpiration; (6) Periodicity of transpiration.

γ. General.

Epiphytes.†—Prof. K. Goebel sums up the known facts with regard to the life-history of tropical epiphytes. At the end of the root there is formed an attachment-disc with root-hairs similar to that of the Loranthaceæ. In *Terniola* (Podostemonaceæ) the attachment to stones is effected by a "thallus" composed of coalesced dorsiventral branches. In *Clusia* and some species of *Ficus*, the aerial roots coalesce into a cylinder surrounding the stem of the host. The velamen of Aroideæ and Orchideæ is regarded by the author mainly as an organ of assimilation, the absorption of moisture being only a secondary function. In some Bromeliaceæ, as *Tillandsia usneoides*, the leaves absorb water directly through their surface, and the roots then often completely disappear. The absorption of water through the auricles of epiphytic Hepaticæ and by the leaves and stem of epiphytic ferns and flowering plants, and the accumulation of humus by the leaves of ferns specially constructed for the purpose, previously described by the author, ‡ are now treated of more in detail.

Succulent Plants.§—In an exhaustive account of the structure and biology of succulent plants, Prof. K. Goebel describes the vegetation of the "catingas," in which the trees are bare of leaves during the dry season in the summer. The resistance of succulents to desiccation depends not only on their anatomical structure, but also on the mucilaginous character of their sap. Protection against animals is afforded either by mechanical means—the thorns of *Cactus*, or a coating of wax; or by chemical means—alkaloids, tannin, poisonous substances, or latex. Extrafloral nectaries occur in some species of *Cactus*.

Succulents may be classified into those with succulent leaves, and those with succulent stem. Of the former class, when the leaves resemble ordinary leaves, as in *Oxalis carnosa*, it is the upper epiderm which assumes the character of hydrenchyme or a reservoir of water; in other cases the hydrenchyme is surrounded by chlorophyllaceous cells. In Crassulaceæ the hydrenchyme is wanting.

Stem-succulents occur in the Euphorbiaceæ, Cactaceæ, and Ascle-

* 'Die Transpiration d. Pflanzen u. ihre Abhängigkeit v. äusseren Bedingungen,' Marburg, 1889, 98 pp. (2 pls. and 2 figs.). See Bot. Centralbl., xxxix. (1889) p. 257.

† 'Pflanzenbiologische Schilderungen,' Pt. i., Marburg, 1889, pp. 147-239 (3 pls. and 37 figs.). Cf. this Journal, 1889, p. 414.

‡ Cf. this Journal, 1888, pp. 90, 92.

§ Pflanzen-biol. Schild., Pt. i., Marburg, 1889, pp. 23–110 (4 pls. and 46 figs.).

piadeæ; the leaves are often greatly reduced, the chlorenchyme of the stem performing the function of assimilation; though some species of *Euphorbia* have quite normal leaves. In some species both of *Euphorbia* and *Mesembryanthemum*, the growing point is protected against desiccation by being deeply imbedded in the tissue of the stem. Many Cactaceæ have brittle branches which readily break off and are scattered by the wind; the seeds of the epiphytic *Rhipsalis Cassytha* are disseminated in the same way as those of the mistletoe. In some species, as *Cereus tuberosus* and *Euphorbia tuberosa*, the storage of water takes place in the root. The ribs of many Cactaceæ are the result of the coalescence of rows of papillæ.

Vegetation of Mud-Banks.*—Prof. K. Goebel describes the peculiarities of the vegetation of mangrove-swamps. The air-roots serve simply for support, the nutriment being absorbed through the mud-roots. A similar germination of the seeds while still within the seed-vessel to that of *Rhizophora* takes place also in *Aegiceras* (Myrsinaceæ), *Avicennia* (Verbenaceæ), and in *Crinum asiaticum* (Amaryllideæ); and the phenomenon may be compared to that in the epiphytic species of *Hymenophyllum*, *Pellia*, and *Fegatella*, where the first stages of germination take place within the sporange or sporogone. The aerial roots of *Sonneratia* and *Avicennia* † which grow erect out of the mud are respiratory organs.

Temperature of Trees.‡—Mr. H. L. Russell has conducted certain experiments upon the temperature of trees. Holes one-half inch in diameter were bored into the trees at equal heights from the ground, and thermometers were inserted in the borings so that the base of the bulb came in contact with the wood; the space about the thermometer was packed tightly with cotton-wool. An experiment made upon *Carya alba* gave the following result. The temperature of the tree, as a general rule, ranged higher than the outside with two or three exceptions, when the air temperature was higher during the warmer portions of the day. Comparative observations were made with the pine, larch, oak, poplar, and outside air, and in all cases the temperature of the pine was found to be considerably lower than any of the remainder (except during the latter part of the night and early morning). Presumably the thick coating of foliage has a tendency to prevent absorption of heat by the trunk. The conclusion arrived at by the author is that the direct absorption of heat is the main cause of the higher temperature of trees, and that it is largely dependent upon the character of the bark.

Cotton Fibre.§—Mr. T. Pray describes the structure of various cotton fibres. Fibres of the best Pernambuco cotton will be found to be rather flat and of the nature of narrow tape. The edges are not thickened, and there is little or no spirality in the fibres. The oil-deposits are few, and not very marked. Upland cotton is not strong and robust in appearance; the fibres are weak in their outline, not very well thickened on the edges, but the spirality is more noticeable. There

* Pflanzen-biol. Schild., Pt. i., Marburg, 1889, pp. 111–46 (1 pl. and 4 figs.).
† Cf. this Journal, 1887, p. 111. ‡ Bot. Gazette, xiv. (1889) pp. 216–22 (1 pl.).
§ Journ. Franklin Inst., cxxviii. (1889) pp. 241–57.

are some traces of oil-deposits, but it is of the same not clearly developed type. Upland Georgia cotton is beautifully developed, clean in outline, well formed, full of oil-deposits, and with very good spirality. The finest cotton raised anywhere in the world is the Mississippi delta cotton; beautiful in its structure, perfect in its developments, full of oil-deposits, and with a spirality of nearly 400 per inch.

Wiesner's Biology of Plants.*—This work treats in detail of vegetable biology, arranged under the four following heads:—(1) Life of the individual; (2) Biology of reproduction; (3) Development of the vegetable kingdom; (4) Distribution of plants. Under the first head is given a review of plant-forms according to their mode of life, and a chapter on the origin and development of organs.

B. CRYPTOGAMIA.

Cryptogamia Vascularia.

Meristem of Ferns.†—Prof. F. O. Bower has made an extended comparative examination of the meristem of a great variety of ferns, as a phylogenetic study. The following are the general conclusions arrived at, which tend to accentuate the contrast between the eusporangiate and the leptosporangiate series of Filicineæ.

As regards the roots, the apices of those of the leptosporangiate ferns are comparatively small, while those of the Osmundaceæ are larger, and those of the Marattiaceæ still larger. In the leptosporangiate ferns the apex of the root has always one tetrahedral initial cell; but in the Osmundaceæ there are often three or four initial cells. The initial cells of the Osmundaceæ and Marattiaceæ are narrower and deeper in proportion than in the leptosporangiate ferns, and are often not pointed, but rectangular at the base. In respect of the structure of the apex of the root, the leptosporangiate ferns, Osmundaceæ and Marattiaceæ, constitute an ascending series.

In the stem the apex of most leptosporangiate ferns is distinctly conical, while in Osmundaceæ and Marattiaceæ it is flatter and larger. In other respects the conclusions drawn from the comparative study of the apices of the stem in the three classes closely correspond to those drawn from the roots.

A comparative study of the apices of the leaves leads to the same general results. In the leptosporangiate ferns a two-sided apical cell with regular segments is the type for the leaf, though with a few irregularities; while in Osmundaceæ a three-sided apical cell with three rows of segments is the rule; and in *Angiopteris* (Marattiaceæ) the apex is occupied, not by one initial cell, but by a number, apparently three. The leptosporangiate ferns, Osmundaceæ and Marattiaceæ, therefore again form a series gradually increasing in complexity.

In the large majority of ferns the leaves are winged, and these wings may be traced, more or less distinctly, from the apex to the base of the leaf. In the Hymenophyllaceæ they are delicate and thin; in the

* 'Biologie der Pflanzen,' Wien, 1889. See Bot. Centralbl., xxxix. (1889) p. 286.
† Ann. of Bot., iii. (1889) pp. 305–92 (5 pls.).

Polypodiaceæ they are more robust; while in the Osmundaceæ, except *Todea*, and in the Marattiaceæ, they are thick and almost coriaceous, developing, in some genera, as the massive "stipules."

The sporanges, in their mode of origin and structure, give evidence of a similar series ascending in complexity and consisting of the Hymenophyllaceæ, Polypodiaceæ, Schizæaceæ, Osmundaceæ, and Marattiaceæ. The change in form of the archespore, from conical in the leptosporangiate ferns to cubical in the eusporangiate, is similar to that of the initial cells of the root, stem, leaf, and wing. The structure of the wall and the tapete is more complex in the eusporangiate ferns, and the number of spores in each sporange is larger, while the sporanges themselves are fewer in number.

Tissues of the Leaves of Ferns.*—Herr A. Vinge classifies ferns under three heads in relation to the structure of the tissue of their leaves, viz.:—(1) All the mesophyll-cells are flat, i.e. the vertical is less than the longitudinal or lateral diameter, even in the cells of the uppermost chlorophyllous layer; (2) the cells of the uppermost chlorophyllous layer of the mesophyll are usually nearly isodiametrical; (3) a typical palisade-parenchyme occurs on the upper side of the leaf. Several subdivisions are described in each class, and a large number of species named belonging to each subdivision.

Underground Development and Affinities of Sigillaria.†—M. Grand' Eury shows, by characters drawn from the development, together with those of reproduction, that the *Sigillariæ* are Cryptogams of a high degree of organization. The stem is characterized by presenting itself at first in the form of large undifferentiated tubers; and it is only gradually that the root assumes the character of *Stigmaria*. The author concludes by stating that the *Sigillariæ* belong to no living type of Cryptogams, and that they form a family of fossil plants which entirely disappeared at the end of the palæozoic epoch.

Leaves of Lepidodendron.‡—M. B. Renault describes the leaves attached to the branches of *Lepidodendron rhodunnense*, reserving for a later description those belonging to *L. esnostense*. The leaves of *L. rhodunnense* are small and short and 5–6 cm. long at the base, measuring 3 mm. and 1·5 in thickness. Their transverse section somewhat recalls the leaves of *Sigillaria*. The axis of the leaf is occupied by a single vascular bundle composed of radiating tracheids. The bundle is completely surrounded by a layer of parenchymatous cells, which constitute the liber; this liber is itself surrounded by a layer of thick sclerenchymatous cells. The leaves of *L. rhodunnense* differ from those of *Sigillaria* on the outside by the absence of the furrow on the upper surface of the leaf towards the base. When it exists in the middle region of the leaf it is less marked than in *Sigillaria*. The peculiar vasiform tissue which is common to these two genera of fossil plants was intended, no doubt, to ward off any inconvenient results caused by the alternating humidity and excessive dryness to which the plants of this epoch were exposed.

* Lunds Univ. Arsskr., xxv. (1889) 82 pp. and 3 pls. See Hedwigia, xxviii. (1889) p. 290.
† Comptes Rendus, cviii. (1889) pp. 879–83. ‡ Op. c., cix. (1889) pp. 41–3.

Muscineæ.

Peristome.*— M. Philibert continues to describe the differences between the Nematodonteæ and the Arthrodonteæ; and points out certain transitions between these two groups. The genus *Encalypta* can be divided into three principal sections, the peristome of which belongs to three different types:—(1) *E. procera* and *streptocarpa* show a well-characterized diplolepideous type. (2) *E. longicolla*, *brevicolla*, and *apophysata* represent the nematodonteous type, passing by degrees to the arthrodonteous. (3) *E. ciliata*, *rhabdocarpa*, *vulgaris*, and *commutata* form a third group, which includes most of the non-European species, where the peristome presents first the aplolepideous type, and then disappears completely.

The author concludes by describing the remarkable structure of the peristome to be found in the genus *Splachnum*, where we have an outer network, and beneath this a second network, and finally a third. This singular structure of *Splachnum* can easily be interpreted, and it will be found to belong to the general type of the diplolepideous peristome.

Sphagnaceæ and the Theory of Descent.†—Dr. Röll recurs to the consideration of the vast number of intermediate stages which bridge over the space between any two extreme forms in the genus *Sphagnum*, and proposes the construction of a genealogical tree which shall elucidate the relationships of the various forms to oneanother. He repeats his suggestion of the appointment of a "sphagnological" committee for the purpose of determining the limits of species or of forms, and questions of priority in nomenclature.

"Species" of Sphagnaceæ.‡—Herr E. Russow, from the examination of an enormous amount of detail of the bog-mosses, concludes that the variety of form is greater, and the limitation of species more difficult, than in the typical mosses or in other groups of plants. The author defines the term "species" in relation to Sphagnaceæ as a group of forms consisting of members united to one another in all directions, and sharply separated from another group of the same nature, it may be by only a single character.

Algæ.

Thallus of Delesseria.§—Mr. M. C. Potter describes the structure of the thallus of *Delesseria*, especially *D. sanguinea*. It is differentiated into a well-marked foliar expansion and a cylindrical portion—the "leaf" and the "stalk." The "leaf" is, with the exception of the "veins," only one cell in thickness; and the protoplasm is everywhere continuous from cell to cell through pits in the cell-walls. The "veins" are arranged like those of the leaf of a Dicotyledon, and are several cells in thickness, the cells being elongated instead of polygonal, like those of the rest of the leaf; their protoplasm is continuous,

* Rev. Bryol., xvi. (1889) pp. 67–77. Cf. this Journal, 1889, p. 673.
† Bot. Centralbl., xxxix. (1889) pp. 305–11, 337–44. Cf. this Journal, 1888, p. 775.
‡ SB. Dorpat. Naturf.-Gesell., 1888, pp. 413–26. See Bot. Centralbl., xxxix. (1889) p. 347.
§ Journ. Marine Biol. Ass., i. (1889) pp. 171–2 (2 pls.).

both among one another and with the adjacent cells; and this is also the case with the cells of the stalk. The thin "lamina" constitutes the assimilating tissue of the "leaf"; while the "veins" have a conducting function comparable to that of the veins in the leaves of flowering plants. The "stalk" serves also as a reservoir for food-material.

Development of the Fucaceæ.*—Dr. F. Oltmanns has followed out the development from the oosperm of a number of species belonging to the Fucaceæ. The species specially investigated and described in great detail are:—several species of *Fucus*, especially *F. vesiculosus*, *Pelvetia caniculata*, *Ascophyllum nodosum* and allied sp., *Halidrys siliquosa*, *H. osmundacea*, *Cystosira* sp., *Sargassum linifolium*, *S. varians*, *Himanthalia lorea*, and *Durvillæa Harveyi*. The thallus of all the species examined presents, at a definite period of their development, a club-shaped form with three-sided apical cell, agreeing in all essential points. Its further development may be classified under five heads, viz.:—(1) DURVILLEÆ; thallus a large stalked and variously divided and leaf-like structure bearing the conceptacles on the entire surface or on the margin, *Durvillæa*, *Ecklonia* (?), *Sarcophycus* (?); (2) LORIFORMES; young plant radiar, afterwards assuming a bilateral form; shoot branching dichotomously, with a three-sided apical cell; conceptacles wanting only on the lower, much smaller part of the plant; oogone with only one oosphere, *Himanthalia*; (3) FUCEÆ; young plant radiar, very soon passing into bilateral or dorsiventral; shoots with four-sided apical cell; branching dichotomous or monopodial; conceptacles only on the slightly modified apices of the primary or lateral shoots; oogones with 2–8 oospheres; *Fucus*, *Pelvetia*, *Ascophyllum*; (4) CYSTOSIREÆ; the plant either maintains its radiar structure, or forms bilateral branches; three-sided apical cell permanent; branching monopodial; conceptacles on slightly modified apices of branches, or on special branches; oogone with one oosphere; *Halidrys*, *Pycnophycus*, *Cystosira*, &c.; (5) SARGASSEÆ, bilateral or radiar structure with three-sided apical cell; the branches form at the base one or more leaf-like branches, which give the plant a peculiar habit; conceptacles on special branches; oogone with one oosphere; *Sargassum*, *Turbinaria*, *Carpophyllum*, &c.

With regard to the number of oosperms in an oogone, the author found the number of original nuclei to be always eight; and those which do not develope into oospheres are still to be clearly detected at the period of maturity. His observations on the actual mode of impregnation closely correspond to those of Thuret.

Conferva and Microspora.†—After a *résumé* of the observations hitherto made on the various species of Confervaceæ by different algologists, Prof. G. v. Lagerheim gives a careful diagnosis of these two genera and of all their known species. In *Microspora* the chloroplasts have the form of branched bands containing starch; in *Conferva* of small discs which do not contain starch; in other words, the products of

* Haenlein u. Luerssen's Biblioth. Bot., Heft 14, 1889, 100 pp. and 15 pls.; and SB. K. Preuss. Akad. Wiss., xxx. (1889) pp. 585–99 (1 pl.).
† Flora, lxxii. (1889) pp. 179–210 (2 pls.). Cf. this Journal, 1888, p. 94.

assimilation consist in the former genus of starch, in the latter genus of some other substance, possibly the drops of mucilage. In *Microspora* there are two kinds of spores; the megaspores have two or four cilia, and escape by the breaking of the wall of the mother-cell or by its gelatinization, and pass over, on germination, into a resting condition, either in the form of aplanospores or akinetes; in *Conferva* megazoospores only are known, which are uniciliated, escape only by the rupture of the cell-wall, and germinate directly into new filaments. The genera agree in having only a single nucleus in each cell, and in the structure of the cell-wall.

Under *Microspora*, Lagerheim enumerates thirteen species, including two new ones, *M. Willeana* and *M. Moebii;* and in it are comprised also several species usually placed under *Conferva* or *Ulothrix*, as *C. stagnorum*, *U. tenerrima*, and *U. seriata*. Under *Conferva*, in which the resting-cells (not formed from zoospores) always have the form of aplanospores, two species only are named, *C. bombycina* and *C. utriculosa*. The author regards both these genera as fully formed organisms, and not as stages of development of higher algæ.

The other genera of the order are *Hormiscia*, *Urospora*, *Chætomorpha*, *Ulothrix*, *Schizogonium*, *Hormidium*, *Rhizoclonium*, *Glœotila*, *Binuclearia*, and *Uronema*. *Tribonema* is a synonym of *Conferva bombycina*.

Cephaleuros.*—This genus, found growing on leaves in Surinam' and placed by its discoverer, Kunze, among the Mucoroideæ, and later among Lichens, is now referred by M. P. Hariot to the Trentepohliaceæ among Algæ; and he thinks it probable that it is the algal constituent of the lichen-genus *Strigula*, at least of some of its species, while those of other species of *Strigula* belong to the genera *Phycopeltis* and *Protococcus*, while other species referred to *Strigula* are not lichens at all.

With regard to *Hansgirgia flabelligera* and *Phyllactidium tropicum*, the author agrees with De Toni,† that these are distinct species, although the genera *Hansgirgia* De Toni, *Mycoidea* Hans., and *Phyllactidium* Moeb. should be sunk in *Phycopeltis;* and the original *Mycoidea* of Cunn. is superseded by *Cephaleuros*.

Botrydiopsis.‡—Under the name *Botrydiopsis arhiza* Prof. A. Borzì describes a new species and genus of green algæ belonging to the Botrydiaceæ. It occurs in the form of a dense green layer on a wall over which water is constantly trickling. In its ordinary condition it consists of perfectly spherical cells, in some cases as much as 30–40 μ in diameter. It possesses a distinct but very thin membrane clothed with a number of chromatophores. In young individuals the protoplasm is homogeneous, with a nucleus distinguishable only with difficulty; no starch or oily substances could be detected. Each individual, when it has attained its full size, becomes a zoosporange, the zoospores being formed, with great rapidity, by successive bipartitions of its contents. The zoospores are quite naked, without any pigment-spot or pulsating vacuole, but with a remarkably active power of movement by means of

* Journ. de Bot. (Morot), iii. (1889) pp. 274–6, 284–8 (6 figs.).
† Cf. this Journal, 1889, p. 786. ‡ Boll. Soc. Ital. Micr., i. (1889) pp. 60–70.

a long and extremely slender cilium. As soon as the motion ceases the zoospore rounds itself off, and begins to germinate.

Botrydiopsis may also multiply vegetatively by repeated divisions; and the resulting cells may either become transformed directly into zoosporanges, or may go through a period of rest in the form of hypnosporanges invested by a thick membrane, the contents of which subsequently divide into zoogametes; these are biciliated, without a pigment-spot or pyrenoids, and conjugate in groups of 2, 3, 4, or rarely a larger number. The zygosperms thus formed are perfectly spherical, with a diameter of 10–15 μ. After a period of rest, they develope into individuals precisely resembling those from which the series started.

Signor Borzì considers *Botrydiopsis* as most nearly allied to *Botrydium*, but as approaching the typical Confervaceæ through *Bumilleria* (*Hormotheca*). He proposes to divide the Confervales into 3 families, viz.:—(1) SCIADEACEÆ (*Characiopsis* n. gen., *Characii* sp. auct., *Peroniella*, *Chlorotheceium*, *Mischococcus*, and *Sciadium*, including *Ophiocytium*); (2) CONFERVACEÆ (*Conferva*, *Dictyothele*); (3) BOTRYDIACEÆ (*Bumilleria*, *Botrydiopsis*, and *Botrydium*).

Boodlea.*—Mr. G. Murray describes this new genus of Siphonocladaceæ, with the following diagnosis:—Alga viridis, marina, spongiosa, aspectu frondis defecta, ex filis confervoideis regulariter articulatis, iterum atque iterum ramosis, quocumque vergentibus, inter se per tenacula adhærentibus composita. The only species, *B. coacta*, is from Japan.

The author regards the genus as forming a very important link in establishing a connection between the Siphoneæ and the jointed green algæ. The individual filaments closely resemble those of *Cladophora*; but instead of forming one plane, as in *Microdictyon*, they run in all directions, and are united by apical tenacles into a body which, when swollen with water, has a pulpy spongy texture, and is net-like in whatever section it may be viewed. The apical tenacles adhere to any portion of the adjoining filaments with which they may come in contact.

Dr. G. B. de Toni † refers to this genus several species hitherto included under *Microdictyon*.

Volvox.‡—Mr. E. Overton has made a careful study of the structure and development of this genus, especially of *V. minor*. His results agree to a large extent with those of Klein.§ He is disposed to regard the organism as an individual rather than as a colony. The colouring-matter of the red pigment-spot he finds to present similar chemical and optical properties to that of the fruit of *Solanum*. He confirms recent observations that the globe is filled, not with water, but with a mucilaginous substance. The parthenospores are found only in the posterior hemisphere. In *V. globator* the number of these is almost invariably eight, while in *V. minor* it varies between one and eleven. The number of antherozoid-plates varies in direct proportion to that of the parthenospores or ovum-cells.

* Journ. Linn. Soc. (Bot.), xxv. (1889) pp. 243–5 (1 pl.).

† Malpighia, iii. (1889) pp. 14–7.

‡ Bot. Centralbl., xxxix. (1889) pp. 65–72, 113–8, 145–50, 177–82, 209–14, 241–6, 273–9 (4 pls.).

§ Cf. this Journal, 1889, p. 558.

The paper concludes with a full diagnosis of the two European species, *V. globator* and *V. minor* Stein (*V. aureus* Ehrb.), and a discussion of the systematic position of the Volvocineæ. Stein's *V. Carteri* from Bombay seems to be intermediate between the two European species. The nearest relationship of the Volvocineæ appears to be undoubtedly with the Chlamydomonadineæ, that with the Chrysomonadineæ, *Synura* and its allies, being not nearly so close, the chromatophores differing both in form and colour. The author places *Volvox* in the Flagellata of Bütschli, which he regards as belonging to the Algæ rather than to the Protozoa. The presence of pulsating vacuoles cannot be laid down as a criterium for Protozoa, and the presence of a nucleus has been determined by Schmitz. Bütschli's subdivision of the Flagellata into four groups, the Monadina, Euglenoidina, Heteromastigoda, and Isomastigoda, may be accepted in general terms. The test relied on for an organism belonging to the vegetable kingdom is the presence of true chromatophores, although the absence of chromatophores cannot be regarded as determining its animal nature. Since chromatophores are always the result of division, and not of new formation, their presence must necessarily be of great morphological importance.

Antherozoids of Eudorina.*—M. P. A. Dangeard has observed a case in which the results of the division of a cell in *Eudorina elegans* were not grouped in a disc-like fashion, but formed a hollow sphere, resembling a young vegetative colony; the cells afterwards become longer than broad. From this he concludes that the differentiation of the male and female cells in *Eudorina* and *Volvox* had its origin in the conjugation of isogamous planogametes.

Fungi.

Respiration of Fungi.†—Prof. G. Arcangeli has determined the elevation of temperature which takes place during the development of the receptacle of fungi, which he finds to be invariable in the species examined, *Armillaria mellea*, *Phallus impudicus*, *Lepiota excoriata*, *Clavaria flaccida*, *Polyporus fraxineus*, *Clitocybe spinulosa*, and *Scleroderma Geaster*. The period of maximum elevation was found to be always about the middle of the day, varying between noon and 2.30 P.M., and the greatest elevation recorded was 1°·25 C. in the case of *Lepiota excoriata*.

Salmon-Disease.‡—Mr. A. P. Swan gives a detailed account of the life-history of *Saprolegnia ferax*, and of the conditions under which salmon are liable to its attacks.

New Entomophthoraceæ.§—The following additional new species of Entomophthoraceæ are described by M. Giard:—*Entomophthora Cyrtoneuræ*, on the abdomen of the dipter *Cyrtoneura hortorum; E. telaria*, on the cantharid *Ragonycha melaneura; E. arrenoctoma*, on Tipulidæ; *E. Syrphi*, on Syrphidæ; *E. Isatophagus;* the last two

* Bull. Soc. Linn. Normandie, ii. (1889) pp. 124–7. See Bot. Centralbl., xl. (1889) p. 138.
† Nuov. Giorn. Bot. Ital., xxi. (1889) pp. 405–12.
‡ Rep. and Proc. Belfast Nat. Hist. Soc., 1888–9, pp. 54–85 (1 pl.).
§ Bull. Scient. de la France et de la Belgique, 1888, p. 296. See Bot. Centralbl., xl. (1889) p. 211. Cf. this Journal, 1889, p. 561.

possibly only varieties of *E. Muscæ;* and *Lophorhiza Carpentieri.* All the gnats attacked by the parasite were males.

New Chytridiaceæ.*—M. P. A. Dangeard describes two new species of *Chytridium*, *C. Brebissonii*, parasitic on *Coleochæte scutata*, in which the sporanges have 4–8 strap-shaped appendages on the anterior side; and *C. simplex*, parasitic on the cysts of *Cryptomonas*, the sporanges being outside the gelatinous envelope of the host, and the rhizoids penetrating into it.

New Fungus-parasite of the Cucumber.†—Under the name *Ustilago Cucumis* Dr. A. B. Griffiths describes a fungus which attacks the roots of the cucumber, causing the well-known nodular swellings on the root rich in albuminoids. It differs from the normal Ustilagineæ in the absence of septa in the hyphæ. The spores retain their vitality for a long time in the soil. The fungus was readily cultivated in Sachs' nutrient solution.

Fasciation of Mucedineæ.‡—By this term M. J. Costantin understands the *Coremium*-form of such fungi as *Penicillium*, and proposes that when both forms of any species are known, the name by which it was first described should be retained, but with the prefix "syn" or "haplo," accordingly as it is the coremial or the simple form; thus *Coremium* must in future be known as *Synpenicillium;* but that when a generic name has been employed for compound fungi belonging to different forms, it should be suppressed; thus *Isaria* must be replaced by *Synsterigmatomyces.* He further states that *Coremium vulgare* is a fasciate form of *Penicillium crustaceum*, and *Isaria farinosa* of a form resembling *Spicaria;* and that there are similar relationships between *Stysanus stemonitis* and *Hormodendron*, and between *Verticillium ruberrimum* and *Acrostalagmus cinnabarinus: Isaria arachnophila* is the coremial form of a *Sterigmatocystis.*

Alternaria and Cladosporium.§—M. J. Costantin describes both *Alternaria* and *Cladosporium*, and the various forms which they assume when cultivated. *Alternaria tenuis* is a filamentous fungus with a short fertile stem. *Cladosporium*, which is a very common fungus, has never been well described, on account of the variability of its microscopic characters. The author then traces the passage of *Cladosporium* to *Hormodendron*, and gives a short account of several species belonging to both these genera. In conclusion, he states that it is possible to obtain by the culture of *Alternaria* forms closely resembling *Cladosporium*, observation confirming this result while multiplying the stages of passage to a form which can reproduce itself as *Cladosporium.* This last form can transform itself into *Hormodendron.*

Fusisporium moschatum.‖—Dr. J. Heller found on a dried-up anatomical specimen a fungus-growth which he decided was identical with the *Fusisporium moschatum* described by Kitasato ¶ and others.

* Bull. Soc. Linn. Normandie, ii. (1889) pp. 152–3. See Bot. Centralbl., xl. (1889) p. 138.

† Proc. Roy. Soc. Edinb., xv. (1887–8) pp. 403–10 (1 pl.).

‡ Soc. Mycol. de France, iv. (1888) pp. 62–8 (1 pl. and 7 figs.) See Bot. Centralbl., xl. (1889) p. 212.

§ Rev. Gén. de Bot., i. (1889) pp. 453–66, 501–7 (2 pls.). Cf. this Journal, 1889, p. 563.

‖ Centralbl. f. Bakteriol. u. Parasitenk., vi. (1889) pp. 97–105 (3 figs.).

¶ Cf. this Journal, 1889, p. 560.

The spores of *F. moschatum* are crescentiform or sickle-shaped. Their average length is 20 μ, and their breadth 1–3 μ. Each spore usually shows three, or even four, transverse septa. When grown on potato, the spores are seen to contain many vacuoles or areas of attenuated protoplasm which are faintly stained by dyes. Besides the vacuoles there are also highly refracting corpuscles, possibly droplets of fat. Although a spore-membrane is not demonstrable, the constancy of the form of the spores is striking evidence of its existence. The spores are easily stained with an aqueous solution of any anilin dye, but unlike the spores of Bacteria and those of *Penicillium glaucum*, which only stain with anilin water plus pigment, retaining the stain after decolouring action of hydrochloric acid, *Fusisporium* loses its stain after this treatment.

The author observed the germination of the spores in hanging drops of gelatin.

The macroscopical appearance of a colony varied with the nutritive medium, and development was possible only within certain limits of temperature, the most favourable being about 15° C. *Fusisporium* is not only essentially aerobic, but water is indispensable for its development.

It forms a red pigment diffused in both the mycelium and the spores, but is most intense in the latter. It is developed more copiously in potato-cultivations than in bouillon. The author found that it was insoluble in alcohol and ether, but, according to De Bary, this fungus produces two pigments—one soluble in water, and the other insoluble in water and soluble in alcohol and ether.

Fusisporium exhales an odour which resembles, according to both the author and Kitasato, that of musk. It is perceptible in cultivations on any medium, but is stronger from some than from others, notably potato.

Inoculation experiments made with cold-blooded animals (frog) showed that it would develope as an epiphyte on the skin, but doing no material harm, while when injected beneath the skin the animal died in the course of a few weeks, and *Fusisporium* was found post-mortem in the viscera.

Botrytis cinerea.*—Herr S. Kissling has undertaken an exhaustive investigation of the variations in this parasitic form of *Peziza Fuckeliana* when growing on various host-plants. The following is a summary of the more important results:—

The germ-filaments from the conids penetrate very readily the delicate parts of the flower, and especially the anthers and stigmas. The mycele which grows rapidly on these parts is infective. It spreads in the flower-stalk and axis, and hence attacks organs where direct infection from the conids is impossible. Plants containing much water, and with a thin epiderm, also offer very little resistance to its attacks. The injury inflicted by the hyphæ is due to the excretion of an enzyma. The conids of later generations germinate much more rapidly than those of earlier ones. This parasite causes extensive injury to *Gentiana lutea* growing wild, to greenhouse plants, and to chestnuts stored up in cellars. The vegetative and the propagative hyphæ of *Botrytis* differ

* Hedwigia, xxviii. (1889) pp. 227–56.

greatly from oneanother; the sclerote has no other function than that of propagation, and is incapable of infection. Starting from the sclerote, the myceles of later generations are more infective than the earlier ones. Culture on different substrata alters the form of the conidiophores, and the activity of the conids; and the unequal rapidity of growth is dependent on variations in the nature of the food-supply.

Peziza tuberosa.*—Dr. J. H. Wakker describes the structure and development of this fungus, parasitic on several species of *Anemone*, especially *A. nemoralis* and *ranunculoides*, in which it causes the disease known as "morve noire"; and the nature of the injury which it inflicts on the tissues. The well-known "gumming" of hyacinths and other bulbs the author is unable, on the other hand, to trace to the attacks of any parasite.

Trichomes within Trichomes.†—Dr. G. Ritter Beck v. Mannagetta records this peculiar structure in the brown segmented marginal filaments of *Peziza hirta*—trichome-like mycelial filaments penetrating the cell-cavity of neighbouring trichomes. He compares the phenomenon with the well-known prolification of the rhizoids of *Marchantia* and *Lunularia*.

Platysticta.‡—Under this name Dr. M. C. Cooke establishes a new genus of Stictieæ, formed from *Platygrapha magnifica* B. & Br., and *Lichenopsis sphæroboloides* Berk. The genus *Lichenopsis* must be suppressed; and the following is the diagnosis of the new genus:—Erumpens, orbicularis, urceolatus, marginatus; disco plus minus decedente; sporidiis magnis, hyalinis, pluriseptatis vel muriformibus, dissilientibus.

Taphrina deformans.§—Signor U. Martelli describes the injury inflicted on the leaves of the peach-tree in Italy by this fungus. The hyphæ do not penetrate through the stomates, and the asci appear to be formed on the upper surface only of the leaf.

Organisms of Leaven and their relation to the fermentation of bread.‖—Herr W. L. Peters, who has recently examined the micro-organisms found in bread-yeast, states that, as a rule, three *Blastomycetes* were present, and on one occasion a fourth variety, in the yeasts he examined. In addition to these he also describes three kinds of bacteria and two kinds of bacilli.

The bacteria and *Saccharomyces* were easily distinguished from starch-granules by means of anilin-water-methyl-violet, which stained the microbes and left the starch-granules uncoloured. This preliminary investigation is of some importance, inasmuch as a previous observer had denied the existence of *Saccharomyces* in yeast.

Pure cultivations of the three varieties were easily obtained. The first variety the author identifies with *Saccharomyces minor* Engel. This form is almost always quite spherical, with a diameter of 3·5 μ. The second

* Arch. Néerland. Sci. Exact. et Nat., xxiii. (1889) pp. 373–400 (2 pls.).
† Oesterr. Bot. Zeitschr., xxxix. (1889) pp. 205–6.
‡ Grevillea, xvii. (1889) pp. 94–6.
§ Nuov. Giorn. Bot. Ital., xxi. (1889) pp. 532–5.
‖ Bot. Ztg., xlvii. (1889) pp. 405–19, 421–31, 437–49. Cf. this Journal, 1889, p. 253.

variety is nearly equal in size to the former, but is oval in shape, and measures 3–4 μ in length and 2·5–3 μ in breadth. This form has no name. The third variety is *Mycoderma vini*, which occurs in very variable quantities. In fresh yeast the quantity is small, but as the leaven becomes stale the quantity increases, and the author is disposed to regard it as an impurity. The fourth variety, only occasionally found, is apparently *Saccharomyces cerevisiæ.* No importance is attached to its presence.

Bacterium A. This is a small rod about $1\frac{1}{2}$ times longer than broad. It was isolated in neutral gelatin, and does not possess any positive characteristics.

Bacterium B, isolated in a similar way, is about 1·5 μ long and 0·4 μ broad. It was found to possess a slight power of dissolving starch, and of forming lactic acid in the presence of a yeast-water-sugar solution.

Bacterium C is about 1·6 μ long and 0·8 μ broad; the individual elements are rounded at one end and pointed at the other. It is incapable of movement. This bacterium was found to produce acetic fermentation, and the cultivation fluid used for the purpose was neutral yeast-water, to which 5 per cent. of alcohol had been added.

Bacillus D was isolated on gelatin plates, and found to consist of individuals 2–3 μ long and 0·5 μ broad. These elements are mobile in one stage of their development; they produce spores and also long motionless filaments at other periods of their existence. It does not liquefy gelatin, but was found to dissolve starch.

Bacillus E. The spores of this bacillus are about 1·6 μ long and 0·8 μ broad. Grown in hanging drops, these swell up, forming small rods with rounded ends. After a short time these begin to increase by fission and become active. The rods then grow out into long threads. The cultivation medium was boiled white of egg, the ordinary sugar-pepton-meat-extract-gelatin being found useless, although, if the sugar were replaced by soluble starch, the gelatin was rapidly dissolved. It was also found that this bacillus was able to liquefy starch. In this experiment wheat-starch was mixed with sterilized yeast-water.

From his experiments with the foregoing organisms, the author concludes that the fermentation of bread called forth by yeast consists in a series of coincident and co-operative processes, of which the most essential, the alcoholic fermentation, is effected by Saccharomycetes, while the lactic fermentation and the dissolvent processes are matters of only secondary consideration.

Cotton-blight.*—Mr. L. St. Pammel has determined the cause of the widely-distributed "root-rot" of the cotton-plant or cotton-blight to be the attacks on the root of a parasitic fungus *Ozonium auricomum*, the same that causes also the rotting of the batatas, vine, mulberry, apple, and *Dolichos*.

Uredo-stage of Gymnosporangium.†—Mr. H. M. Richards states that since, in their mode of germination, both the obtuse and fusiform

* Bull. Texas Agricult.-Exp. Station, Dec. 1888, pp. 3–18. See Bot. Centralbl., xl. (1889) p. 59.

† Bot. Gazette, xiv. (1889) pp. 211–5 (1 pl.). Cf. this Journal, 1889, p. 563.

spores bear the promyceles characteristic of teleutospores, we must conclude that, if the obtuse spores are teleutospores, the fusiform spores are also teleutospores. The only ground for supposing that the latter are uredospores is the statement of Kienitz-Gerloff that they do not produce promyceles, but rather the tubes found in uredosporic germination. *G. clavariæforme* is the only species in which two forms of teleutospores are known. The mode of germination of the teleutospores of *Gymnosporangia* is subject to a good many modifications, depending, in part at least, on the variations in the amount of moisture to which they are subjected.

Æcidium of Melampsora Euphorbiæ.*—Herr P. Dietel finds the hitherto unknown æcidio-form of this Uredine on the same host as the uredo- and teleutospore-forms, viz. *Euphorbia dulcis;* this form making its appearance in the spring, and the other two generations in the autumn, on the same individual.

New Poisonous and Luminous Fungus.†—Under the name *Agaricus* (*Pleurotus*) *noctilucens*, Dr. Y. Inoko describes a fungus parasitic on the Japanese beech, *Fagus Sieboldi.* A strong white luminosity is exhibited by the gills; this is less intense on the surface of the pileus, and altogether absent from the stipe. It is evidently the result of a process of rapid oxidation. The alcoholic extract was poisonous to dogs, rabbits, mice, and frogs.

Development of the Hymenogastreæ.‡—Dr. R. Hesse describes a new species of *Leucogaster* under the name *L. floccosus*, differing from *L. liosporus* in the very thin and flocculent peridium, which is destitute of pores, in the very irregular form of the spores, and in its onion-like odour. Connected with the failure of all attempts hitherto made to germinate artificially the spores of the Hymenogastreæ, Tuberaceæ, and Elaphomycetes, he states his belief that in the first of these families, as in the two latter ones,§ the phenomenon, hitherto described as the decay or dissolution of the fructification, has a totally different significance, and must be regarded as the commencement of the period of reproduction; the structures, hitherto believed to be bacteria, which appear in great abundance during this process, playing an important part in this reproduction.

Spore-formation in Phlyctospora.‖—The mode of formation of the spores in this rare underground genus of Fungi has not hitherto been observed. It was placed by its discoverer Corda among the Sclerodermaceæ, by Rabenhorst among the Trichogastreæ. Dr. G. Beck has now determined that the spores are borne on swollen club-shaped basids, each basid producing from two to five spores on very short sterigmas. The basids present the peculiarity of producing a large number of filamentous outgrowths, which envelope the ripe spores in a weft. *Phlyctospora* must be placed in the Hymenogastreæ among the Melanogastreæ.

* Oesterr. Bot. Zeitschr., xxxix. (1889) pp. 256–9. Cf. this Journal, 1889, p. 266. † Mitteil. Med. Facult. K. Japan. Univ., i. (1889) pp. 277–306 (1 pl.).
‡ Bot. Centralbl., xl. (1889) pp. 1–4, 33–6 (2 pls.).
§ Cf. this Journal, 1889, p. 679.
‖ Ber. Deutsch. Bot. Gesell., vii. (1889) pp. 212–6 (5 figs.).

Structure of Phallus impudicus.*—M. C. v. Bambeke describes in great detail the morphology of *Phallus* (*Ityphallus*) *impudicus*, especially of the peridium. He states that it consists of five layers, the mode of formation of which is fully described, as is the nature of the hyphæ of which they are composed. In the outermost layer occur imperfect loop-connections, and intercalary cavities which contain sphærocrystals of calcium oxalate. In all the layers are hyphæ with swollen ends, containing a homogeneous mucilaginous substance, which the author regards as analogous to the latex-tubes of *Lactarius*, *Russula*, &c.

Ward's Diseases of Plants.†—After a general account of parasitic and saprophytic Fungi, and the mode in which they act in the "damping off" of seedlings, and in the production of "fingers and toes," "anbury," and "club root," Prof. Marshall Ward gives a succinct description of the life-history and pathogenic action of the fungi which produce the potato-disease, the smut of corn, "bladder plums" or "pocket plums," the lily-disease, the ergot of rye and other grasses, the hop-disease, and the rust of wheat.

Protophyta.

α. Schizophyceæ.

Structure of Diatoms.‡—In his contribution to the algal flora of Siberia, M. W. Koslowskij describes a new species of *Pinnularia*, *P. oblongo-linearis*, which presents the peculiarity of the cells always having two nuclei lying on each side of the shorter plane of symmetry, each imbedded in a mass of denser protoplasm bounded by a strongly refringent protoplasmic membrane.

The author contests Wallich and Pfitzer's views of the double character of the valve of diatoms. It is a peculiar and temporary phenomenon belonging only to certain forms, and occurs only when the individual is in the act of dividing, never in young individuals; while many species do not exhibit it at any time. He further states that in the act of division entire young valves are never formed, but only the sides, without new girdle-bands, which coalesce directly with the old band. It is therefore not necessary that successive generations should decrease in size. The double character of the shell results, when it does occur, from the girdle-band splitting into three layers, the middle one of which is converted into mucilage.

The author further explains the wavy appearance of the front-view of *Cymatopleura Solea*. The valve-side has a row of transverse furrows and ridges, which, in different individuals, are either confluent or symmetrical.

Raphidodiscus.§—Mr. C. M. Vorce describes this rare and anomalous genus of diatoms from Virginia, and proposes the following diagnosis:—Valves discoid, with a central thickening or obscure nodule, and an interrupted raphe terminated by minute spines or spiniform nodules

* Bull. Soc. Roy. Bot. Belgique, xxviii. (1889) pp. 7–50 (3 pls.).

† 'Diseases of Plants,' by H. M. Ward, London, 1889, 12mo, 196 pp. (53 figs.).

‡ Arb. Kiew. Naturf. Gesell., ix. (1888) pp. 395–436 (1 pl.) (Russian). See Bot. Centralbl., xl. (1889) p. 40.

§ Microscope (Detroit), ix. (1889) pp. 132–7 (1 pl.).

somewhat within the margin of the disc; central portion of disc naviculoid, depressed, its ends terminating in the spines; striæ radiate, moniliform, extending from the raphe to the margin of the valve. The author considers that the three described species should be reduced to one, *R. Christianii*, and that the nearest affinities of the genus are with *Aulacodiscus* and *Eupodiscus*, differing from them only in the presence of a raphe. He considers that it should be placed among the Cryptoraphidæ in H. L. Smith's classification, as an abnormal genus possessing a raphe or pseudo-raphe. *Melonavicula* appears, however, to enjoy priority as the generic name.

β. Schizomycetes.

Formation of Nuclei and Spores in Bacteria.*—Dr. P. Ernst has, by means of three quite different methods, demonstrated in a number of bacteria a new element, small granules which are most frequently seen when the bacteria are developing with difficulty or are about to sporulate. There is no constancy in the number of these granules, for there may be one or more. They stain blue-black in warm alkaline methylen-blue and cold Bismarck-brown solution. Delafield's hæmatoxylin stains them black-violet, and Platner's nucleus-black blackish.

The author believes that he has proved that these granules develope into spores, and therefore calls them *sporogenous granules.*

As they did not under some conditions become stained with Neisser's spore-stain, they are to be considered as being actually different from spores, although the predecessors of these. This view is further supported by the fact that hæmatoxylin and Platner's nucleus-black stain the granules, but not spores. In their earlier condition they are easily peptonized (3 hours in solution of pepsin 0·5, HCl 0·2, H_2O 100), but as they become older the greater is their resistance to digestion; and this is complete when they have developed into spores. With methylen-blue-Bismarck-brown the sporogenous granules stain blue-black, the spores blue. All boiling fluids, including pure water, cause their disappearance. The granules are certainly not vacuoles, and do not consist of fat (insoluble in boiling ether), or of starch (do not stain with iodine).

Relations of Purple Bacteria to Light.†—The forms studied by Prof. T. W. Engelmann are well known, viz. *Bacterium photometricum, roseo-persicinum, rubescens, sulfuratum; Beggiatoa roseo-persicina; Clathrocystis roseo-persicina; Monas Okeni, vinosa, Warmingi; Ophidomonas sanguinea; Rhabdomonas rosea; Spirillum rubrum, violaceum.* All these are coloured more or less intensely by a red-purple matter diffused throughout the protoplasm, Bacteriopurpurin; and their reaction to light is due entirely to this substance, and not to the presence or absence of sulphur or sulphuretted hydrogen.

The influence of light on purple bacteria is shown very markedly by the production of various movements, according to the various species; and the amount of these movements appears to vary directly as the

* Zeitschr. f. Hygiène, v. (1888) 61 pp. (2 pls.); cf. Bot. Centralbl., xxxviii. (1889) p. 853.

† Arch. Néerland. Sci. Exact. et Nat., xxiii. (1889) pp. 151–98. Cf. this Journal, 1888, p. 473.

intensity of the light. And not only do differences and variations in the intensity of the light affect these bacteria, but they are sensitive to differences of wave-length; this sensitiveness depending on the species, the individuality, and external conditions. In addition to visible rays, they are affected by certain ultra-red radiations; so that mobile forms will gather together in the ultra-red between λ 0·90 and 0·80. They also collect in other bands, but in decreasing quantity between λ 0·61–0·58, λ 0·55–0·52, λ 0·75–0·64, and in the ultra-violet. From this disposition a "bacteriospectrogram" is formed by the bacteria themselves beneath the cover-glass.

Spectroscopic examination of the colour, and calculations as to the absorption of the dark heat-rays by these bacteria, were carefully made by the author, who sums up the results in tables, for which the original must be consulted.

That the purple bacteria give off oxygen under the influence of light was demonstrated from the zooglœa conditions of *D. photometricum*, *Monas vinosa*, *Warmingi*, *Okeni*, and *Clathrocystis roseo-persicina*. As tests it was necessary to employ Schizomycetes very sensitive to oxygen. In the result it was found that these purple Schizomycetes occupy a place among those organisms which assimilate after the manner of green plants, and that bacterio-purpurin may be considered a true chromophyll; inasmuch as, after having absorbed the actual energy of the light, it transforms it into potential chemical energy. In conclusion, the relations between the assimilation and absorption of rays of different wave-lengths by bacterio-purpurin are entered into. Put shortly, this may be summed up as the more light the more oxygen, and the most striking proof of this was furnished by the experiments with the ultra-red rays. Here all visible rays were occluded by means of a 4 cm. layer of bisulphide of carbon. These experiments also show that the disengagement of oxygen is not connected with the action of the visible rays, but that the dark rays are equally capable of setting free oxygen.

New Capsule Bacillus.*—Dr. Pfeiffer found in the abdomen of a guinea-pig a puriform exudation, which was found not to consist of pus, but to be a pure cultivation of bacilli, which were also found in considerable quantity in the blood.

These bacilli have rounded ends, and are arranged in longer or shorter filaments. They are enveloped in a capsule, wherefore the author proposes to call them *Bacillus capsulatus*. They are not endowed with motion. They grow luxuriantly on gelatin, agar, bouillon, and potato. They do not liquefy gelatin. They are pathogenic for both white and house mice, these animals dying in two or three days. After death the bacillus is discoverable in all the organs and juices of the body. Guinea-pigs and pigeons could be infected from the peritoneal cavity, but rabbits through the circulation only. This bacillus is said to be easily distinguishable from the pneumonia bacillus and the pseudo-pneumonia bacillus.

Bacterium phosphorescens.†—Prof. K. B. Lehmann, who, in conjunction with Dr. P. Tollhausen, has been making some experiments

* Zeitschr. f. Hygiène, vi. (1889) p. 145.
† Centralbl. f. Bakteriol. u. Parasitenk., v. (1889) pp. 785–91.

with *Bacterium phosphorescens*, finds that on salt-gelatin stained red with phloxin, the bacteria grew up of a red colour, and on methylen-blue-gelatin a dark blue. The coloration was intimately associated with the presence of oxygen, for along the needle track the bacteria were colourless.

The appearance of the organisms under the Microscope was very variable. In young colonies the most frequent form was short rods with rounded ends. These were usually in pairs. As the colony grew older, the rodlets tended to become ovalish or spheroidal, and were mixed up with all kinds of involution-forms. No spores were observed, and specific movements were quite absent.

If the gelatin were only slightly acidulated (acetic acid), the fungus grew brilliantly, but increased acidulation diminished development, and finally stopped it. Similar observations were made with alkalies.

The illuminating power of these bacteria seems to depend entirely on the presence of oxygen. On saline media a green-coloured light is developed; while, if the salinity be scanty, the light is less and more yellowish. The light is developed only on the surface of the culture, the organisms in the deeper parts being non-illuminant. Hydrogen, carbonic acid, and carbonic oxide rapidly extinguish the light. If a liquid medium be shaken up, the whole fluid becomes phosphorescent.

The fungus was found not only to be able to live well but to grow without developing light.

The phosphorescence originates in one of two ways:—(1) The process is intracellular; that is, the molecular processes within the cells, which in general give rise to heat, the formation of carbonic acid, &c., are here followed by the development of light; or (2) the bacteria produce by their metabolism a substance which unites with oxygen outside the cells, and thereby light is produced. The formation of such a photogenic substance would place it on a level with the chromogenous substances produced by some bacteria, e. g. by *Bacillus prodigiosus*.

The fact that the light is wanting after filtrations through porcelain, and disappears on the addition of disinfectants, would seem to favour the extracellular theory. But experiments at different temperatures decided the author in favour of the intracellular view. It was found that the greatest light was given off at 24° C., and that it was extinguished at 39·5°. On cooling the culture down to 0·1°, a faint light was observed for four days, and even at − 12° the light remained for 10–12 minutes.

Certain gases, such as CO, CO_2, and H, were found to extinguish by merely preventing the access of oxygen; while H_2S acted toxically, the illumination rapidly disappearing and not returning on the cultivation being shaken up with air, while after-inoculations showed that it was sterilized. Sulphate of morphia produced no effect, nor did saponin. Strychnine had a slow and slight influence on the phosphorescence; while sulphate of quinine had a decided result.

Photobacterium luminosum.*—M. W. Beyerinck describes a new phosphorescent bacterium which he obtained from the sea water near Scheveningen.

The edge of puddles left by the retreating tide on a warm summer's

* Arch. Néerland. Sci. Exact. et Nat., xxiii. (1889) pp. 401–5 (4 figs.).

day is found to be passing rich in bacteria. Some of such water is sown on the following media:—A decoction of fish is made in sea water, and to this 0·5 per cent. peptone and 7 per cent. gelatin are added. Some of the luminous puddle-sand is then mixed up with boiled sea water and a few lines traced across the gelatin with a needle dipped in the mixture. The gelatin is then covered with sea water, and the latter drained off. At the end of about twenty-four hours, at summer heat, numerous brightly luminous colonies will have appeared. *P. luminosum* liquefies gelatin if this be effected in the presence of a large quantity of nitrogenous matter. No fœtid products are evolved, but when the amount of azotized material is insufficient, a putrefactive process takes place. Like other phosphorescent bacteria, *P. luminosum* developes only in neutral or slightly alkaline media, a small quantity of acid being sufficient to prevent the production of light. On gelatin or peptonized meat-broth the bacterium will not develope unless 3–3·5 per cent. of sea salt, of chloride of potassium, or chloride of magnesium be added.

In form this bacterium varies with the cultivation medium. When this contains little nitrogen or a small quantity of carbohydrates, the bacterium is small, and resembles the cholera vibrio. Among the rods, spirilla, more or less long, may be seen, and these sometimes break up into short vibrios. Both spirilla and vibrios move rapidly towards the margins of the preparation, where they gain access to free oxygen, without which their development is impossible.

Like other phosphorescent bacteria, descendant colonies of *P. luminosum* frequently diminish in luminosity, and even cease to emit light. The exact conditions which give rise to this degeneration are not at present understood, but certain differences in the nutrient media have direct influence on the light-production. This diminution in the luminosity is always accompanied by a similar diminution in the liquefying power, and also by changes in the shape of the organism. Among the substances which cause this diminution are glucose, levulose, maltose, and asparagin.

Luminosity of Bacteria and its relation to Oxygen.*—In examining the relations between the luminosity of bacteria and free oxygen, M. W. Beyerinck employed three species of photobacteria—*P. phosphorescens*, *indicum*, and *luminosum*. In addition to the physiological combustion from the influence of free oxygen to which the phosphorescence is owing, the reducing and fermenting functions had also to be taken into consideration. In estimating the amount of action excited by oxygen, the author made use of hydrosulphate of soda and indigo. His conclusions on the subject of luminous bacteria in general, and *P. phosphorescens* in particular, are that oxygen necessary for anaerobiosis, called fixed or exciting oxygen, is not of itself able to maintain phosphorescence, but it can keep up, at least to a certain degree, both the fermentative and reducing functions of the organism.

As regards phosphorescence, the oxygen must be in a more free condition; and though this oxygen is not physically dissolved in the

* Arch. Néerland. Sci. Exact. et Nat., xxiii. (1889) pp. 416–27.

living substance of the bacteria, it forms with the protoplasm a combination capable of maintaining itself in vacuo.

Action of Bacillus pyocyaneus on Anthrax.*—Owing to the experiments of Bouchard, who found that inoculation with *Bacillus pyocyaneus* had some effect on the development of anthrax, MM. Charrin and L. Guignard have endeavoured to ascertain the mechanism of this influence by examining *in vitro* the action of the microbe of blue pus upon that of charbon. With this intent the pus bacillus was sown in active charbon cultivations. Guinea-pigs were inoculated with the mixed cultivations. During the first six days the virulence of the anthrax was not modified in any constant manner, but from the eighth day the virulence was diminished; thus, while a pure anthrax cultivation killed in three or four days, the mixed culture required seven or eight days. From the twentieth day, although the results were not constant, the guinea-pigs became immune. It is noteworthy that if the attenuated virus be sown in pure bouillon, the germs regain their virulence. The diminished virulence is accompanied by morphological modifications; involution-forms make their appearance, and spores are not developed.

The authors conclude that in the attenuation of the charbon microbe by that of blue pus, the products of the latter play some part, and this first by secreting some substance harmful to the development of charbon, and secondly by using up the nutritive medium.

Anthrax, Tuberculosis, and Actinomycosis.†—Prof. E. M. Crookshank publishes seven reports relating to anthrax, tuberculosis, and actinomycosis, containing numerous facts hitherto misunderstood or overlooked. The two papers on anthrax relate to the disease in swine and horses. It had been hitherto presumed that while swine died after eating carcases of animals dead of anthrax, they were not really susceptible to the disease. Now Prof. Crookshank succeeded in infecting swine with true anthrax; consequently the liability of swine to suffer from this disease is set at rest, while the same observations also go to prove that the anthrax organism does not grow readily in the pig.

The report on tuberculosis was instituted chiefly with regard to the infectivity of milk, and also to tubercular mammitis. It was found that the milk of cows suffering from tubercular mammitis contained tubercle bacilli; and, taking into consideration that the milk of cows is, in dairies, mixed together before distribution, it is laid down that there is danger in using such milk. The report concludes with a case of transmission of the disease from man to cows, and general remarks on the tubercle bacillus. In these remarks it is shown that while the disease is common to many animals, the pathological expression of the disease is different in different species and individuals, and also that there are morphological differences in the bacilli.

The third disease, actinomycosis, is discussed at considerable length, but at the same time with perspicuity, and these four papers form together the best *résumé* of the subject in the English language we have seen. This fungus disease, which has been found to attack almost every

* Comptes Rendus, cviii. (1889) pp. 764–6.

† 'Annual Report for 1888 of the Agricultural Department Privy Council Office, on the Contagious Diseases, &c., of Animals (Appendix),' 1889, pp. 20–128 (23 pls.).

part of the body, was first brought into notice by Bollinger in 1876. The first cases were discovered in oxen, but a few years afterwards the same disease was found in man. The macroscopical appearances vary with the anatomical distribution, and also with the rapidity of the disease. The microscopical appearances of the fungus are of two kinds, club-shaped elements which tend to arrange themselves in rosettes, and delicate filaments. The club-shaped elements, which were the first to be recognized, easily stain a red colour, while the filaments, which were only discovered comparatively recently, stain blue. It is owing to this staining difference that Prof. Crookshank was able to demonstrate the intimate connection between the two; for, by making careful preparations, he has shown that the filaments spring out of the clubs, and that "the structure of a rosette consists centrally of a dense mycelial network, and externally of a hymenium of basidia."

The question of transmissibility from man to lower animals is easily answered in the positive, for calves and rabbits have been successfully inoculated with the fungus.

By the aid of the Microscope, the author was able to show that "wens" or "clyers" are only local manifestations of the disease; previously they were regarded as the result of a strumous or tubercular diathesis.

These seven reports are copiously illustrated from photographs and microscopical preparations, in all twenty-three plates.

Micro-organisms of the healthy Stomach and their action.*— M. J. E. Abelous confirms the results of Pasteur and Duclaux relative to the action of microbes in the stomach, and the part they play in digestion. The microbes were taken from the author's stomach by washing it out after fasting. The usual precautions were taken to prevent external contamination, and the mouth and pharynx were previously washed out with sublimate. The microbes were cultivated on gelatin, peptonized and glycerined gelatin, potato, gelatinized serum, neutral and acidulated bouillon. The species isolated were *Sarcina ventriculi*, *Bacillus pyocyaneus*, *Bacterium lactis aerogenes*, *Bacillus subtilis*, *Bacillus mycoides*, *Bacillus amylobacter*, *Vibrio rugula*, and nine other species, which are distinguished by letters, A, B, C, &c. These include one coccus and eight bacilli. The chief facts about these are that their resistance to an artificial gastric juice is greatly in excess of the mean duration of digestion in the stomach, and that they are potentially anaerobic.

The author also examined the separate and collective action of the microbes in certain sterilized alimentary substances. These were skim-milk, egg-albumen, fibrin, gluten, lactose, cane-sugar, glucose, and starch. From these experiments he concludes that these microbes act more or less energetically on alimentary substances, but that the real theatre of their action is rather the intestine than the stomach.

Micro-organisms of Malaria.†—Dr. M. B. James concludes from his researches that (1) there occur in the blood of malaria patients appearances which are included under the name *Hæmatozoon malariæ*; (2) the half-moon-shaped bodies appear only in chronic cases; (3) the segment

* Comptes Rendus, cviii. (1889) pp. 310–2.
† Medical Record, xxxiii. (1888) p. 269.

form is visible only immediately before or during the cold stage; (4) all forms, except the half-moon shape, disappear after large doses of quinine; (5) malaria can be induced by the intravenous injection of malarial blood.

The foregoing statements are regarded as matters of fact, and the following, though hypothetical, quite probable:—That (1) between the appearances in the blood and the disease there exists an ætiological connection; (2) these appearances are not present in the blood under other circumstances; (3) the bodies described are to be considered as one and the same organism; and (4) no form except the flagellate is to be regarded as an independent organism.

New Pleomorphous Schizomycete, Bacillus allantoides.*—Dr. L. Klein describes a pleomorphous bacillus which he obtained originally 4½ years ago from an impure cultivation of *B. megatherium.* The name given to the species is derived from the sausage-like zooglœa. Starting from a rod-stage in the developmental cycle, the micro-organism is distinguished as motionless rodlets about $0 \cdot 5\ \mu$ thick and three or four times as long. The motionless rods grow up into filaments of 4–8 cells, surrounded by a gelatinous membrane. Slight but distinct movements are now visible, and in this mobile condition the individual elements are capable of immediate reproduction, forming short filaments. These secondary bacilli next degenerate into coccus-like elements, then rapidly multiply, and pass on to the sausage-like zooglœa-stage. The next step in the development shows the bacilli being reproduced from the zooglœa mass.

Movements of Micrococci.†—Professor Mendoza, after alluding to Dr. Ali-Cohen's communication on the specific movements of Micrococci,‡ states that he was the first to describe a micrococcus endowed with motion. This micrococcus was found by the author when examining for *Sarcina ventriculi.* Cultivations on various media showed that the fungus was essentially a tetrad, forming on gelatin plates white circular sharp-edged colonies. With increasing age the colonies became sugar-coloured, and gave off an odour resembling skatol. The fungus did not liquefy gelatin. In fluid media development was slow, and the cultivation dark to the bottom.

Morphologically this coccus is almost always a tetrad, although this form is sometimes less obvious. It possesses a distinct capsule and sheath inclosing a finely granular protoplasm.

The movements are best seen in fluid media, and consist in rapid forward rollings of the tetrads, which seem to turn in various directions. The name given by the author to this microbe is *Micrococcus tetragonus mobilis ventriculi.*

Recent Bacteriology.—Dr. H. C. Ernst reports§ on recent advances in Bacteriology. As he cites a number of medical journals, such as the 'Präger Medicinische Wochenschrift,' 'Le Bulletin Médical,' and Russian medical journals, he gives information as to a number of discoveries which there has been no opportunity to note in this Journal.

* Centralbl. f. Bakteriol. u. Parasitenk., vi. (1889) pp. 383–6 (16 figs.).

† T. c., pp. 566–7.

‡ Cf. this Journal, 1889, p. 795.

§ 'Annual of the Universal Medical Sciences.' Issue for 1889. Philadelphia, 1889, vol. v. section 1, 24 pp.

MICROSCOPY.

a. Instruments, Accessories, &c.*

(1) Stands.

Mirand's and Klönne and Müller's Microscopes with revolving stages.—In 1880 we described† the Microscope of MM. Klönne and Müller with a revolving stage for eight slides, which had then been issued. Subsequently we heard of a similar instrument by M. Mirand in which, however, the stage had also a motion from back to front, so that three objects could be observed on each of the slides, and in 1883 we described‡ this as an extension of the principle of MM. Klönne and Müller's Microscope. It is now stated§ that M. Mirand's instrument was exhibited at the Paris Exhibition of 1878, and was therefore the original form, so that in place of the French makers having devised a "modification mieux comprise," it is the German makers who are responsible for an "imitation mal comprise."

Nobert's Micrometer-Microscopes.—Fig. 1 shows an early form of Microscope devised specially by the late F. A. Nobert for fine measurements by stage-micrometer.

The chief peculiarities in the design are (1) the application of the stage-micrometer, and (2) the arrangement of the fine-adjustment.

(1) The stage-micrometer is a permanent attachment of the stage, the micrometer-screw acting upon a travelling stud fixed beneath the upper plate, causing it to traverse the field of view laterally. The screw is actuated by a large radial wheel, the spokes being of such a length that a very small movement can be effected. The radial wheel is removable, when the Microscope can be used for ordinary observations.

(2) The fine-adjustment is effected by a screw passing through the standard from the back and pressing against a bar or arm about 2 inches in length, extending downwards at the back of the stage. The stage is suspended on the standard on coned screw-pivots fitted in a fork-piece, and is easily detached by releasing the pivots by the milled heads shown on either side of the standard. The fine-adjustment screw pressing against the bar beneath the stage causes the latter to incline upwards from the horizontal, and so to approach the objective; with the reverse motion of the screw the stage inclines the opposite way by gravitation. This system of fine-adjustment was (we believe) first devised by Herr Nobert, and has been largely adopted in Germany for low-priced Microscopes.

Fig. 2 shows the improved form of Micrometer-Microscope as exhibited by Herr Nobert at the Exhibition of 1862.‖

(1) The stage-micrometer with its graduated drum and vernier is carried by the stage, whilst the screw is actuated by a large milled

* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

† This Journal, 1880, p. 144. ‡ This Journal, 1883, p. 897.

§ Journ. de Micrographie, xiii. (1889) pp. 523-4.

‖ Vide Reports of the Juries, Class XIII., p. 25.

head (instead of the radial wheel of fig. 1), which is supported on a separate standard and connected with the screw by a Hooke's joint. We believe this plan of providing a separate standard for the milled

Fig. 1.

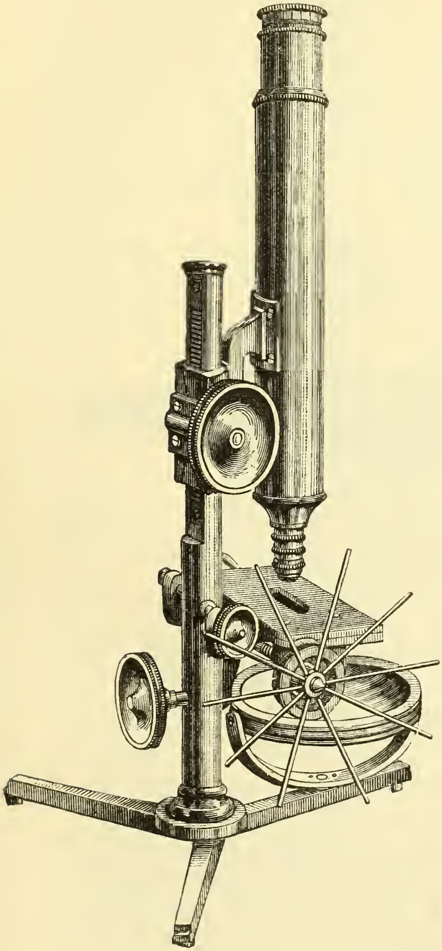
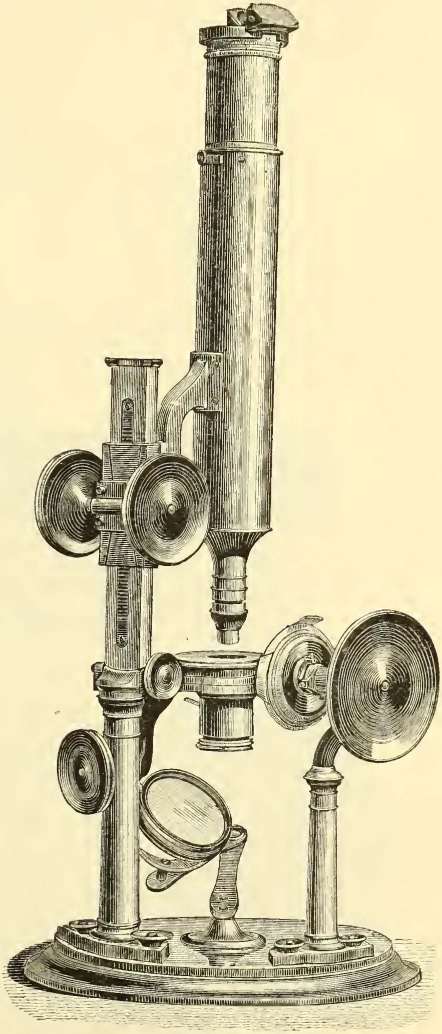


Fig. 2.



head and actuating the screw by means of a Hooke's joint was devised by Herr Nobert to avoid the tremor of the hand being communicated to the micrometer, and yet to utilize this peculiar fine-adjustment acting upon the stage.

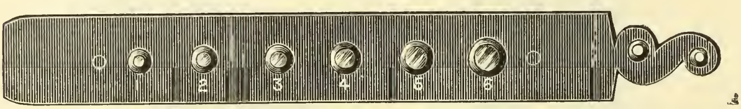
(2) The base is double; the upper plate, carrying the standards of the Microscope and of the micrometer, rotates on the lower on a centre in the line of the optic axis.

(3) The mirror is attached to a rotating cylinder in the centre of the lower base-plate by two elbow joints set at an angle, by which it can be adjusted at any angle in altitude beneath the object, whilst maintaining very nearly an equal distance from the object in all positions. The mirror can thus be rotated radially upon the object, or *vice versâ*.

The example of this second form of Nobert's Micrometer-Microscope in Mr. Crisp's collection is furnished with a mechanical stage (with glass surface) in which the rectangular movements are effected by means of a single plate. Fine micrometer-screws are applied to project from two right-angle edges of the stage and pass through fixed shoulder-rings; each screw has a spiral spring encircling it and pressing against the shoulder-ring; milled nuts exterior to the shoulder-rings act on the micrometer-screws, giving very smooth and delicate rectangular movements to the stage.

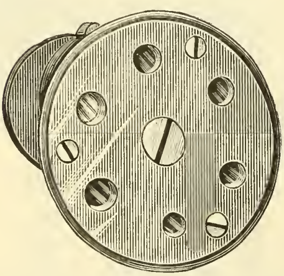
Old Microscope with nose-piece for rapidly changing objectives and mirror formed of a silvered bi-convex lens.—The nose-pieces of which so many were brought out a few years ago for rapidly changing

Fig. 3.



the objectives were generally considered to represent an entirely modern idea, though our forefathers had placed objectives in a long dove-tailed slide like fig. 3, or more commonly in a rotating disc like fig. 4.

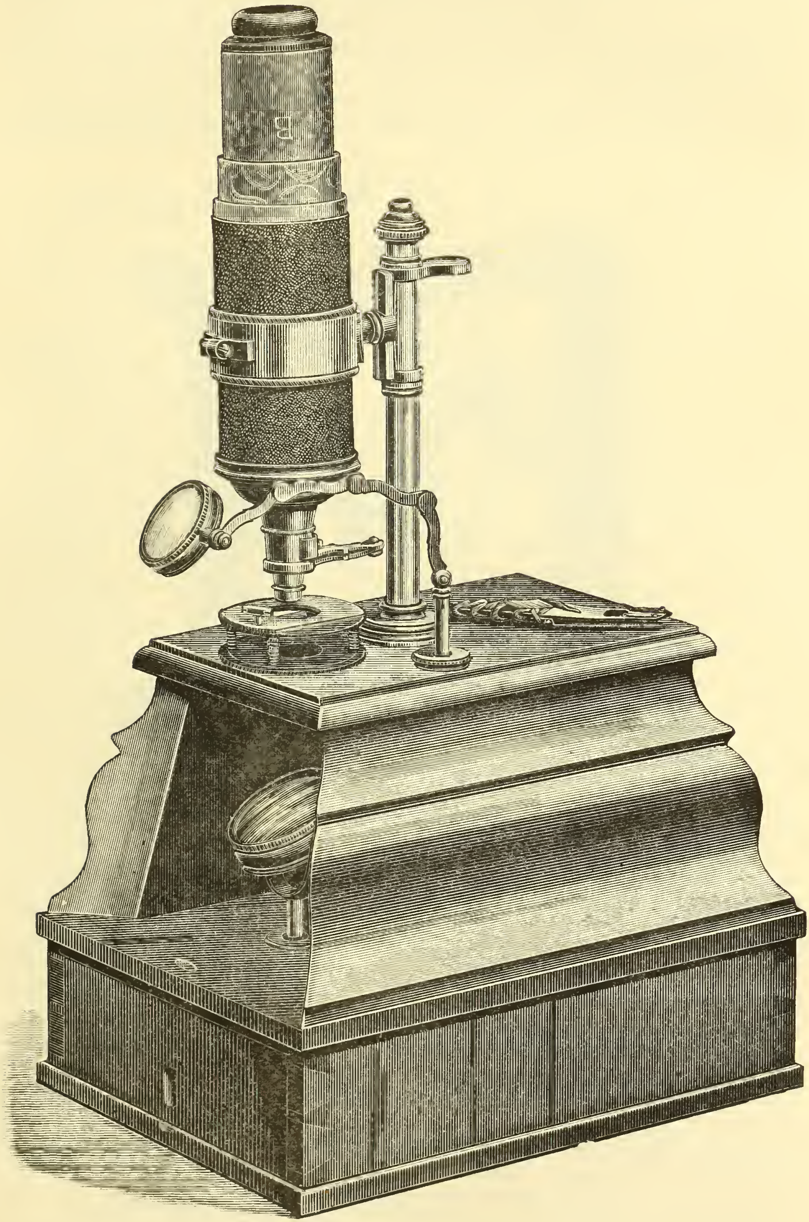
Fig. 4.



An old Microscope recently acquired by Mr. Crisp (shown in fig. 5) has an arrangement which is doubtless the earliest of its kind. To the body-tube is screwed a nose-piece, to which is attached a short arm, on which pivots a second arm with a "cell" at the end, into which the objectives drop. To change the objective the second arm, which has a slight amount of "spring," is depressed and then swung away from the body-tube, the objective lifted out of the cell and another inserted in its place, and the arm turned back again. The cell, which is about 1/8 in. deep, fits over the end of the nose-piece, and thus keeps the objective in position.

The Microscope is apparently of Augsburg make, probably by G. F. Brander, whose career as a mechanician and optician was comprised between the years 1734 and 1783, when he lived at Augsburg. The mirror is a biconvex lens silvered—a device which has been reinvented more than once during the last ten years!

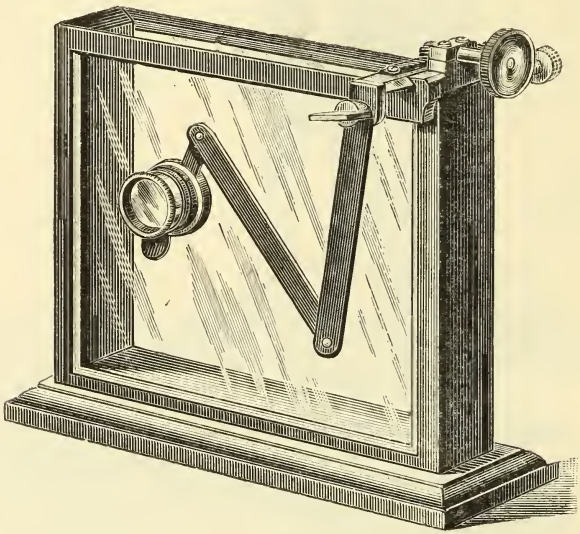
FIG. 5.



Rousselet's Simple Tank Microscope.—Mr. C. Rousselet exhibited at a recent meeting of the Society a small tank Microscope (fig. 6) designed for the purpose of rapidly looking over pond water and weeds collected at a day's excursion and placed in a small parallel-sided window aquarium.

One of Zeiss' aplanatic lenses is carried on a jointed arm, which moves parallel to the side of the tank, and the lens is focused by means

Fig. 6.



of a rack and pinion, the whole being fixed to the upper left-hand corner of the tank by means of a screw clamp.

The following points, Mr. Rousselet considers, will recommend themselves to those who are in the habit of looking at their captures with the pocket-lens in the ordinary way:—

When an object of interest is found it can be followed with the greatest ease and taken up with a pipette, both hands being free for this operation. It frequently happens that a minute object is lost simply by removing the pocket-lens for an instant to take up the pipette; in the above apparatus the lens remains in the position in which it has been placed. The definition of these aplanatic lenses is excellent; the lowest power has enough working distance to focus through tanks of moderate size, and the magnification (6 diameters) is sufficient to permit of the identification of all ordinary rotifers, and anything uncommon or new is at once recognized. Such delicate creatures as the Floscules, which are all but invisible with the ordinary pocket-lens, are seen without difficulty, and the whole contents of the tank can be ascertained with a great saving of time.

Mr. Rousselet also specially recommends these small window aquaria to those not already acquainted with them, as affording the very best means of examining pond water for microscopic life.*

In Mr. Rousselet's original figure the lens-carrier was clamped on the vertical side of the tank; we have ventured to show the apparatus clamped on the top of the tank, where we think it will be found safer in practice.

(2) Eye-pieces and Objectives.

New Objective of 1·63 N.A.—This objective is further described by Dr. H. Van Heurck † (see also the paper by Dr. S. Czapski, *supra*, p. 11), who says that "its advantages have surpassed all that could be hoped for."

The design of the objective was started by Prof. Abbe four years ago, but it was only in August last that he was able to complete the preliminary calculations and to commence the actual execution of the objective, which was finished on the 17th September.

The objective is 1/10 in., apochromatic, and with an aperture of 1·63 N.A. A special compensating eye-piece 12 removes the last traces of colour. The cover-glasses of Dr. Van Heurck's objects have a refractive index of 1·72, and the slide is approximately of the same index; both are of flint glass. The diatoms are melted in the cover-glass. The mounting medium has an index of 2·4, and the immersion fluid (monobromide of naphthaline) an index of 1·65. The aperture of the immersion condenser is 1·60 N.A., and the upper lens is of flint, for utilizing the most oblique light. Monobromide of naphthaline is used here also as the immersion fluid.

The lenses of the objective are thus disposed:—

(1) Front lens (more than a hemisphere) of flint. Index 1·72.
(2) Achromatic lens.
(3) Crown-glass lens.
(4) Achromatic lens.
(5) Correcting lens (three glasses).

Three of the lenses are in fluorite.

Prof. Abbe considers that the difference between the indices of the cover and the immersion liquid notably favours the resolution.

In regard to its management, Dr. Van Heurck has used it daily for two months, and for hours together, and he finds it in every way as practical as other objectives of large aperture.

"In oblique light *Amphipleura* is entirely resolved in beads, as clearly as we see *Pleurosigma* with the best existing objectives, the beads being much closer than the previous imperfect resolutions had led one to believe. Repeated measurements of photographs show that it has 3600 transverse and 5000 longitudinal striæ per millimetre. It is not, therefore, surprising that there has hitherto been so much difficulty in showing these beads.

It is only for these beads that oblique light is required. All the other difficult tests, such as *Frustulia saxonica*, *Surirella gemma*, and

* Journ. Quek. Micr. Club, iv. (1890) pp. 53–4 (1 fig.).

† Cf. Bull. Soc. Belg. Micr., xv. (1889) pp. 69–71; Journ. de Microgr., xiii. (1889) pp. 527–8.

even the transverse striæ of *Amphipleura*, are resolved with axial light. *Pleurosigma angulatum* shows new details which have still to be studied. On examining it without the eye-piece eleven spectra are seen, i. e. five new intermediate spectra. Some bacteria have also shown new details.

The illuminating power of the objective is very great. Strong photographs of the beads of *Amphipleura* have been obtained in six minutes with a magnification of 1500 diameters with monochromatic solar light, whilst with the ordinary apochromatics at least ten minutes was necessary with only 1000 diameters and ultra-oblique illumination.

Only three objectives have yet been made, two for the Continental tube and one for the English. One of the former is in the hands of Dr. Koch, the Berlin bacteriologist, and will, it is hoped, give some interesting results.

Dr. Van Heurck considers that "the new objective forms an honourable practical crowning of the long theoretical labours of the illustrious Prof. Abbe, who for fifteen years has so happily led the Microscope into new paths, and who has with indefatigable patience realized practically all that theory indicated."

Semi-apochromatic Objectives.—Mr. E. M. Nelson read the following note at the December meeting:—

As these new semi-apochromatics are "Students'" lenses, let me briefly trace their development. The earliest form of student's lens was a combination of three "French buttons" or doublets; almost the whole of the medical and students' work, both here and on the Continent, was carried on by means of these lenses. The one I am exhibiting to-night is an example of the favourite form in this country, the sale of which, as I am credibly informed, must be counted by thousands. This lens gave way to the Hartnack, which consisted of two doubles and a single. The Hartnack was an immense advance over the French button, but looking at them from a present day point of view, we should say that while some picked specimens were good, the bulk of them were very mediocre. Somewhat later came Seibert of Wetzlar. His lenses, in form not differing greatly from those of Hartnack, were decidedly superior to them in finish; at the same time, his angles were low for the most part. Of his lenses two even now justly have world-wide celebrity. I allude to his No. III. and his water-immersion 1/16.

Before leaving Seibert let me point out that a Seibert No. III., unscrewed from its brass mount, constitutes the best high-power pocket-lens ever made. One mounted like a Coddington would be a useful appendage to a microscopist's outfit, as it has fully 1/8 in. working distance, which the Coddington has not.

One other point. You are all aware that on the Continent almost nothing has been done with low-power lenses. Seibert alone of all the Continental makers produces a No. 0, which is a first-class $1\frac{1}{2}$ in. With this lens Mr. Rousselet and myself have seen the cilia on *Volvox*. An example of this lens is on the table. The Hartnack was superseded by the Zeiss achromatic, a lens much of the same form, i. e. two doubles and a single, but altogether of superior workmanship. Zeiss also, by making each class of lens both wide and low angled, suited all tastes. To illustrate this period of lens I have brought a D D or 1/6 in.

I have now come to the time when English opticians made students' lenses; they adhered to the usual form of two doubles with a single front. Among the first and most successful was Swift; an early example is on the table. This lens is a 1/5, and was sold for half the price of the English 1/4 of that day.

A new competitor appears on the field, viz. Reichert of Vienna. The example before you is one of the first batch of his lenses that came to this country; it is a 1/7 of 0·84 N.A., very well corrected and very well finished. Its price was 2*l.*, and at that time there was nothing made here that would at all compare with this lens for three times that sum. Next in order comes Leitz of Berlin, who was mainly known by his 5*l.* oil-immersion, and now as I have brought up the history to recent times I will give no more particulars with regard to achromatics, but go straight to semi-apochromatics.

I call these lenses "semi-apochromatics" because, while they are not "apochromatic," they possess a higher degree of achromatism, due to the employment of Jena glass in their construction, than previously possible with the old glass. Among others the most remarkable instance of the capabilities of this Jena glass will be seen in the production by Leitz of two lenses, a 2/3 of N.A. 0·26 and a 1/8 of 0·88 N.A. The 2/3 is a remarkably fine lens which has no achromatic rival, even though it consists of only two pairs, and the 1/8, which to my fancy is rather too high in power for its aperture, by far surpasses any similar achromatic lens. Now when we remember that the price of these two lenses together is only the modest sum of 2*l.* 8*s.*, we are in a position to realize the great strides the manufacture of Microscope lenses has made quite recently. I hope to show a blow-fly's tongue under one of these presently.

In this country Swift has made use of Jena glass in the production of "Students'" lenses with great success; some dry 1/6 and 1/8 may be specially noted as having eclipsed every similar lens, and this without entailing any extra complication in construction.

Last week Mr. Baker sent me a new Reichert 5*l.* oil-immersion 1/15 of 1·25 N.A., which on measurement I found to be a true 1/12 of 1·24 N.A. Under this lens I am exhibiting the secondaries of *Coscinodiscus Asteromphalus.*

This lens is the finest oil-immersion I have ever seen, excepting only the apochromatics. The spherical aberration is beautifully balanced, as can be seen by the large cone of illumination used, viz. the full aperture of the Zeiss achromatic condenser, with bull's-eye. Beyond this, however, the lens falls off. I know of no similar lens that will stand such a severe test. The object I have chosen has thick intercostal silex, and therefore is especially one to show up any colour left outstanding. The thicker the silex the stronger the colour (hence an excellent means of determining roughly the thickness of diatomic structures). Most lenses show this same object deeply coloured. With another object such as a *Navicula Rhomboides* (Cherryfield) in balsam, the silex on either side of the raphe will appear as very pale lilac. The lens also shows admirably a difficult test such as the secondaries on *Aulacodiscus Sturtii.* Such a lens cannot fail to play an important part in the microscopy of medical and science schools.

At present it is a short-tube lens, but by slightly closing the lenses it could be made into an objective for the long tube.

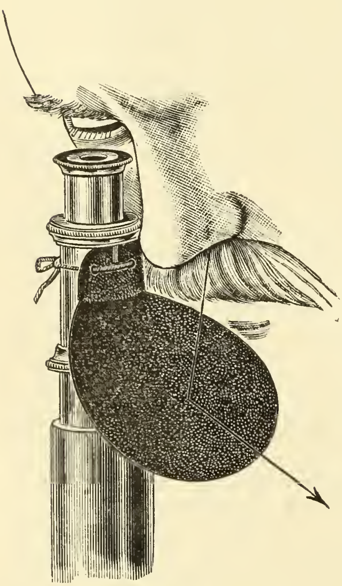
In conclusion let me ask you to go back to the microscopy of 1879, and then you will be better able to appreciate the great advance that has taken place in the improvement of the optical portion of the Microscope during the past ten years.

(3) Illuminating and other Apparatus.

Improvement in Abbe's Camera Lucida.*—Dr. H. W. Heinsius has devised the following alteration in Abbe's camera, so that it can be readily removed from the eye-piece and replaced, and that without disturbing the coincidence of the two images. The special advantage of the arrangement is that it allows the details of the preparation to be directly inspected from time to time, an advantage which any one who has tried to draw with a camera of any sort will appreciate.

A ring of blackened brass of the same dimensions as the lower part of the camera, is connected by means of a joint to the arm which carries the mirror, and at the place where this is screwed to the mount of the prism. The three binding screws pass through the new tube instead of the old one, and thus clamp the instrument to the Microscope. One slight alteration is necessary in order to prevent the neutral-tint glasses from falling out when the camera is turned up. The frames of these glasses are turned so that the latter are pushed in at the front and not at the top.

Fig. 7.



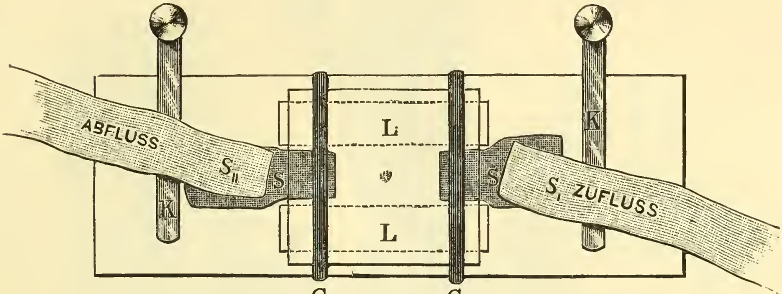
Breath-screen.†—In snub-nosed persons, says Dr. P. Schiemenz, the expired air tends to pass down parallel to the tube during a microscopical examination. The deposit of moisture, especially in winter, is sometimes annoying, and to obviate this the author recommends the adoption of a screen. This (fig. 7) may be made of a piece of stiff paper, the principal part of which is nearly circular (diameter about 8 cm.). The smaller portion is pierced by two holes, through which passes a string by which the apparatus is attached to the Microscope-tube. This breath-screen can of course be easily fixed in or moved to any position.

Siphon Apparatus for cultivating living organisms under the Microscope.‡—Dr. J. af Klercker describes an apparatus which he has used for some time for observing living organisms under the Micro-

* Zeitschr. f. Wiss. Mikr., vi. (1889) pp. 36–7.
† T. c., pp. 37–8 (1 fig.). ‡ T. c., pp. 145–9 (3 figs.).

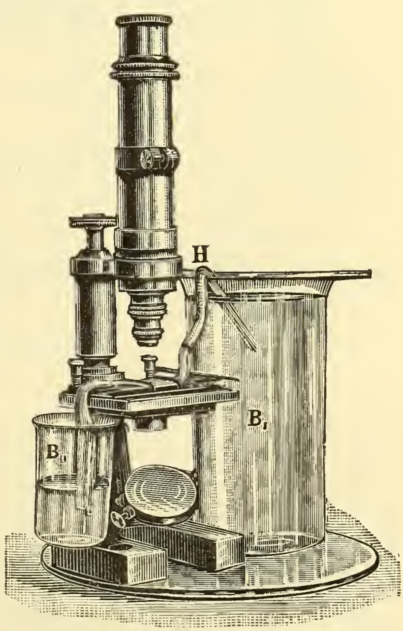
scope (figs. 8-10). The current of water for keeping the organisms alive is maintained by siphon action. Two oblong strips L of cover-glass (0·14 mm.), 28 mm. long and 6 mm. broad, are fixed parallel to

Fig. 8.



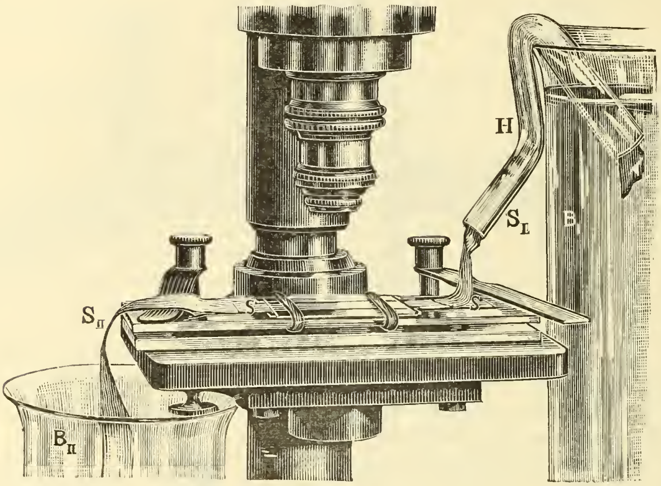
each other on a 3 by 1 in. slide, and at a distance of 8 mm., by means of Canada balsam. Within the channel thus formed is placed the object to be examined in a largish drop of water, and then a fairly large cover-glass superimposed. Should the object not be exactly in the centre, it can easily be pushed into the desired position by inserting a bristle or glass thread under the cover-glass. At each end of the channel a short piece of linen S is pushed under the cover, which is fastened to the slide by a couple of rubber rings G. A second slide is laid underneath the first, and the two connected by means of wax. The pair of slides are then fixed to the stage in the usual manner by the clamps K. A large glass vessel $B_{/}$, the lip of which projects over the Microscope for about 5 cm., is filled with water, and in this hangs a doubly bent siphon H. Within the siphon is placed a strip of linen S_1, the free end of which lies on the short strip S. By this arrangement a constant and regular inflow of water is assured. The volume of water passing through the siphon is easily regulated by jamming the linen strip S_1 into the siphon tube more or less tightly. The outflow is managed by means of another strip of linen $S_{//}$, one end of which rests upon the short

Fig. 9.



strip S, while the other dips down into a tumbler B_{II} placed below and underneath the Microscope stage. With this apparatus nearly 50 ccm.

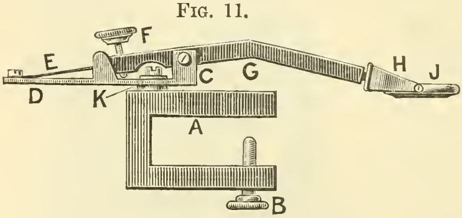
Fig. 10.



of water flows across the stage in the twenty-four hours, this being at the rate of about 3 cm. a minute.

Schulze's Compressorium.*—The object of this apparatus (fig. 11) is to apply pressure to an ordinary slide when upon the stage.

Fig. 11.



A B is a clamp to be attached to the side of the stage, carrying the piece C D, which rotates on the pin at K. The bent lever G is supported at C, and can be raised and lowered against the spring E by the screw F. At the other end of G is the fork H, in which screws a ring J, with an opening of 12 mm.

The apparatus is screwed on the stage so that the opening of the ring lies on the cover-glass of the preparation, when by turning the screw F pressure can be applied as desired.

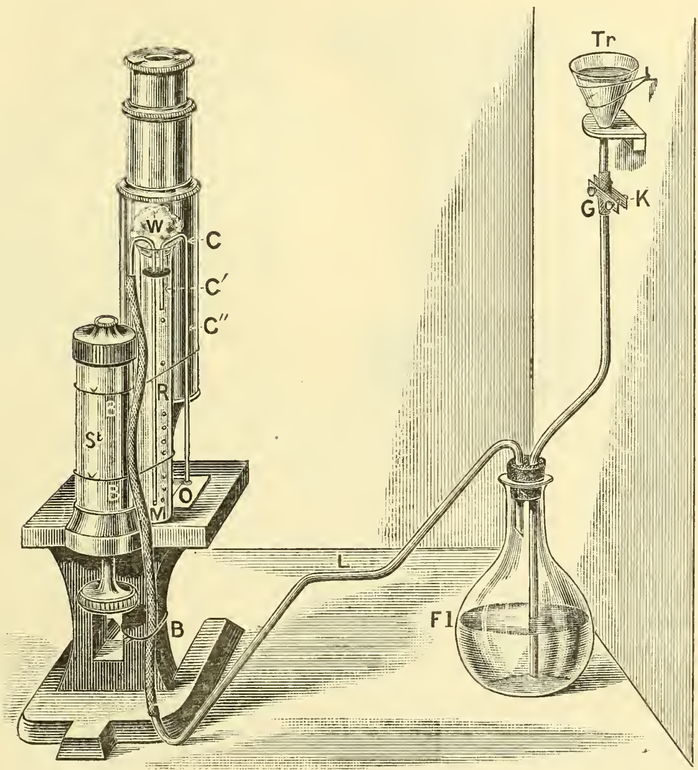
Apparatus for examining the developmental stages of Infusoria under the Microscope.†—Dr. L. Rhumbler devised the following apparatus for examining *Colpoda cucullus* and *C. Steinii* in hay infusion. To the vertical bar of the Microscope S*t* (fig. 12), is fastened a medium sized

* Behrens, Kossel, and Schiefferdecker, 'Das Mikroskop und die Methoden der mikroskopischen Untersuchung,' Band i., 8vo, Braunschweig, 1889, p. 53 (1 fig.).

† Zeitschr. f. Wiss. Zool., xlvi. (1888) p. 549. Cf. Zeitschr. f. Wiss. Mikr., vi. (1889) pp 50–1.

test-tube R filled with sterilized hay infusion. Two very fine capillary glass tubes C C′ C″ bent to a U shape are then placed in the test-tube. The longer leg of one rests close to the cover-glass on the slide O. This allows a very small quantity of water to flow down by capillary

Fig. 12.



action, and if it should be too much the excess may be removed by means of strips of blotting-paper placed on the other side of the cover-glass.

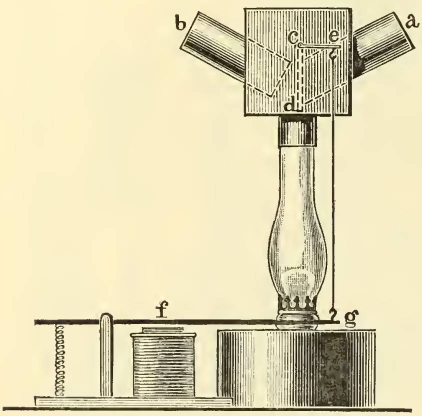
The rest of the arrangement is merely to supply air to the test-tube, as the infusoria tend to run towards the edge of the cover-glass if air be deficient. The water in the funnel *Tr* presses the air from the flask through the tube L out of the capillary point M in the test-tube.

Thermostat with Electro-magnetic Regulator.*—N. Sacharoff has devised an instrument which is at the same time a modification and combination of Sahli and Scheibler's regulator (fig. 13). Upon the chimney of a mineral-oil lamp is placed a tin box, from opposite sides of which

* Protokoll. d. Kaiserl. Kaukas. Med. Gesell., 1888, p. 111 (Russian). Cf. Zeitschr. f. Wiss. Mikr., vi. (1889) pp. 49–50 (1 fig.).

project two tubes *a b*, the ends of which nearly meet inside, and the direction of which is obliquely upwards. Above these internal openings is a transverse bar *c*, from which is suspended the valve *c d*, and this when hanging free covers the mouth of the tube *a*, and the heat escapes through *b*. When, however, *c e* is pressed down, the valve *c d* closes the aperture to *b*, and then the heat from the lamp escapes through *a*. If, therefore, a thermostat be connected with *b*, it can be warmed or cooled by the action of this valve. This action is governed by the electro-magnet. When the current is closed and the bar *f* drawn down by attraction, the latter pulls on *g e* and the valve closes *b*.

Fig. 13.



The opening and closing of the current is effected by means of a vessel filled with 500 g. of mercury. This vessel, which is placed within the water-mantle of the thermostat, has a narrow tube let into it. Within the narrow tube, and also in the vessel of mercury, are placed two platinum wires; these are connected with magnet and battery. When the temperature rises the mercury ascends in the narrow tube and reaches the platinum wire. Hereby the current is closed and the entrance to *b* also, and therefore the access of heat. As the thermostat cools the action of the valve is reversed and the heat again enters. The apparatus regulates to about 1/2°.

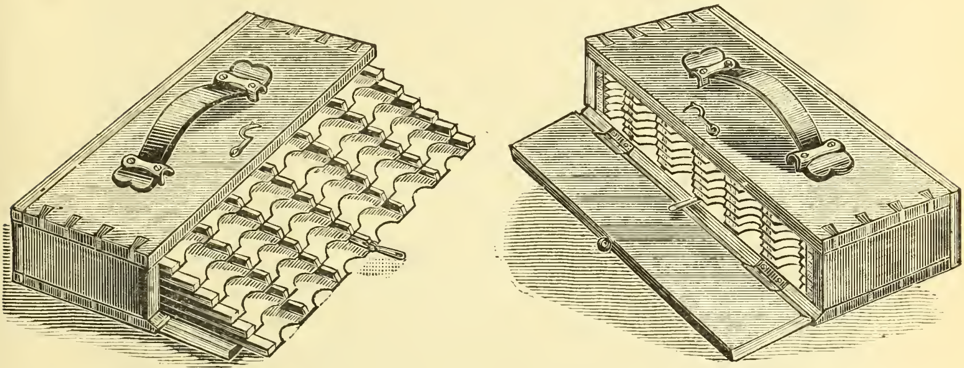
Krutickij's Microspectroscope.*—Herr P. Krutickij describes a micro-spectroscope which he invented sixteen years ago. Placed between the stage and the mirror it throws an objective spectrum on the slide, which is seen at the same time as the preparation examined. In order to facilitate the employment of any magnification which may be required, it is necessary to narrow the slit of the spectroscope in proportion to the magnification of the object. This is effected by screwing to the spectroscope an objective of the same power as that with which the object is observed. The spectroscope itself consists essentially of a combination of three prisms (two of crown-glass, the middle one of heavy flint-glass). The light is thrown from the mirror on to the slit (which is protected by a glass plate and can be narrowed to any extent by a screw), and is then concentrated by a lens on the prisms, dispersed by them, and thrown through the objective as a microscopically small spectrum upon the slide. The apparatus is provided with a divided ring, by turning which the slit is brought into the focus of the objective; and a contrivance to move the spectrum in a horizontal position in the field of view.

* Script. Bot. Hort. Univ. Imp. Petropolitanæ, ii., pp. 35–40, 1887–8. See Bot. Centralbl., xl. (1889) p. 10.

Moseley's Object-box.—This (fig. 14) is a new form of object-box invented and provisionally protected by Mr. E. Moseley.

The special feature of the box (which was exhibited at the November meeting by Messrs. W. Watson and Sons) is that, by drawing forward

FIG. 14.



the bottom tray all the others follow in series, displaying the labels of the slides. In the old form of object-box each tray has to be removed to pick out any object, but in Mr. Moseley's the object can be at once seen without any trouble. The box occupies no more space than the old form.

Maddox's Simple Substage Condenser.*—Dr. R. L. Maddox writes:—"On the supposition that the following remarks may be of interest, I beg to offer them to your notice. They are founded on the application of a rather novel kind of substage condenser for the Microscope, which has furnished me with some rather unexpected results, both visually and photographically. Whatever may be its real value, it has one claim which cannot be questioned, and that is its cost can be placed at zero. No doubt many of your readers have perused Professor Lowne's interesting article on "Interference Phenomena in Relation to True and False Images in Microscopy," reported in the Journal of the Quekett Microscopical Club for April of this year. Prof. Lowne suggests also a new theory for the formation of the diatom-image when it is brighter than the field, and that 'the cause of the positive image is that the diatom is illuminated from above, not from below. It is illuminated by reflected light from the upper surface of the front lens of the objective'; and the Professor cites an experiment showing the 'great illuminating power of the back of the front lens of an objective.' This surface of emergence of the front lens is a concave mirror, which condenses the reflected pencil upon the object. That such is the case to a certain extent is correct; but the following experiment will, I think, show it does not entirely suffice to form a bright image of the object in the case of diatoms. Having suggested to an eminent microscopist and photo-micrographer the use of a cylindrical lens of short focus for a certain

* Brit. Journ. of Photography, xxxvi. (1889) pp. 812–3.

purpose, and even hinting at a trial with a small piece of thermometer-tube retaining the mercury-column, under the supposition of the correctness of the argument used by Prof. Lowne, thinking it might be possible that the bright, reflecting, flat surface of the mercury within the tube would aid the object in view by producing the desired image, I determined to test the same. At the time I was too unwell to carry out my suggestions, but I did so at the earliest moment, and my object in this article is to state the results.

The only properly constructed cylindrical lens I possessed was of too long a focus for the purpose, which was to try and render evident some doubtful markings, dots, lines, or areas on the diatom *Amphipleura pellucida*. To construct a short-focus cylindrical lens means more time and trouble than I could give, so I cut off a piece of a thermometer-tube 1/2 in. long and from 1/6 to 1/5 in. in diameter, and having sealed in the small column of mercury, I mounted it centrally in a thin flat piece of ebonite, as the first thing to hand. It was let into a slot diametrically, cut exactly to fit the tube lengthwise, keeping its surface parallel to the surface of the ebonite. The tube was thus held longitudinally at its widest diameter, the flat face of the little mercury-column showing above and beneath. It was in this extemporized setting fitted on the top of the brass tube of a substage condenser without its lenses, but having its own rackwork, and being capable of rotation in the centering of the substage of the Microscope. Here I had a kind of cylindrical lens formed round one axis of revolution, the central portion being blocked out by the small column of mercury. No time was lost to now test its value as a simple substage condenser for use on lined objects, and also as it appeared to me useful to test Prof. Lowne's theory. After duly centering the mercury column, I placed on the stage a slide with *Pleurosigma balticum*, and by aid of the plane mirror and daylight, using the 1/5-in. objective and No. 1 eye-piece, I noticed that the bright reflecting surface of the mercury in the little tube did not suffice to give by its own light, reflected from the back of the front lens, more than a very faint image of the diatom; but the moment the small tube was decentered, so as to place the mercury-column to one side, or just out of focus, I had a very beautiful image of the object, and could by rotation of the tube round the central axis of illumination easily bring out, separately, either the short horizontal lines or the longitudinal ones by alteration of this substage adaptation, or both, showing the markings or areas in squares. Another objective was tried, as Zeiss E, equal to about one-ninth. Here the image was more perfect, only from its larger numerical aperture there was less difficulty to separate the striation. The next trial was to go over the same ground again, using simply the divergent rays of the Microscope-lamp, and with the same result. The divergent rays were next made parallel by a bull's-eye condenser, also by a crossed lens before reaching the small tube, which rendered this image very bright.

Having thus far satisfied myself, I next cut a small piece from a solid glass rod of about the same diameter. This was mounted more carefully, and upon testing its use in the same manner, I was greatly surprised at its efficiency when used to illuminate the same object, and also other diatoms. The extreme brightness of the images with a 1/12 water-immersion made by Gundlach, and selected for me years since by

Mr. Winspear, optician, Hull, for photomicrography, when focused on *Pleurosigma formosum*, led me to test its value photographically. Unfortunately, I had to fall back on some old slow quarter-plates, and being without any guide as to exposure, I simply made use of my small camera arrangement, described in one of your almanacks, and attached it to the draw-tube of the Microscope, using for illumination a large paraffin lamp, and a crossed lens as a condenser. At the first trial a very fair image was obtained, using the developing solution described in the present 'British Journal of Photography Almanac,' 1890. It seemed evidently worth while to try another more magnified image, so I managed to centre a quarter-plate camera by means of a blackened card with a central dark-lined paper tube fitted to the draw-tube of the Microscope, and made to fill up the lens aperture in the camera. As soon as ready, I took a photomicrograph of *Pleurosigma formosum*, using the 1/12-in. bull's-eye condenser and lamp, the little rod being set parallel to one set of lines on the diatom. The result I inclose for your notice, as it possibly may be one of the first negatives you may have seen produced under such conditions. Unfortunately it is a trifle over-developed, but with the naked eye, or better with a lens, you will see the effect that can be obtained by such a simple piece of apparatus.

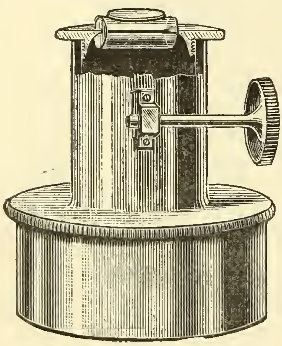
The value of the little rod as a condenser appears to me to rest chiefly in giving linear illumination of a convergent character, which can be directed in any position as regards the striation of lined objects. Some very curious effects can be brought out by keeping the eyes fixed on the object at the same time that the rod is gently rotated round the axis of the Microscope, and it is just possible some of the peculiarities in the structure of striated diatoms may be better brought out than with an all-round convergent illumination. There is one point that must be carefully observed to obtain the best result, which is to be careful to use it at its own focus, otherwise the image is pale or fogged. It is not pretended to offer this plan for anything more than a *costless* substitute for a *costly* piece of apparatus. It possesses a certain value, but is not intended to compete in general excellence with a first-rate achromatic substage condenser. You will be able to judge for yourself. I should have liked to have tested rods of coloured glass, but could not put my hands on any suitable; and there remains yet to try the rod with a right-angle prism, instead of the plane mirror or parallel light by means of the bull's-eye condenser. To find the best position of the rod requires a little trouble."

Maddox's Small Glass Rod Illuminator.—Dr. Maddox refers to the preceding as follows:—"In this age of rapidly advancing microscopy may I for a few moments crave the attention of the Fellows of the Society to the claims of a small piece, 1/2 in. long, of solid white or blue glass rod, about 1/5 or 1/6 in. in diameter, when used as an illuminator, and substituted for an ordinary substage achromatic condenser. I ask this permission as several errors have crept into the pages of a weekly contemporary journal, through the incorrect statements of a writer who noticed an article on the use of the white glass rod, contributed to the 'British Journal of Photography' of December 13th, 1889.

A few days since I mounted a piece of blue glass rod in the same manner, i. e. by fitting it horizontally at its widest diameter into a thin cell, which screws on the top of a substage fitting which has its own rackwork, and this, when inserted into the substage support, is capable of being rotated; thus the centering, focusing, and position—matters of importance—are secured. By both plans I have been enabled to examine many lined objects, whether the appearance be due to ridges, or areas as elevations or depressions, and I have reason to suppose, if employed properly and patiently, either will render visible any markings any objective, at least of the old school, is capable of revealing.

The rod has been used with the 1/2, 1/5, 1/9, and 1/12 in. water-immersion, the latter photographically, the radiant being a small paraffin lamp, and between it and the rod a large No. 1 eye-piece, or a crossed lens, or a bull's-eye condenser. After numerous trials, preference was given to the first.

Fig. 15.



The white rod has also been made into an immersion illuminator by fixing on the top horizontal edge a small cover-glass (fig. 15). Two of the negatives accompanying this were taken by it used thus, as an immersion illuminator; the others by the blue rod, dry.

I have been rather surprised at the minutiæ either will reveal, as small bars of silex extending into the large areas in some of the fragments from the Oamaru deposit; the secondary markings in *Triceratium*, &c., are remarkably well shown by either rod, and they well define the areas in *Navicula rhomboides*, &c. It appears to act as a narrow convergent central line of light, which, by careful manipulation, yields at certain points of rotation, excellent definition.

Possibly what I have said will be called in question, but it must be understood I do not claim for the rod more than has been stated, and trust others, if induced to try it, may find it has not been exaggerated."

(4) Photomicrography.

Photomicrography.*—Dr. Th. Kilt reviews the history of photomicroscopy and the present condition of its technique. He describes in detail the apparatus of Zeiss and Klönne and Müller, light-filters, and orthochromatic plates; the various copying methods are thoroughly discussed. The specimens of photography given by the author show the great superiority of this method over drawing, and it is safe to prophesy that if the improvements of this art can be continued, it will soon sweep the field for bacteriological and histological illustrations. Although, from motives of economy, photozincography, which only imperfectly reproduces the delicacy of the negative, was selected, the illustrations given are extremely clear and sharp.

Silver Combinations of Eosin.†—Dr. E. Zettnow finds that the orthochromatic power of eosin-silver plates is due to the erythrosin or its silver combinations, and not to the eosin. The erythrosin plates

* 'Encyklopädie d. gesammt. Thierheilkunde u. Thierzucht,' Wien u. Leipzig, 1889. Cf. Zeitschr. f. Wiss. Mikr., vi. (1889) p. 193.

† Zeitschr. f. Wiss. Mikr., vi. (1889) p. 193, from Photogr. Correspondenz, 1889.

are moreover extremely sensitive to yellow, and as long as this kind of light predominates, the excellence of their delineation is unsurpassable. By their aid sharp negatives can be obtained with a mineral oil lamp and the ordinary low-power objectives, and this without a filter. With sunlight, or as soon as the light becomes impregnated with many blue rays, they fail.

(5) Microscopical Optics and Manipulation.

Amphipleura pellucida and Pleurosigma angulatum.—Dr. H. Van Heurck sent for exhibition at the December meeting some remarkable photomicrographs of *Amphipleura pellucida* and *Pleurosigma angulatum* taken with the new Zeiss's 1/10 in. objective of 1·63 N.A.

Monochromatic sunlight was used. Medium for the preparations 2·4. For those of *Amphipleura* moderately oblique light was used with magnifying powers of 2000 and 3000 diameters. The *Pleurosigma* photographs were taken with strictly axial light and a small aperture of the diaphragm, the magnification being 3000, 10,000, and 15,000.

The photographs of *Amphipleura* show the valve completely resolved in beads (cf. *supra*, p. 91), while those of *Pleurosigma* show details not hitherto observed.

Dr. Van Heurck considers that his "conclusions as to *Pleurosigma* are now complete and positive and may be summed up as follows:—

(1) The alveoles of *P. angulatnm* are hexagonal, at any rate in the place where the two layers of the valve unite.

(2) The intermediate beads are produced by bad focusing of the angles of the alveoles."

The following is a translation of a communication made by Dr. Van Heurck to the Belgian Society of Microscopy:—

"I have the pleasure to submit a new series of photographs of *Pleurosigma angulatum* obtained with the 2·5 mm. objective 1·63 N.A.

On studying this diatom attentively, I observed a very singular appearance; the alveoles or beads showed themselves in the form of very minute points, and were surrounded by a ring of six secondary beads when each alveole was viewed separately. If, however, the whole valve was viewed it was seen that the secondary beads were really intermediate between two principal adjacent layers of the valves.

I thought at first that this appearance of structure was new, but later I saw that a similar appearance existed on the margin of the valve photographed by Dr. R. Zeiss (5000 diameters), and which is figured in his 'Atlas of Photomicrography.'

Photograph No. 1 reproduces the above appearance. No. 2 shows it under a power of 10,000 and with an exact focus. In No. 3 the focus was purposely altered so as to show the secondary beads better.

How is this structure to be explained?

If the photograph No. 2 is attentively observed it will be seen that the alveoles are not round as has been generally believed in modern times, but that they present sensible angles.

An absolutely exact focus (photograph No. 4) shows that the opinion of the old microscopists was well founded and that the alveoles are really hexagonal.

This hexagonal form being admitted, an easy explanation is obtained of the secondary beads, which are produced by the imperfect focusing of the angles of the network, that is, by the places where two lines run into one another. To verify this hypothesis I have studied with the same objective a great number of large diatoms where the structure allows of no doubt, and I have found in *Coscinodiscus excentricus* the confirmation of my assertion.

The structure of this diatom is well known. With low-power objectives it is seen to present large hexagons. The valve is very convex, and by regulating the focus suitably we can obtain at the same time all the appearances from the real hexagons to the isolated point surrounded by six illusory intermediate beads. It is this which is shown in photograph No. 5.

The last photograph, No. 6, shows that the valve of *Pleurosigma* is formed of two layers, and that the alveoles are hollowed out in the substance of the valve. The photograph shows a valve where the lower layer bears, on a part of the surface only, a fragment of the upper layer. The hexagonal form of the alveoles is seen round the median nodule. It may therefore be considered that the form of the alveoles is hexagonal at the point of union of the two layers, and that each alveole terminates above and below very gradually in the form of a dome. This is what my latest researches seem to demonstrate. I hope to be able, as soon as I have leisure, to send photographs in support of this view.

List of photographs:—

1. *Pleurosigma angulatum* W. Sm. × 3000.
2. Ditto—exact focus on the intermediate illusory beads—about × 10,000.
3. Ditto—out of focus, to show the intermediate beads better—about × 10,000.
4. Ditto—focus on the hexagon—about × 15,000.
5. Ditto—showing partially the two layers of the valve.
6. *Coscinodiscus excentricus.*"

Structure of Diatom Valves.—Dr. Van Heurck also sends us the following paper:—

In my 'Synopsis of Diatoms' I showed that in the large *Crypto-Raphides*, for instance, *Coscinodiscus*, we can clearly distinguish three parts: an upper membrane, a lower membrane, and an intermediate layer, and these may be identified when isolated, either wholly or partially, in certain gatherings.

We know from Prof. Abbe's theory that the Microscope *alone* does not enable us to determine with certainty the structure of minute forms. But though technical means fail us, we can still make estimations by analogy as we do in most of the sciences. The study of large forms authorizes us to infer that the structure of the more delicate forms may be identical or at least very similar.

It has frequently happened that the examination of favourable fractures has enabled me to confirm these views, and they have also been confirmed by careful observers, such as Deby, Cox, and others. The portion of the intermediate layer photographed by Mr. T. F. Smith, and figured as No. 5 in his note on the *Pleurosigma* valve, is a case in point that may be considered quite conclusive.

The more recent and powerful optical means placed at our disposal by the house of Zeiss, of Jena, allow us to go a step further in the study of the valve, firstly, in producing an optical image which is more complete and hence more real, and further by reducing more nearly to a mathematical plane the portion of the valve that can be seen with one and the same focal adjustment.

The new results obtained and confirmed by photography—which all serious observers now regard as the best criterion—still further simplify our opinions, and enable me to summarize them as follows :—

(1) Diatom valves consist of two membranes or thin films, and of an intermediate layer, the latter being pierced with openings.

The outer membrane, which is often very delicate, may readily be destroyed by the action of acids in cleaning, or by friction, &c. It may be also that this membrane exists only in a very rudimentary state. Specialists on this subject are generally agreed in supposing that these membranes may be sufficiently permeable to allow circulation by endosmose from the interior to the exterior of the valve, though they have no real openings during the life of the diatom and whilst it remains intact.

(2) When the openings of the interior portion are arranged in alternate rows, they assume the hexagonal form; when in straight rows, then the openings are square or oblong.

The hexagonal form, which occurs so frequently in nature, seems to be the typical form of the openings in the interior portion, and this form obtains mostly in large valves, which are not otherwise provided with strengthening ribs. Even in the forms having square openings we frequently perceive deviations, and the tendency to recur to the hexagonal type on certain portions of the valve. It may be that the interior consists of several layers superposed, formed successively and very closely joined, but so far I have not met with any form exhibiting superposed layers differing from each other in type.

This description seems to me to represent in broad outline the structure of diatom valves. But this structure may appear complicated, either by the presence of secondary internal valves ("Regenerationshülle"), or by deposits of silica on various parts of the valve. These deposits originate the "thorns" met with in divers forms (such as *Triceratium*), the rings found on the under membrane of certain forms of *Coscinodiscus*,* and the anastomosed ribs of *Navicula aspera* Ehr. (*Stauroneis pulchella* W. Sm.†) &c.

All these deposits are merely secondary silicious products which have nothing to do with modifying the general structure of the valve in its primordial elements.

Description of the Plates.

Plate II.—(1) *Amphipleura pellucida* Kütz. resolved into beads × 2000. The insufficient magnification shows a good general view, but the beads are not so sharp in the print as in the negative.

* I have observed the rings in *Pleurosigma formosum* referred to by Mr. T. F. Smith, but the new objective (1·63 N.A., medium 2·4) when employed on valves that were purposely broken, shows them lying flat on the under membrane, precisely as in *Coscinodiscus*. Possibly these rings are portions of secondary valves. I have not been able yet to determine the point.

† The valves of *Navicula aspera* Ehr. appear at first sight very complicated, and they have hitherto been erroneously figured by all writers. My latest examinations would show that the appearances observed are due to the mixing up in vision of more or less distinct views of ribs or thickenings regularly anastomosed so as to form rings more or less alternate.

2. *ib.* × 3000.

3. *ib.* × 8000, upper part of the valve, showing square beads identical with those of *Amphipleura Lindheimeri* Grun.

4. *Amphipleura Lindheimeri* Grun. × 2500.

5. *Surirella gemma* Ehr., about × 1000.

6. *Pleurosigma angulatum*, in hexagons, about × 10,000.

7. *Van Heurckia crassinervis* Bréb. (*Frustulia saxonica* Rabh.) × 2 00.

8. *Van Heurckia crassinervis*, Bréb., about × 6000.

In all the photographs the focus was upon the intermediate layer, and here and there in most of them the gradations of form are shown between squares and hexagons.

Plate III.—*Pleurosigma angulatum* W. Sm. × 2000. On the right of the centre the illusory intermediate beads are seen at the same time as the real beads (the openings), of hexagonal form.

The photographs were all produced with Zeiss's new apochromatic 1/10 in. of 1·63 N.A. Monochromatic sunlight. Compensating eye-piece (special) 12. Condenser 1·6 N.A.

The preparations were all in a medium of 2·4. Cover-glass and slides of flint, 1·72. Diatoms melted into the cover-glass softened by heat.

Ilford dry plates, developed with hydroquinone and eosine solution as supplied by Mercier, of Paris.

Resolving Power a "Superfetation."—The following extract from M. A. Zune's 'Traité de Microscopie' (1889) should be interesting to microscopists.

"Resolving power. We regret not to have the necessary authority to erase this word from the dictionary of microscopists, since it appears to us to constitute an entire superfetation. To say of an objective that it has resolving power is, according to most authors, to attribute to it the power of isolating so to say one from another the finest details of structure on the surface of a transparent object such as striæ, fibrillæ, depressions, reliefs, &c.; but an objective which defines well in the complete sense of the word, ought it not to resolve perfectly?"

This carries a long way further the error on which we commented in the case of the Quekett discussions, where, however, it was not proposed to abolish the term "resolving power"! As we explained then, and shall probably have to repeat again, an objective may have perfect defining power, and yet, by reason of its want of aperture, it will be unable to show particular markings. It defines all that it can take up, but cannot define what is not imaged by it.

It would be possible, no doubt, to arrange that "definition" should be considered to include "resolving power," but nothing would be gained by confusing the two terms, especially as we have already the term suggested by Prof. Abbe—delineating power—to denote the combination of the two qualities, an objective having large delineating power when it both defines well and has large aperture.

The author's views are in other respects peculiar, as he is of opinion that "an objective of large angle, *well constructed*, will—all other things being equal—show details in depth as well as it will show those on the surface."

(6) Miscellaneous.

Paris Exhibition, 1889.—The following English opticians obtained rewards at the last Paris Exhibition, though not necessarily for Microscopes alone:—

Grand Prize.—Messrs. Ross & Co.

Gold Medals.—Mr. J. H Dallmeyer, Mr. J. Pillischer, and Messrs. Watson & Sons.*

Carlisle Microscopical Society.—The official report which we have received embodies a *résumé* of the work done by this vigorous provincial Society since its foundation in the year 1881, and especially since its affiliation with the Royal Microscopical Society in 1883. The Society was inaugurated by a public address delivered to a large audience by its first President, the Rev. Canon Carr, who afterwards gave a series of educational papers on Vegetable Histology. Papers have been read at successive meetings by various members of the Society on such subjects as the adulteration of food, water, coal fossils, trichina, diseases of plants, animal physiology, photomicrography, the Microscope in manufactures, slide-mounting, and others too numerous to mention. Frequent excursions have been made by the Society to collect material for microscopical examination. Two public lectures have been delivered to crowded audiences by the Rev. Dr. Dallinger, and one by Sir Robert S. Ball, Astronomer Royal for Ireland, who has also promised to give another in the course of the present session. The aim of the Society has been eminently a practical one, and much earnest work has been done. The President of the Society is C. S. Hall, Esq., and the Hon. Vice-Presidents, Prof. Pasteur and the Rev. Dr. Dallinger.

Orthography of the Microscope.—There is no word which is so variously spelt as "Microscope" or (with "microscopical," &c.) so often misspelt by printers.

The form "Miscroscope" occurs times out of number.

The Germans, apart from the standard form of "Mikroskop," also spell it "Mikroscop," "Microskop," and "Microscop."

"Microscrope" appears in Proc. Amer. Soc. Micr., 1886.

"Mikrospischen" is found in Stenglein's 'Anleitung,' 1887.

"Miroscopical" in Amer. Mon. Micr. Journ., viii. (1887) p. 49, and this Journal, 1887, p. 1039.

"Microscopial" in 'The Microscope,' 1888, p. 108.

"Mikrokopiker" in 'Flora,' 1888, p. 39.

Mr. Crisp and this Journal.—The 'Athenæum' says:—"Microscopists, abroad as well as at home, will hear with great regret that Mr. Frank Crisp is about to resign the office of Secretary to the Royal Microscopical Society, which he has held for twelve years. During that period the character and position of the Society have been greatly improved, and the numerous microscopical societies which have sprung up elsewhere have come to regard it as their common parent; the number of its Fellows has been doubled, and its Journal has been converted into one of the most useful aids to research which are now put into the hands

* Cf. Journ. d. Micr] ogr., xiii. (1889) pp. 481–93, and Mr. J. Mayall, junr., this Journal, 1889, pp. 851–2.

of working biologists. For twelve years this Journal has averaged a thousand pages in each volume, and its circulation is understood to be more than one thousand copies. This result, it is generally known, has only been obtained by the yearly expenditure of a sum of money larger than the annual income of the Society; Mr. Crisp's banker alone, in all probability, knows how large that sum is. But Mr. Crisp has not only given money; he has also devoted a large amount of time to editing and improving the character of the Journal, and by his own contributions and criticisms has done a great deal in making intelligible to microscopists the modern theories of the Microscope. His retirement from, no less than his election to, the office which he holds marks a critical period in the history of the Society. But though his legal duties are so much increased as to leave him no choice, he will still be intimately associated with the Society, as he is willing to act as its Treasurer, and we may be sure that his interest in it is in no way abated." *

β. Technique.†

(1) Collecting Objects, including Culture Processes.

Cultivation of Actinomyces.‡—Dr. Kischensky inoculated blood-serum and agar to which 6 per cent. of glycerin had been added with actinomyces granules. The next day evidences of growth were observed. In the course of a few days filaments associated with coccus forms were seen under the Microscope, and after two or three weeks the ends of the filaments were observed to possess bulb-shaped expansions (involution forms). In cultivations on potato the fungus grew in the form of yellowish granules. In gelatin at 39° C. the filaments seemed to grow in a radiate way, and sometimes showed bulbous expansions at their ends. The filaments were easily stained by Gram's method.

Whether these cultivations were really pure cultivations of actinomyces seems doubtful at present, as inoculation experiments were not tried.

Pure Cultivation of Actinomyces.§—For some months past, says Dr. O. Bujwid, "I have easily obtained pure cultivations of actinomyces, and have further ascertained the important fact that it is an anaerobic fungus."

The method adopted by the author was to take some of the granules from the abscess-pus of a person suffering from actinomycosis and cultivate them in ordinary gelatin, ordinary and glycerized agar, sterilized milk and potato at a temperature of 36° C. For some of the tubes 10 per cent. pyrogallic acid was used to absorb the oxygen (Buchner's method).|| In these anaerobic cultivations the points inoculated were observed to have swelled in about 48 hours, while the rest of the tubes only showed copious growth of *Staphylococcus aureus*, *S. albus*, and some sort of rodlet.

* Athenæum, 1890, Jan. 11, p. 53.

† This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Imbedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservative fluids, &c.; (6) Miscellaneous.

‡ Arch. f. Experimentelle Pathol. u. Pharmakol., xxvi. (1889) p. 79.

§ Centralbl. f. Bakteriol. u. Parasitenk., vi. (1889) pp. 630–3 (2 photos.).

|| See this Journal, 1888, p. 1039.

The granules increased in size and in a few weeks had become pretty large yellowish-white grains which penetrated within the substance of the agar so that they could only be removed with difficulty. Microscopical examination afterwards showed that the colonies grew radiately, forming branches and mycelia like some moulds do, whence it would seem highly probable that *Actinomyces* is a sort of mould fungus. This appearance does not resemble that of the club-shaped elements found in human pus and in the fresh pus and nodules of ruminants, but is identical with that of the nodules found in human organs or in human pus after treatment with caustic soda.

In older agar cultivations bulb-shaped expansions formed on the ends of the filaments, but whether these were gonidia or an involution form the author cannot yet say.

Two photographs from sections magnified 340 and 840 times were obtained as follows:—An agar cultivation three weeks old was cut up into small pieces and placed in absolute alcohol for 48 hours; then for 24 hours in 1 per cent. and afterwards for six hours in 5 per cent. photoxylin solution. From these pieces sections were made in the usual way and removed from spirit to a slide, and when they were dry (20–30 minutes) were stained by Gram's method. The photographs were taken with Zeiss's apparatus by sunlight. Zettnow's light-filter was used and Attout-Tailfer's isochromatic plates.

Cultivation of Typhoid Bacillus in Sewer Water.*—M. L. Olivier states that sewer water is a very favourable medium for the cultivation of typhoid bacilli; they develope in it quite as well as in bouillon.

(2) Preparing Objects.

Preparation of Cells for showing the Division of Nuclei and the Formation of Spermatozoa.†—For examining cell-fission, and the formation of semen in the hermaphrodite glands, Dr. G. Platner recommends immersion in the strong Flemming's mixture. Fresh pieces of gland cut up small, if necessary, are placed in the mixture for an hour; the fluid is then diluted with three or four times its bulk of water, and allowed to harden further for 24 hours longer. They are then thoroughly washed in the usual manner, and afterwards transferred to spirit of increasing strength. The best nuclear stain is logwood, and the author recommends Apáthy's modification of Heidenhain's hæmatoxylin (hæmatox. crystals 1, absolute alcohol 70, aq. dest. 30, the fluid to be kept in dark-coloured bottles).

The objects were stained *in toto* for 24 hours, and afterwards acted on by a 1 per cent. alcoholic solution of bichromate of potash. This solution is made by mixing 10 parts of bichromate with 300 of distilled water, and then, when required, diluting 30 ccm. of it with 70 ccm. of strong spirit. This gives the proper colour after acting for 12 hours. If a lighter stain be desired, it must work for 24 hours. The objects are then transferred to 70 per cent. spirit, and kept in the dark for one or more days. After this they are dehydrated in absolute alcohol, and

* Comptes Rendus Soc. Biol. Paris, 1889, No. 27; Centralbl. f. Bakteriol. u. Parasitenk., vi. (1889) p. 519.

† Arch. f. Mikr. Anat., xxxiii. (1889) pp. 125–52 (2 pls.).

then soaked in cedar oil. They are next soaked in paraffin for 20 minutes. The series of sections are stuck on the slide with castor-oil collodion, and after the removal of the paraffin with xylol, mounted in balsam.

For studying the division of the nuclei in the Malpighian vessels of *Dytiscus marginalis*, the author used Kleinenberg's picrosulphuric acid for hardening. This was found specially advantageous in that it decolorized the dark-brown granules which beset the cell-plasma.

By staining with borax-carmine and then treating with acidulated alcohol, a beautiful colour was obtained.

Preservation of Mucous Granules in Secretory Cells.*—Mr. J. N. Langley advises the following method for preserving mucous granules in secretory cells. The animal is killed by bleeding or decapitation. A small piece is then snipped off a salivary gland, the piece having been previously pierced with a threaded needle. The piece of gland is suspended by the thread in a bottle, which contains some 2 per cent. osmic acid. The thread is fixed between the stopper and neck of bottle, and the piece of gland hangs just above the level of the fluid. The object is hardened in about 24 hours. It is then removed, washed for a few minutes in water, and then for 15 minutes apiece in 30 per cent. and 50 per cent. spirit. Next, for half an hour apiece in 75 and 95 per cent. alcohol; finally for one or two hours in absolute alcohol. The preparation is then soaked for half to one hour in benzol previously to being imbedded in hard paraffin. The series of sections are fixed on the slide with albumen stained with methylen-blue, and mounted in balsam. Or the paraffin may be dissolved out by means of benzol or turpentine. This method is said to give good results with mucous cells from the mucosa of many of the lower vertebrata.

Removing the Jelly and Shell from Frogs' Eggs.†—The method for removing the coverings from frogs' eggs recommended by Prof. F. Blochmann is essentially the same as that previously advocated by Prof. C. O. Whitman.

The author employs eau de Javelle, a solution of hypochlorite of potash, while Whitman used sodium hypochlorite. The ova which have been preserved in chrom-osmium acetic acid, and been well washed in water, are placed in the solution, twice or thrice diluted, and then shaken up by inverting the vessel. The eggs, freed from their gelatinoid coat, sink to the bottom in 15 to 30 minutes. They are then very carefully washed in water, and afterwards transferred to strong spirit. If the eggs be kept in the dark the chromic acid is removed more effectually. The author recommends borax-carmine for staining. Hæmatoxylin is not suitable.

Carbonate of Ammonia for demonstrating Sarcolemma.‡—Prof. B. Solger recommends a cold saturated solution of ammonia carbonate for demonstrating the sarcolemma of frog's muscle. In this solution the muscle is placed for 3 to 5 minutes, and having been teased out, examined under the Microscope. The reaction is more complete if the animal be previously kept for several weeks in captivity.

* Journal Physiol., x. (1889) pp. v. and vi.
† Zool. Anzeig., xii. (1889) p. 269.
‡ Zeitschr. f. Wiss. Mikr., vi. (1889) p. 189.

Demonstrating the Neurokeratin Network of Nerve-fibres.*—Dr. G. Platner advises the following procedure for demonstrating the neurokeratin network.

Thin fresh pieces of nerve, freed from connective tissue and fat, are placed in the following solution—Liquor ferri perchloridi 1 part, distilled water or rectified spirit 3–4 parts. In this the pieces of nerve are left for days to weeks. The iron chloride is then to be thoroughly washed out so that no trace of iron can be chemically detected in the water or spirit. After this the pieces are to be kept till wanted in spirit.

The best stains for nerves thus manipulated are "Echtgrün," a dinitroresorcin which in combination with the iron still remaining in the tissues gives a green colour, and alizarin, which imparts a deep violet hue.

To use dinitroresorcin, a supersaturated solution of the solid pigment is made in 75 per cent. alcohol. In this solution large pieces of tissue require to lie for several weeks. When thoroughly freed from iron the immersed pieces gradually become dark green, but the fluid itself exhibits no trace of green. After having been dehydrated, the pieces are imbedded, and sections, both longitudinal and transverse, made. In transverse section, the axis cylinder is stained a dark emerald green, and from this radiate outwards to the medullary sheath, numerous green delicate filaments, the neurokeratin network. In longitudinal section the same network is shown.

The stain is fairly resistant to acid and alkaline reagents, and the different methods of hardening do not exclude the use of the perchloride solution.

Preparing the Silk-glands of Araneida.†—Dr. C. Apstein, in making a macroscopical examination of the living animal, opened the body under water and then removed the heart, intestine, liver, and organs of generation. An addition of some drops of sublimate to the water imparted to the previously glass-like spinning-glands a milky appearance. Alcohol-material was prepared under 35 per cent. spirit. For sectioning the author prepared the animals with hot water, boiling them from 1/2–3 minutes, according to size, and then imbedding in paraffin, after passing them through turpentine or chloroform. The author cautions against using cedar-oil, as it is a poor solvent of paraffin. Borax-carmine, and after-staining with hæmatoxylin, are recommended for staining.

The statement that the silk-threads of the glandulæ pyriformes consist of a double substance is interesting, since the secretion from the upper part of the gland forms a solid non-staining cord, while the cells from the lower parts of the glands secrete a tubular filament which is clearly stained. The author verified this in different species.

Preserving Actiniæ.‡—Dr. J. P. M'Murrich recommends the collector of Actinians who has not the time to properly carry out the narcotizing methods to act as follows. After noting general characteristics, place the animal in a jar just wide enough to allow of its complete

* Zeitschr. f. Wiss. Mikr., vi. (1889) pp. 186–8.
† Inaugural-Dissert. Kiel, 1889. Cf. Zeitschr. f. Wiss. Mikr., vi. (1889) pp. 199–200.
‡ Journal of Morphology, iii. (1889) pp. 2–3.

expansion, and with just enough water to cover it when fully expanded. A glass syringe filled with Perenyi's fluid should have its nozzle quickly inserted into the mouth of the Actinian, and the contents should be rapidly injected. At the same time, if possible, a quantity of the same fluid should be poured over the animal. After half an hour the animal should be treated successively with 50, 70, and 90 per cent. alcohol, care being taken to inject a considerable quantity of the spirits into the interior at each change. Though considerable contraction and loss of colour ordinarily follow the use of this method, the parts are satisfactorily preserved for future histological study.

Demonstrating Cyclosis in Vallisneria spiralis.*—Prof. S. Lockwood says that Mr. F. W. Devoe is able to show the circulation in this plant to the best advantage. "Having selected a bit of a leaf, not too mature, he shaves off one side with a sharp knife, although a razor is better. It is then put on a slide, the shaven side up. A drop or two of clean water and a cover-glass of medium thickness with good illumination follows, Mr. Devoe using a prism illuminator. Begin with a 6/10 objective, and continue to a 1/6 or a 1/10, and a vision is got of a startling clearness. The vivid individuality of each bioplasmic molecule and the mystic, almost solemn movement of this pellucid stream of infinities of life, form a sensational picture of which the beholder never tires."

Cleaning Diatoms from Sand.†—Mr. Norman N. Mason communicates the following method:—

After removal of the organic matter with acid by the usual methods, add to the diatoms and sand in a large bottle, thirty, forty, or fifty times the quantity, by measure, of water, and gently shake until they are mixed. This water, with the diatoms and sand kept suspended by an occasional shake, is slowly poured in a small stream upon the upper end of a strip of clean glass, 3 ft. long by 3 in. wide, and securely supported. The upper end of the glass should be from 1/8 to 1/4 in. higher than the lower end, and the glass should be level transversely. Beneath the lower end place any convenient receiver. The water and diatoms will pass into the receiver. The sand, which will form little bars on the glass, must be removed occasionally, as it gradually creeps towards the lower end of the glass, and there would eventually pass into the receiver.

The loss of diatoms will be very small. Usually one pouring is sufficient for cleaning. The sand can be re-washed if necessary, or a little clear water run over the sand on the glass strip will carry forward almost the last diatom; but this will scarcely pay for the trouble. A short piece of glass will cause a failure, and too great an incline will be found almost as bad.

Preparing Crystals of Salicine.—Dr. F. L. James a few years ago ‡ described a phenomenal class of crystals produced from salicine. The process is now stated § to depend on bringing a saturated solution of salicine made with distilled water in contact with cold below the

* The Microscope, ix. (1889) pp. 327-8.
† Journ. New York Micr. Soc., v. (1889) p. 116.
‡ See this Journal, 1887, p. 507. § Amer. Mon. Micr. Journ., x. (1889) p. 214.

freezing-point, and the explanation is, that the rapid congelation of the water interferes with the usual arrangement of the crystals, producing a wonderful series, which are entirely unlike any forms resulting from crystallization at the ordinary temperature.

(3) Cutting, including Imbedding and Microtomes.

Dextrin as an Imbedding Material for the Freezing Microtome.* —Mr. T. L. Webb says that by taking an aqueous solution of carbolic acid (1 in 40) and dissolving therein sufficient dextrin to make a thick syrup, a medium is obtained which is superior to the time-honoured gum and sugar in three ways. It freezes so hard as to give a firm support without being too hard. It keeps better than gum. It is much cheaper, costing only 4*d.* a pound, whilst powdered gum acacia costs 5*s.* Dextrin dissolves but slowly in cold water, so that a gentle heat is advisable when making the mucilage.

Imbedding in Celloidin.†—Dr. A. Florman recommends the following procedure for imbedding pieces of animal tissue in celloidin so as to obtain thin sections. After hardening the tissue in absolute alcohol, pieces about 3 mm. thick are placed for some hours in absolute alcohol, and after this in a test-tube containing a mixture of 3 parts ether and 1 part alcohol. In a couple of days some celloidin solution is added until the mixture is about as thick as a thin syrup. Herein the pieces remain for 14 days or longer, when more celloidin is poured in to make a thicker solution. After 4–8 days the contents of the test-tube are turned into a shallow glass capsule, wherein the celloidin solution must form a layer of 10–12 mm. thick over the preparation. The pieces having been arranged in the desired position, the capsule is covered with a glass plate, a cover-glass being interposed so as to allow of slow evaporation of the celloidin solvents. In 2 or 3 days' time a consistent mass free from air-bubbles is obtained, and from this the pieces are cut out so that each is surrounded by a layer of celloidin at least 3 cm. thick. When removed their under surface is to be daubed over with a thick solution of celloidin, so as to make all the surfaces of the same width. The pieces are replaced in the capsule to allow the new layer to become consolidated by evaporation of the ether and alcohol. Pieces thus prepared will have the consistence of cartilage, and sections from a block the sides of which are 1·5 cm. can be made 0·015 mm. thick, and if the area of the surface be decreased, still thinner.

Manipulation of Celloidin.‡—The failures that some microtomists experience when dealing with celloidin are due, says Dr. S. Apáthy, to the neglect of a few slight artifices. Commercial celloidin in plates or in shavings should be first of all thoroughly dried in the air, whereby it is rendered hard, transparent, and yellowish. Pieces of celloidin thus hardened are put into an air-tight vessel and just covered with a mixture of equal parts of sulphuric ether and absolute alcohol. After having been allowed to stand for some time with frequent stirring, the supernatant fluid is decanted off. This may be called the original or No. 1 solution. Some of this, diluted with an equal volume of equal

* The Microscope, ix. (1889) pp. 344–5, from the 'National Druggist.'
† Zeitschr. f. Wiss. Mikr., vi. (1889) pp. 184–6. ‡ T. c., pp. 164–70.

parts of ether and alcohol, forms solution 2, and some of solution 2 similarly treated forms solution 3. The preparation is placed for 24 hours or longer in each of these solutions successively. For consolidating the celloidin flat glass capsules are to be used. In these the objects are placed, and the capsules filled to the brim and covered over for some hours with a glass plate, in order that by preventing the surface from becoming hardened any air-bubbles may be allowed to escape. The glass plate is replaced in the course of some hours by a bell-jar, and in 6–24 hours, when a hardish film has formed upon the celloidin surface, the capsule is filled up with 75 per cent. spirit. In 24 hours the celloidin is fit for sectioning. From the glass capsule the pieces are cut out and stuck with a *thick* solution of celloidin on elder-pith. The celloidin block should be broader than high, and the under surface scratched with a needle. The elder-pith and celloidin are to be firmly pressed together, and then placed in 70 per cent. spirit.

For cutting sections from these blocks the knife should be smeared with yellow vaseline, and during the act of sectioning moved as nearly parallel as possible.

(4) Staining and Injecting.

Benzoazurin and Benzopurpurin Stains for Microscopical Purposes.*—Dr. Martin employs benzoazurin in watery dilute solution. The sections are overstained (1–4 hours, according to thickness of section or strength of solution). The sections are then decolorized with spirit acidulated with 1/2–1 per cent. hydrochloric acid. If a nuclear stain be desired, this effect may be counted on if the section be withdrawn when the celloidin is blanched. If the tissue elements are also to be dyed, then the decolorizing action must be interrupted earlier. A beautiful blue nuclear stain is thus obtained, and this is quite as distinct and sharp as that from carmine or logwood. This pigment seems, from the author's account, to be very useful for epithelial cells, where it brings out the nucleus and the contour of the cell, and also for most connective-tissue elements.

This dye seems to possess two valuable properties. The first is that old spirit-preparations are stainable with comparative ease; this is very difficult with other pigments, especially logwood, and the second is that preparations containing picric acid are little or not at all affected. Benzo-purpurin seems to be most suitable for double staining with hæmatoxylin or benzoazurin.

Hæmatoxylin Staining.†—Dr. S. Apáthy advises serial sections to be stained with a solution of 1 part hæmatoxylin crystals dissolved in 100 parts 70 per cent. spirit. They are then to be transferred to 70 per cent. spirit, to which a few drops of a 5 per cent. aqueous solution of bichromate of potash have been added. The hæmatoxylin solution is allowed to act for 10 minutes; the sections are then mopped up with blotting-paper and placed in the bichromate spirit in the dark for five to ten minutes, when they assume a bluish tinge, the celloidin remaining unstained. A double stain for differentiating the nervous and connective

* Deutsche Zeitschr. f. Thiermed. u. Vergleich. Pathol., xiv. (1889) pp. 420–2.
† Zeitschr. f. Wiss. Mikr., vi. (1889) pp. 170–1.

tissues of the Hirudinea is also given by the author. The object is placed for half an hour in a half per cent. watery solution of hæmatoxylin, then having been quickly washed in distilled water, it is transferred for two hours to a 1 per cent. aqueous solution of bichromate of potash. It is then again washed and imbedded in celloidin. The sections, which should show a pale yellowish staining, are after-stained in a weak aqueous alum-hæmatoxylin solution.

New Method of Hæmatoxylin Staining.*—Dr. N. Kultschitzky advocates the following procedure as being more simple than Weigert's method for staining nervous tissue. Pieces of brain or cord are hardened in Müller's or Erlitzki's fluid, and imbedded in celloidin. The sections are then placed in the following hæmatoxylin solution:—1 grm. of hæmatoxylin dissolved in a little alcohol is added to a mixture of 20 ccm. saturated watery solution of boracic acid and 20 ccm. distilled water. Before using this solution a little acetic acid is added (two or three drops to a watch-glassful). The sections require some few hours (to 24) for staining. The medullated nerve-fibres are stained blue, the rest of the tissue yellow, or yellowish-red. If the sections are then placed for twenty-four hours in a saturated watery solution of carbonate of soda or lithium the nerve-fibres become dark blue, while all the rest is almost uncoloured. Then alcohol, mount in balsam.

A still more simple hæmatoxylin solution, which gives the same results, is 100 ccm. of 2 per cent acetic acid, and 1 grm. of hæmatoxylin dissolved in a little alcohol.

Simplification of Weigert's Method.†—Dr. U. Rossi, who says that Weigert's method is unnecessarily complicated, recommends the following simplified procedure:—Pieces of spinal cord or brain are fixed at the ordinary temperature, or in a thermostat at 35°, in the following solution:—distilled water 100 ccm., chromic acid 0·75–1 gramme, acetate of copper 5 grammes. The time required for hardening the human cord is six to eight days; cord of dog, three to four days; for the entire brain of the dog fifteen to eighteen days, and so on according to the size of the pieces. In the thermostat the fixing process is completed in half the time required for doing the same thing at the ordinary temperature. The pieces are next transferred to rectified spirit 24 to 48 hours, and afterwards to absolute alcohol. When properly hardened they are imbedded in celloidin and sectioned. The sections are placed for staining in a vessel containing about 30 ccm. of rectified spirit, to which has been added 7 or 8 drops of a hæmatoxylin solution made as follows:—absolute alcohol 20 ccm., hæmatoxylin 1 gramme. In less than 2 or 3 hours the sections become dark, and they are then placed in some of the following solution:—absolute alcohol 100 ccm., hydrochloric acid 8 drops. Herein they assume a brick-red hue, and when the grey and white matters become differentiated they are removed to distilled water, wherein they quickly become blue. After this they are to be well washed again to remove all traces of acid, then dehydrated, cleared up, and mounted in balsam.

In addition to the foregoing stain, the author says a double stain

* Anat. Anzeig., iv. (1889) pp. 223–4.
† Zeitschr. f. Wiss. Mikr., vi. (1889) pp. 182–4.

with a weak solution of Grenacher's borax-carmine adds to the effect. The use of xylol is to be avoided, as the stains are thereby weakened.

Staining Animal Mucus with Anilin Dyes.*—Various mucoid secretions, such as saliva, synovia, &c., have been examined by Dr. Sussdorf in order to show that basic anilin dyes have a specific staining action, both on free mucus and while it is still in the secreting tissue.

As may be supposed, there seems to have been no difficulty in staining free mucus by the simple method of dropping the staining solution in the secretion, and then looking at it under the Microscope.

For showing the existence of mucus within the cells of tissues and organs, the author used sublingual, submaxillary, and parotid glands of the horse, and also the intestinal and tracheal mucosa of the horse and cat. These were well hardened in alcohol, osmic acid, and chrom-osmic acid. The sections were stained with methyl-violet, methylen-blue, or fuchsin in one per cent. solution for a few minutes only. They were then washed in alcohol or spirit acidulated with one per cent. hydrochloric acid until the dye was no longer given off. Some of the sections were also stained with borax-carmine. In the latter the nuclear and plasma-elements of the cells were stained by the carmine, while the mucinous parts were dyed by the anilin pigment. In the single-stained preparations the mucinous parts alone were coloured. Some more experiments on salivary glands by the method of double-staining seemed to the author to support Haidenhain's division of the salivary glands into serous and mucous.

Use of Colouring Matters for the Histological and Physiological Examination of Living Infusoria.†—M. A. Certes says that anilin black dissolved according to circumstances in sea or fresh water possesses striking advantages for the study of living organisms. After filtration the solution, though loaded with pigment, will keep quite a long time without forming a precipitate even on evaporation. The effect produced resembles that obtained by Nachet's dark-ground illumination method, with the special advantage that high powers and homogeneous-immersion objectives can be used.

Anilin-black is in no way toxic to Infusoria, for they will live therein and multiply for weeks together. The contractile vesicle and other anatomical details as observed by this method are particularly interesting.

Staining Actinomycosis bovis.‡—Dr. A. Florman states that he has made very successful preparations of Actinomyces by the following method which, though complicated, shows the club-shaped elements as well as the filaments. The sections used were 0·008 mm. thick. These were stained for 5 minutes in a solution of saturated alcoholic solution of methyl-violet 1 part, water 2 parts, aqueous (one per cent.) solution of carbonate of ammonia 2 parts. They were then washed for 10 minutes in water, and after this placed for 3 minutes in the iodine solution, iodine 1 part, iodide of potassium 2 parts, water 300 parts. After being carefully washed they were decolorized for 20 minutes in

* Deutsche Zeitschr. f. Thiermed. u. Vergleich. Pathol., xiv. (1889) pp. 345-59 (3 figs.).
† Bull. Soc. Zool. France, xiii. (1888) pp. 230-1.
‡ Zeitschr. f. Wiss. Mikr., vi. (1889) pp. 190-1.

fluorescin-alcohol (i. e. until no more dye was given off). The fluorescin was washed out in 95 per cent. alcohol. Then anilin oil for some minutes. The anilin oil was removed with oil of lavender, then xylol, and finally balsam.

Decoloration of Osmized Fat by Turpentine and other Substances.*—Dr. W. Flemming gives the results of experiments on fat stained with osmic acid, and afterwards acted on by various substances. Turpentine decolorizes in $1\frac{3}{4}$ hours, ether in 4 hours, xylol in $5\frac{1}{2}$ hours. Canada balsam dissolved in turpentine and thinned with xylol in $4\frac{1}{2}$ hours, dammar dissolved in turpentine and chloroform in 3 hours; balsam dissolved in xylol, no action observed; chloroform, no action; oil of cloves, no action.

Hence xylol is much to be preferred to turpentine. But chloroform and oil of cloves are obviously safer.

(5) Mounting, including Slides, Preservative Fluids, &c.

Manipulation of Paraffin-imbedded Sections.†—Prof. H. Strasser, who keeps on devising alterations in the technique of paraffin imbedding, describes a new procedure, the chief feature of which is the manipulation of the section on a "provisional" or temporary slide.

The provisional slide is thin well-sized paper, one side of which has been smeared with a gum solution containing 10 per cent. by volume of glycerin. The section is then stuck on with a solution of collodium simplex 2, castor oil 1—and then fixed down by brushing over the upper surface with collodium conc. dupl. 2–3, castor oil 2.

The preparation is then removed to turpentine to dissolve out the oil and the paraffin, and also set the collodion. The plate, i. e. the imbedded section plus the paper, is then placed in an aqueous or watery-spirituous fluid for staining or other purposes. During the water stage the gum is dissolved, and the section in its collodion case thereby set free. The next step is to put this into turpentine again, after which it may be mounted in a resinous medium on a temporary or permanent slide.

Owing to the fact that the paper, i. e. the provisional slide, which plays the principal part in this procedure, becomes dyed in its transit through the staining solutions, the method, as the author confesses, is at present somewhat imperfect.

New Method for Fixing Sections.‡—Dr. W. M. Gray who describes the following method, says that it is identical in its procedure with the "gum arabic process," provided the tissue from which the sections are cut has been successfully stained in mass. "The process is as follows. Dissolve one part of gold label gelatin in one hundred parts of warm distilled water; after the gelatin has dissolved, filter and add a crystal of thymol, to prevent the formation of fungi. If, on standing, the gelatin coagulates, warm slightly and use the fixative in the same manner as the gum arabic solution, or in other words, flow a small quantity on the perfectly clean slide, place the object on the fluid, and heat gently until the sections or series of sections are flat and free from

* Zeitschr. f. Wiss. Mikr., vi. (1889) pp. 178–81. † T. c., pp. 150–63.
‡ The Microscope, ix. (1889) pp. 325–6.

wrinkles, taking special care not to melt the paraffin surrounding the preparations. As they are perfectly flat, drain off the superabundant fluid, and stand the slide on end to dry. The best results are obtained if the slide is allowed to stand over-night to dry spontaneously. After the sections are dry, the whole is immersed in turpentine or other solvent to remove the paraffin, then into alcohol to remove the turpentine, thence into a two per cent. solution of potassium bichromate for five minutes, which renders the gelatin fixative *insoluble.* After washing the slide in water to free the section from bichromate) which, by the way, will not injure the most delicate tissue or interfere with any staining process) the section may be stained as desired. For sections stained in mass the soaking in bichromate is unnecessary, but if, after mounting, the stain should prove insufficient, the sections may be readily restained by removing the cover-glass, soaking off the balsam with a suitable solvent, transferring to alcohol and then rendering the fixative insoluble by soaking in bichromate before immersing in the stain. This process is especially valuable in staining tissues for bacteria, as it admits of extremely thin sections being placed on the slide free from wrinkles, and does not blister by prolonged soaking in aqueous solutions, as frequently happens in Schällibaum's clove-oil-collodion process, the method in general use for staining sections on the slide."

Use of Oil of Cloves.*—Mr. W. Hatchett Jackson points out that sections to which oil of cloves has been added and which have turned milky are not, as is often supposed, useless. If a small quantity of oil is poured on the sections and the whole gently warmed for a short time, the milkiness disappears. If it does not disappear at once the oil in the slide should be poured off, fresh oil added, and the heating repeated. The milkiness is due to a combination between the essential oil and a small residuum of water, and this is readily soluble by the aid of warmth in an excess of the essential oil. Repeated soaking in absolute alcohol effects the same end.

Cement for fixing down Glycerin Preparations.†—The cement recommended by Dr. S. Apáthy is said to be hard, without brittleness, and not to run under the cover-glass.

It is made of equal parts of hard paraffin, melting-point 60° C., and commercial Canada balsam. The mixture is heated in a porcelain dish until it assumes a gold yellow hue, and a resinous odour is no longer perceived. When cold the mixture forms a hard mass, which requires to be heated for use and to be laid on with a glass rod or brass spatula. The metal spatula is then heated and run round the edge to finish it off.

(6) Miscellaneous.

Detection of Blood-stains.‡—Dr. C. Charles remarks that, according to Linassier, the most sensitive spectroscopic reaction of blood is that given by reduced hæmatin.

The blood-stain is dissolved in water and examined for the spectrum

* Zool. Anzeig., xii. (1889) pp. 630–1.
† Zeitschr. f. Wiss. Mikr., vi. (1889) pp. 171–2.
‡ Amer. Mon. Micr. Journ., x. (1889) p. 236, from 'The Dosimetric Medical Review,' July 1889.

of oxyhæmoglobin. A drop of freshly prepared hyposulphite of soda is now added, when the spectrum of hæmoglobin appears at once; finally, a couple of drops of a concentrated solution of soda are added, which decomposes the hæmoglobin into globulin and reduced hæmatin, the spectrum of the latter consisting of two absorption-bands situated between D and *b*, the left one lying between D and E and being well marked; indeed, this intense band is the only one to be distinctly observed in dilute solutions, and it ought to disappear if the solution is heated to 50° C. without stirring, or agitation, and reappear on cooling; it ought further to disappear when shaken in the air, and reappear on the addition of a drop of hyposulphite of soda. This test applies even to putrid blood. Should the blood-stain have become insoluble in water, we are directed to dissolve in ammonia and reduce by adding one or two drops of a solution of ferrous sulphate and tartaric acid.

Jaksch's 'Clinical Diagnosis of Disease by Bacteriological, Chemical, and Microscopical Examination.'*—The fact that within two years Dr. R. von Jaksch's book on the diagnosis of disease has gone through two editions, and that translations into several languages are in preparation, shows that it supplies a want.

While this second edition is an improvement on the first, and is not a mere reprint thereof, yet there are several small points which are either errors of omission or commission. For example, there is no mention of Fraenkel and Netter's researches on the diagnosis and prognosis from a bacteriological examination of pleuritic fluid. On the other side, the Finkler-Prior bacillus seems to be regarded by the author as the bacillus of Cholera nostras.

These and similar deficiences apart, the work may be considered very useful, and fairly up to date.

Israel's 'Pathological Histology.'†—Dr. O. Israel's introduction to pathological histology seems to be biassed by his views on the staining of microscopical preparations, which he scornfully designates coloured mummies. In other respects the work does not seem to differ materially from the usual run of text-books on this subject, and it is well got up.

Insects in Drugs.‡—At a meeting of the Chemists' Assistants Association some rather disquieting specimens were lately exhibited, demonstrating the existence of "insects and germs" in sundry pharmaceutical preparations and drugs. The first was a fair-looking sample of crushed linseed recently obtained from a large wholesale firm, and kept in a wooden cask with a wooden cover. The exhibitor gravely asked what would be the effect of applying a poultice containing "thousands of insects" to an open wound, especially if the poultice be made with hot instead of boiling water. The other specimens, from aconite root, nux vomica, and cantharides, are perhaps of less importance, as these substances are not employed in the crude state. In the present anxiety to detect microscopic germs and to render them innocuous, it is worth considering whether we are not in danger of overlooking more obvious sources of infection. In the hunt for small deer a different lens is employed, and mental vision is thrown out of focus for larger game.

* 2nd ed. enlarged, Vienna and Leipzig, 1889, 8vo, 438 pp.

† Berlin (A. Hirschwald), 1889.

‡ Lancet, 1889 (ii.).

Brownian Movement.—The President of the New York Microscopical Society informed * the members at a recent meeting that the specimen of gamboge rubbed up in water which he had prepared on Aug. 3rd, 1874, and which had until recently showed very active movements, seemed at last to have ceased its activity, a leak having developed in the inclosing cell, and evaporation having ensued in consequence. He thought the subject of interest, as fourteen years was probably the longest period during which the phenomenon had been under observation.

We recently purchased a number of the 'Philosophical Magazine and Annals of Philosophy' for 1828, which contained (pp. 161–73) the original article of Robert Brown on the existence of active molecules in organic and inorganic bodies, and at the beginning of the article was inserted a MS. letter addressed to "Revd. Dr. Buckland, Christ Church, Oxford," and signed "J. H. C.," which, we understand from a relative of the late Dr. Buckland, to be the initials of the Rev. John Henry Conybeare, Anglo-Saxon Professor at Oxford, brother of the Dean of Llandaff.

Of Brown's views he writes as follows:—

"Touching Brown's theory that all matter consists of live mites, I don't believe a word on't. I don't wish to regard our own planet as rotten cheese any more than the moon as cream cheese. If you suspend particles of matter in a fluid for microscopical observation, a thousand circumstances, may generate motion, and to this I attribute his facts; if, however, they should be confirmed, I know nothing inconsistent with the received philosophical notions as to the intimate corpuscular structure of bodies in them. Biot, if I remember, in the optics of his Nat. Phil., has some curious speculations on the subject. He states it to be possible that solid bodies may be composed of systems of moving molecules, representing in small what the planetary systems do in large. I would only add one supposition more; that these molecules are inhabited, and have philosophers among their population who, having observed the motions of some half-dozen molecules in their neighbourhood and ascertained their laws, believe they have developed the system of the universe."

Method for Transmitting Microscopic Objects.†—Prof. G. O. Sars describes the following method for transmitting microscopic creatures from a distance:—

On March 14 a quantity of mud was gathered from a freshwater lake in the northern part of Australia. This was dried and sent to Christiania, where it was received on the 29th of October, in masses so hard and stony that they were broken with difficulty. The weather was so cold that the experiments were not begun until the last of May, the mud and its contents having been in a dried condition for more than a year. It was finally placed in an aquarium consisting of a large cylindrical glass vessel, where a great number of the various orders of the Entomostraca were hatched out from the "winter eggs" dormant in the gathering, and in many cases studied through several generations. The method is a suggestive one, and in the hands of others may be followed with as successful results.

* Journ. New York Micr. Soc., v. (1889) p. 46.

† Fordhandlinger i Videnskabs-Selskabet i Christiania, 1887. Cf. The Microscope, ix. (1889) p. 349.

Microscopical Examination of Paper.*—Mr. Herzberg, who has charge of the examinations of paper at Charlottenburg, has just published a very exhaustive work upon the subject, with numerous reproductions of microscopic preparations. He brings specially into prominence the peculiarities of certain fibres for rendering them easily distinguished.

The author uses a solution of iodine for recognizing the various fibres, which, according to their origin, assume various colours: (1) Wood-wool and jute are coloured yellow; (2) straw, "cellulose," and alfa do not change; (3) cotton, flax, and hemp are coloured brown.

For disintegrating the paper, Mr. Herzberg does not employ the processes in common use. Mechanical appliances, either needles or a mortar, do not remove the size, starch, and weighing substances which in part conceal the structure of the fibres and render the examination of them difficult. He recommends that a small quantity of the paper to be examined be submitted to ebullition for a quarter of an hour in a 1 to 2 per cent. solution of soda. In this way the foreign substances are got rid of and the fibres set free. The presence of wood-wool will be ascertained, during the boiling, by the paper becoming yellow.

After this treatment the whole is poured upon a brass strainer with fine meshes, and is washed with pure water. The washed residuum is reduced to a homogeneous paste in a porcelain mortar.

In the case of coloured paper the colouring matter must be removed if the boiling does not effect the removal. To this end, hydrochloric acid, chloride of lime, &c., is used according to the chemical nature of the colouring matter. When the paper is not sized, nothing but water is used for the boiling. If the presence of wool in the paper is suspected an alcoholic solution, instead of an alkaline one, is used, as the latter would dissolve the wool. The solution of iodine in iodide of potassium may be more or less concentrated. The colour produced varies in depth according to the concentration. The author generally uses the following formula:—Iodine, 18 grains; iodide of potassium, 30 grains; water, 5 drachms.

For spreading the paste upon the object-holder of the Microscope he employs two platinum needles. The object-holder is placed upon a white ground, so that the fibres will stand in relief more prominently. The paste is covered with a glass, and the excess of water is removed with blotting-paper. For the determination of the fibres a magnifying power of 300 diameters is best adapted, but for ascertaining the relative proportion of the fibres, one of 120 diameters, that permits of taking in a wider surface, is preferable.

* Amer. Mon. Micr. Journ., x. (1889) pp. 274–5, from 'Guttenberg Journal.'

PROCEEDINGS OF THE SOCIETY.

Meeting of 11th December, 1889, at King's College, Strand, W.C., the Rev. Dr. Dallinger, F.R.S., Vice-President, in the Chair.

The Minutes of the meeting of 13th November last were read and confirmed, and were signed by the Chairman.

The List of Donations (exclusive of exchanges and reprints) received since the last meeting was submitted, and the thanks of the Society given to the donors.

	From
Slides (24) of Botanical Sections	*Mr. H. P. Aylward.*
Slides (2) of Diatoms from Isle of Skye	*Mr. W. Godden.*

Mr. E. M. Nelson read a paper descriptive of a new "semi-apochromatic" objective which he exhibited (*supra*, p. 92).

The Chairman said they were much obliged to Mr. Nelson for his paper, which was a thoroughly practical one. The introduction of such lenses as the one described was a matter of some moment to our English makers, and made it somewhat necessary for them to look to their laurels, because it was not only in a matter of cheapness that they were called upon to compete, but in cheapness combined with perfection. In some of those objectives which he had lately had an opportunity of examining the cheapness had been combined with what certainly was a very close approximation to perfection. In the case of one objective by Herr Schott, and also of two by Leitz, they were found to be so good that the price was perfectly marvellous.

Mr. C. Rousselet exhibited a small tank for Rotifers, &c., with a lens attached, which could be readily moved about in such a way as to render an examination of the contents very easy, so that any desired specimens could be easily picked out. The collection which the tank contained also showed that Rotifers could be readily obtained in winter. The lens used was Zeiss's No. 6 "Steinheil" (*supra*, p. 90).

The Chairman called the attention of the Fellows to this exhibit, which he thought would prove very useful to those who were collectors of Rotifera and other so-called "microscopic" aquatic animals.

Mr. Crisp called the attention of the meeting to a number of stereoscopic photomicrographs of human embryos which were shown at their recent soirée by Prof. Fol. They were of great interest, and would repay careful examination. In addition to their value from an embryological point of view, they also afforded a conclusive answer to the question brought forward at the October meeting as to whether stereoscopic photomicrographs had been produced before that time. Mr. Crisp also showed Prof. Fol's large atlas of the human embryo.

Prof. Bell said that Prof. Fol was so well known as an embryologist that it was hardly needful to enlarge upon his work to a meeting of microscopists. There was obviously great difficulty in obtaining just the specimens wanted in the human subject, though in the case of animals they were procurable at the right time when wanted, and Prof. Fol's work in this direction was likely therefore to remain unique.

The Chairman said they were greatly indebted to Prof. Fol for having afforded them the opportunity of examining the collection of slides, which was from many points of view a most remarkable and interesting one. He was sorry that Prof. Fol when in England was not able to attend their meeting. Whilst they always acknowledged exhibits sent to them, he was sure the meeting would pass a special vote of thanks to Prof. Fol.

Mr. Crisp said that he much regretted that Prof. Fol's visit was made at a time when he was so absorbed in an important matter of business that he was entirely unable to see him. As soon as he was free he called at the Professor's hotel, but found he had left. He hoped that he had been successful in explaining to Prof. Fol how exceptional the circumstances were, so that he did not feel he had been slighted by the representatives of the Society.

Mr. Crisp said they had received notice of the formation of a Scottish Microscopical Society at Edinburgh, together with a copy of the rules and other papers. They were always glad to hear of an increase in the number of Microscopical Societies, both in the interest of science itself, and also because they generally acted indirectly as feeders to this Society (see this Journal, 1889, p. 830).

Mr. C. Haughton Gill's note on a new method of treating diatoms was read by Mr. Crisp. The note, he said, was only handed in at the conclusion of their last meeting, as otherwise it would have been read then, and would have added to the interest of the specimens exhibited by Mr. Gill at the Conversazione (see this Journal, 1889, p. 834).

Mr. Bennett said he examined the specimens with very great interest, and thought they seemed to show in a way never before demonstrated that the "markings" were really openings. He should be glad to hear whether others who were interested in the subject had also looked at them, and if so, what their impressions were.

Mr. Crisp said that the result of his examination appeared clearly to show that there were perforations in the cell-wall.

Mr. A. W. Bennett gave a *résumé* of the chief points of interest in his paper "On the Freshwater Algæ and Schizophyceæ of Hampshire and Devon" (*supra*, p. 1), which he said was in continuation of the series which he had from time to time brought before the Society. The species to which he more particularly directed attention were the result of collections made during his summer holiday in the New Forest and on Dartmoor, and he pointed out to those who might be disposed to take up this or similar studies that it was hardly possible to spend two or three weeks in examining them without coming across some which were not only interesting but also new to science.

The Chairman said the Society were greatly obliged to Mr. Bennett for his very interesting communication, which, like the others which he had made, was both practical and useful, showing that it was possible to do very good work during holidays.

Mr. Crisp reminded the Fellows that at the last meeting mention was made of a new objective with an aperture of 1·63, the price of which was said to be 400*l.* Some doubt was expressed at the time as to whether the account was not somewhat exaggerated, but since then Mr. Mayall had communicated with Jena, and they had received several communications, which enabled them to separate the truth from fiction. These communications were from Prof. Abbe, Dr. Czapski, and Dr. Van Heurck, in English, German, and French respectively, and were read to the meeting in abstract by Mr. Crisp.

A series of photomicrographs taken by Dr. Van Heurck with an objective of N.A. 1·63 with magnifying powers of 3000, 10,000 and 15,000 diameters was exhibited in illustration of the subject.

The Chairman said the meeting was greatly indebted to Mr. Crisp for the trouble he had taken to present to them in so clear a way what it must have been difficult for any one to render into English as he had done whilst reading. They were also very glad to see the photographs which were exhibited in connection with the matter. Those who had seen Dr. Zeiss's plates in his catalogue and had carefully studied the one of *P. angulatum*, would have noticed that there were six intercostal marks shown round each "cavity." In the photograph before them these were all exaggerated, but they were not materially altered in appearance, and were apparently as real as the cavities themselves. By some these appearances have been considered as entirely "ghostly," but if they were so, he could only say that in these photographs of Dr. Van Heurck it had been possible to make them look exceedingly material. The double layers had been seen very clearly before by some of their own observers, but he did not think they had been seen so well in a photograph; the detail of the intercostal markings was also remarkable. No. 4 of the series was marked as being "focused on the hexagons," which he supposed to mean focused so as to get that appearance.

Mr. T. F. Smith said it seemed to him that one material point in the description had been left out, and that was the aperture of the substage condenser, because the truthful nature of what was seen was dependent upon that.

Mr. Crisp referred to the description, and said it was mentioned that the aperture of the condenser was 1·60 N.A.

Mr. Smith asked if it stated whether the condenser was stopped down in any way?

Mr. Crisp said the illumination used was stated to be monochromatic sunlight, "moderately oblique" with *Amphipleura*, and "strictly axial" with *Pleurosigma*.

Mr. Smith thought that if it was oblique it was calculated to give a false image.

Mr. Karop pointed out that if only central light was used it was not necessary that the whole of the series of media from objective to condenser should be homogeneous, but if oblique light was used then it was essential.

Mr. Nelson said he thought there was no doubt that these photographs were taken with oblique light, because they showed the longitudinal striæ thrown out into space. In his own observations he had thought he could see some sign that the longitudinal striæ were beginning to be resolved, but he had searched for the spectra in vain. He supposed that with the new objective they might be able to see the beginning of the blue. He thought it was quite safe to say that the pictures had been taken with a narrow pencil of light, and if so they did not offer a fair test of what the objective was able to do, because it was very well known that with a small pencil like that they could make the appearance anything they pleased.

The Chairman said he thought he should express the feeling of all who were present in saying that they were extremely glad to have had the opportunity of hearing these descriptions and of seeing the photographs to which they related, and that their hearty thanks were due to those who had enabled them so to profit.

The following Instruments, Objects, &c., were exhibited:—

Mr. H. P. Aylward:—Series of Botanical Sections.

Prof. Fol:—Stereo-photomicrographs of Human Embryos.

Mr. W. Godden:—Slides of Diatoms from the Isle of Skye.

Mr. E. M. Nelson:—Semi-apochromatic Objective in illustration of his paper.

Mr. Rousselet:—Tank for Rotifers, &c., with lens attached.

New Fellows:—The following were elected *Ordinary* Fellows:—Messrs. Walter H. Collins, F.C.S.; Frank Conway; Samuel Gasking, B.A.; W. K. Higley, Ph.D.; G. C. Huber, M.D.; Abraham Leigh, M.D.; and Mark L. Sykes.

MEETING OF 8TH JANUARY, 1890, AT KING'S COLLEGE, STRAND, W.C.; THE REV. DR. DALLINGER, F.R.S. (VICE-PRESIDENT), IN THE CHAIR.

The Minutes of the meeting of 11th December last were read and confirmed, and were signed by the Chairman.

The List of Donations (exclusive of exchanges and reprints) received since the last meeting was submitted, and the thanks of the Society given to the donors.

	From
52 Photomicrographic Slides	*Mr. T. F. Smith.*
MS. Catalogue of Mr. Redmayne's Collection of Diatoms	*Mr. Burgess.*

Mr. Crisp having read the Bye-laws relating to the nomination of Officers and Council for the ensuing year, read the list of names nominated by the Council in accordance therewith. He also pointed out that as on their removal to Hanover Square they would be unable to meet on the second Wednesday of the month as heretofore, several of the bye-laws would require to be altered to suit the circumstances, and he therefore gave notice that at the Annual Meeting, to be held on 12th February next, the necessary alterations will be made. It would also be necessary, at the same time, to move the suspension of Bye-law 36, in order to admit of the re-election of Dr. Hudson as President of the Society for a third year.

Mr. J. D. Hardy having been proposed as an Auditor of the Treasurer's accounts by Mr. Dadswell, and seconded by Mr. T. Charters White; and Mr. Suffolk having been proposed by Mr. Reeves, and seconded by Mr. Ward; their names were put to the meeting by the Chairman, who declared them to be duly elected Auditors.

Mr. T. F. Smith exhibited, by means of a lime-light lantern, a series of photomicrographs of various diatoms, taken with Zeiss's apochromatic objectives and projection eye-pieces, giving powers of 1000 to 7500 diameters. At the conclusion of the exhibition, Mr. Smith presented the series of 52 slides to the Society for future use and reference.

The Chairman, in inviting remarks upon the subject, said that for his own part he was convinced that a great deal of hard work was represented by what had been put before them that evening, but he thought nevertheless that he would be wisest who refrained from coming at present to any settled conclusion on the matter, because it seemed obvious that there remained still a very great deal to be learnt. Such work, however, as that which Mr. Smith had been doing, would no doubt lead to results which would be very helpful and instructive if rightly utilized. The subject was one of great interest, but also one in which continual progress was being made, as it was in fact evident that since Mr. Smith had been at work there had been some distinct advances.

Mr. E. M. Nelson said he did not propose to say anything then about the structure of the diatoms before them, because that had been admirably explained by Mr. Smith, so far as it was to be shown by the photographs which had been exhibited; in fact, he might say that Mr. Smith had originated this kind of *Pleurosigma* structure. He had seen not only the photographs, but also the specimens from which they had been taken, and could fully bear out all that had been stated. He thoroughly believed that if anything was to be done further in this direction it must be done with large-angled cones of light and central illumination, and that oblique light for this purpose must for ever be dismissed. With regard to the intercostal points, he believed that they were entirely illusory, because they could be formed equally well in any of the larger kinds if the light was arranged so as to produce them.

Mr. Crisp said that when it was stated work of this kind should be done, not with oblique light, but with a large cone of central light, the fact was apparently overlooked that in every so-called cone of "central light" there was a large proportion of oblique light.

Mr. Crisp also remarked that Mr. Smith, in pointing to the photographs, had said that "anyone could see that the markings were perforations, and not beads." It was, however, quite impossible for anyone to distinguish between the two, by mere inspection, so readily as Mr. Smith seemed to think was possible.

Mr. Smith said he would correct that statement at once, by saying that looking at the edge of a fracture anyone could see this; he quite believed that by looking down upon the structure one could not tell which they were.

The President said they were greatly indebted to Mr. Smith for the trouble he had taken to bring this matter before them. From his own point of view it was only by the continuous prosecution of the inquiry in this and in other ways, without any attempt at explanation, that gave promise of success, and if such demonstrations were steadily continued for some time longer they might reasonably hope for a solution. They had also to thank Mr. Smith for having given to them, in a permanent form, these records of what he had up to the present time accomplished.

Mr. T. Charters White called attention to two slides which he exhibited. One of these he had called *Echinorhyncus*, but since coming to the meeting he had referred to some authorities and had reason to think that this name was inappropriate. The object was an entozoon found in the large cockroaches which infested the sugar ships; they were quite different from the ordinary kind, and were, he believed, known as *Blatta germanica*. In dissecting some of these he found a number of white particles which looked like eggs, each of which contained an embryo. He found altogether about 14, and having mounted them he had brought them for exhibition, and should be glad if anyone would tell him what they were. The other slide contained a quantity of bacilli from a urinary deposit. It was thought that the patient from whom they were obtained was suffering from hæmaturia, and the urine was therefore carefully examined; it was found to contain albumen, but no casts from the kidney could be seen. He took some of the deposited matter, and having stained it, found it to contain bacilli in enormous numbers, as would be seen in the specimen exhibited. He thought it might be of some interest, as bearing upon the subject brought up at the last meeting by Mr. Hall.

Prof. Bell thought that the objects first mentioned by Mr. White were the cystic stage of some species of tape-worm.

Mr. Michael believed that the cockroach described by Mr. White could hardly be *Blatta germanica*, which was a small, rather than a large species, and was common in houses. It was said to be much less offensive than the ordinary species, and it was also said that, though common, the two sorts were not found in the same houses.

Dr. R. L. Maddox's Note on a small Glass-rod Illuminator was read, the note being accompanied by six photographic negatives in illustration (*supra*, p. 101).

The following Instruments, Objects, &c. were exhibited :—

Dr. Maddox :—Photomicrographs of Diatoms.

Mr. E. F. Smith :—Photomicrographic Slides of Diatoms.

Mr. T. Charters White :—(1) Cystic stage of Tape-worm ; (2) Bacilli from a Urinary deposit.

New Fellows :—The following were elected *Ordinary* Fellows:— Messrs. G. R. Beardmore, L.R.C.P. ; Alfred Cornell ; Edward Crawshaw ; H. Emery, M.A. ; John W. Washbourn, M.D. ; Edwin Webster ; and *Honorary Fellow*, Mr. John Ralfs.

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JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY;

CONTAINING ITS TRANSACTIONS AND PROCEEDINGS,

AND A SUMMARY OF CURRENT RESEARCHES RELATING TO

ZOOLOGY AND BOTANY

(principally Invertebrata and Cryptogamia),

MICROSCOPY, &c.

Edited by

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WITH THE ASSISTANCE OF THE PUBLICATION COMMITTEE AND

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FELLOWS OF THE SOCIETY.

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CONTENTS.

SUMMARY OF CURRENT RESEARCHES.

ZOOLOGY.

A. VERTEBRATA:—Embryology, Histology, and General.

α. Embryology.

β. Histology.

γ. General.

B. INVERTEBRATA.

Mollusca.

α. Cephalopoda.

γ. Pteropoda.

γ. Gastropoda.

δ. Lamellibranchiata.

Molluscoida.

β. Bryozoa.

Arthropoda.

α. Insecta.

β. Myriopoda.

γ. Prototracheata.

δ. Arachnida.

Vermes.

α. Annelida.

β. Nemathelminthes.

γ. Platyhelminthes.

δ. Incertæ Sedis.

Echinodermata.

Cœlenterata.

Porifera.

Protozoa.

BOTANY.

A. GENERAL, including the Anatomy and Physiology of the Phanerogamia.

a. Anatomy.

(1) Cell-structure and Protoplasm.

(2) Other Cell-contents (including Secretions).

(3) Structure of Tissues.

(4) Structure of Organs.

β. Physiology.

(1) Reproduction and Germination.

(2) Nutrition and Growth (including Movements of Fluids).

(4) Chemical Changes (including Respiration and Fermentation).

γ. General.

B. CRYPTOGAMIA.

Cryptogamia Vascularia.

Muscineæ.

Characeæ.

Algæ.

Fungi.

Protophyta.

α. Schizophyceæ.

β. Schizomycetes.

MICROSCOPY.

α. Instruments, Accessories, &c.

(1) Stands.

(4) Photomicrography.

(5) Microscopical Optics and Manipulation.

(6) Miscellaneous.

β. Technique.

(1) Collecting Objects, including Culture Processes.

(2) Preparing Objects.

(3) Cutting, including Imbedding and Microtomes.

(4) Staining and Injecting.

(5) Mounting, including Slides, Preservative Fluids, &c.

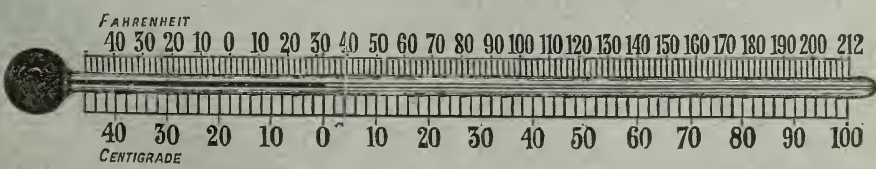
(6) Miscellaneous.

APERTURE TABLE.

Numerical Aperture. ($n \sin u = a$.)	Corresponding Angle ($2u$) for			Limit of Resolving Power, in Lines to an Inch.			Illuminating Power. (a^2.)	Penetrating Power. $\left(\frac{1}{a}\right)$
	Air ($n = 1\cdot00$).	*Water* ($n = 1\cdot33$).	*Homogeneous Immersion* ($n = 1\cdot52$).	White Light. ($\lambda = 0\cdot5269\ \mu$, Line E.)	Monochromatic (Blue) Light. ($\lambda = 0\cdot4861\ \mu$, Line F.)	Photography. ($\lambda = 0\cdot4000\ \mu$, near Line *h*.)		
1·52	..	..	180° 0′	146,543	158,845	193,037	2·310	·658
1·51	..	..	166° 51′	145,579	157,800	191,767	2·280	·662
1·50	..	..	161° 23′	144,615	156,755	190,497	2·250	·667
1·49	..	..	157° 12′	143,651	155,710	189,227	2·220	·671
1·48	..	..	153° 39′	142,687	154,665	187,957	2·190	·676
1·47	..	..	150° 32′	141,723	153,620	186,687	2·161	·680
1·46	..	..	147° 42′	140,759	152,575	185,417	2·132	·685
1·45	..	..	145° 6′	139,795	151,530	184,147	2·103	·690
1·44	..	..	142° 39′	138,830	150,485	182,877	2·074	·694
1·43	..	..	140° 22′	137,866	149,440	181,607	2·045	·699
1·42	..	..	138° 12′	136,902	148,395	180,337	2·016	·704
1·41	..	..	136° 8′	135,938	147,350	179,067	1·988	·709
1·40	..	..	134° 10′	134,974	146,305	177,797	1·960	·714
1·39	..	..	132° 16′	134,010	145,260	176,527	1·932	·719
1·38	..	..	130° 26′	133,046	144,215	175,257	1·904	·725
1·37	..	..	128° 40′	132,082	143,170	173,987	1·877	·729
1·36	..	..	126° 58′	131,118	142,125	172,717	1·850	·735
1·35	..	..	125° 18′	130,154	141,080	171,447	1·823	·741
1·34	..	..	123° 40′	129,189	140,035	170,177	1·796	·746
1·33	..	180° 0′	122° 6′	128,225	138,989	168,907	1·769	·752
1·32	..	165° 56′	120° 33′	127,261	137,944	167,637	1·742	·758
1·30	..	155° 38′	117° 35′	125,333	135,854	165,097	1·690	·769
1·28	..	148° 42′	114° 44′	123,405	133,764	162,557	1·638	·781
1·26	..	142° 39′	111° 59′	121,477	131,674	160,017	1·588	·794
1·24	..	137° 36′	109° 20′	119,548	129,584	157,477	1·538	·806
1·22	..	133° 4′	106° 45′	117,620	127,494	154,937	1·488	·820
1·20	..	128° 55′	104° 15′	115,692	125,404	152,397	1·440	·833
1·18	..	125° 3′	101° 50′	113,764	123,314	149,857	1·392	·847
1·16	..	121° 26′	99° 29′	111,835	121,224	147,317	1·346	·862
1·14	..	118° 0′	97° 11′	109,907	119,134	144,777	1·300	·877
1·12	..	114° 44′	94° 55′	107,979	117,044	142,237	1·254	·893
1·10	..	111° 36′	92° 43′	106,051	114,954	139,698	1·210	·909
1·08	..	108° 36′	90° 34′	104,123	112,864	137,158	1·166	·926
1·06	..	105° 42′	88° 27′	102,195	110,774	134,618	1·124	·943
1·04	..	102° 53′	86° 21′	100,266	108,684	132,078	1·082	·962
1·02	..	100° 10′	84° 18′	98,338	106,593	129,538	1·040	·980
1·00	180° 0′	97° 31′	82° 17′	96,410	104,503	126,998	1·000	1·000
0·98	157° 2′	94° 56′	80° 17′	94,482	102,413	124,458	·960	1·020
0·96	147° 29′	92° 24′	78° 20′	92,554	100,323	121,918	·922	1·042
0·94	140° 6′	89° 56′	76° 24′	90,625	98,233	119,378	·884	1·064
0·92	133° 51′	87° 32′	74° 30′	88,697	96,143	116,838	·846	1·087
0·90	128° 19′	85° 10′	72° 36′	86,769	94,053	114,298	·810	1·111
0·88	123° 17′	82° 51′	70° 44′	84,841	91,963	111,758	·774	1·136
0·86	118° 38′	80° 34′	68° 54′	82,913	89,873	109,218	·740	1·163
0·84	114° 17′	78° 20′	67° 6′	80,984	87,783	106,678	·706	1·190
0·82	110° 10′	76° 8′	65° 18′	79,056	85,693	104,138	·672	1·220
0·80	106° 16′	73° 58′	63° 31′	77,128	83,603	101,598	·640	1·250
0·78	102° 31′	71° 49′	61° 45′	75,200	81,513	99,058	·608	1·282
0·76	98° 56′	69° 42′	60° 0′	73,272	79,423	96,518	·578	1·316
0·74	95° 28′	67° 37′	58° 16′	71,343	77,333	93,979	·548	1·351
0·72	92° 6′	65° 32′	56° 32′	69,415	75,242	91,439	·518	1·389
0·70	88° 51′	63° 31′	54° 50′	67,487	73,152	88,899	·490	1·429
0·68	85° 41′	61° 30′	53° 9′	65,559	71,062	86,359	·462	1·471
0·66	82° 36′	59° 30′	51° 28′	63,631	68,972	83,819	·436	1·515
0·64	79° 36′	57° 31′	49° 48′	61,702	66,882	81,279	·410	1·562
0·62	76° 38′	55° 34′	48° 9′	59,774	64,792	78,739	·384	1·613
0·60	73° 44′	53° 38′	46° 30′	57,846	62,702	76,199	·360	1·667
0·58	70° 54′	51° 42′	44° 51′	55,918	60,612	73,659	·336	1·724
0·56	68° 6′	49° 48′	43° 14′	53,990	58,522	71,119	·314	1·786
0·54	65° 22′	47° 54′	41° 37′	52,061	56,432	68,579	·292	1·852
0·52	62° 40′	46° 2′	40° 0′	50,133	54,342	66,039	·270	1·923
0·50	60° 0′	44° 10′	38° 24′	48,205	52,252	63,499	·250	2·000
0·45	53° 30′	39° 33′	34° 27′	43,385	47,026	57,149	·203	2·222
0·40	47° 9′	35° 0′	30° 31′	38,564	41,801	50,799	·160	2·500
0·35	40° 58′	30° 30′	26° 38′	33,744	36,576	44,449	·123	2·857
0·30	34° 56′	26° 4′	22° 46′	28,923	31,351	38,099	·090	3·333
0·25	28° 58′	21° 40′	18° 56′	24,103	26,126	31,749	·063	4·000
0·20	23° 4′	17° 18′	15° 7′	19,282	20,901	25,400	·040	5·000
0·15	17° 14′	12° 58′	11° 19′	14,462	15,676	19,050	·023	6·667
0·10	11° 29′	8° 38′	7° 34′	9,641	10,450	12,700	·010	10·000
0·05	5° 44′	4° 18′	3° 46′	4,821	5,225	6,350	·003	20·000

COMPARISON OF THE FAHRENHEIT AND CENTIGRADE THERMOMETERS.

Fahr.	Centigr.	Fahr.	Centigr.	Fahr.	Centigr.	Fahr.	Centigr.	Fahr.	Centigr.
°	°	°	°	°	°	°	°	°	°
212	100	158	70	104	40	50	10	- 4	- 20
210·2	99	156·2	69	102·2	39	48·2	9	- 5·8	- 21
210	98·89	156	68·89	102	38·89	48	8·89	- 6	- 21·11
208·4	98	154·4	68	100·4	38	46·4	8	- 7·6	- 22
208	97·78	154	67·78	100	37·78	46	7·78	- 8	- 22·22
206·6	97	152·6	67	98·6	37	44·6	7	- 9·4	- 23
206	96·67	152	66·67	98	36·67	44	6·67	- 10	- 23·33
204·8	96	150·8	66	96·8	36	42·8	6	- 11·2	- 24
204	95·56	150	65·56	96	35·56	42	5·56	- 12	- 24·44
203	95	149	65	95	35	41	5	- 13	- 25
202	94·44	148	64·44	94	34·44	40	4·44	- 14	- 25·56
201·2	94	147·2	64	93·2	34	39·2	4	- 14·8	- 26
200	93·33	146	63·33	92	33·33	38	3·33	- 16	- 26·67
199·4	93	145·4	63	91·4	33	37·4	3	- 16·6	- 27
198	92·22	144	62·22	90	32·22	36	2·22	- 18	- 27·78
197·6	92	143·6	62	89·6	32	35·6	2	- 18·4	- 28
196	91·11	142	61·11	88	31·11	34	1·11	- 20	- 28·89
195·8	91	141·8	61	87·8	31	33·8	1	- 20·2	- 29
194	90	140	60	86	30	32	0	- 22	- 30
192·2	89	138·2	59	84·2	29	30·2	- 1	- 23·8	- 31
192	88·89	138	58·89	84	28·89	30	- 1·11	- 24	- 31·11
190·4	88	136·4	58	82·4	28	28·4	- 2	- 25·6	- 32
190	87·78	136	57·78	82	27·78	28	- 2·22	- 26	- 32·22
188·6	87	134·6	57	80·6	27	26·6	- 3	- 27·4	- 33
188	86·67	134	56·67	80	26·67	26	- 3·33	- 28	- 33·33
186·8	86	132·8	56	78·8	26	24·8	- 4	- 29·2	- 34
186	85·56	132	55·56	78	25·56	24	- 4·44	- 30	- 34·44
185	85	131	55	77	25	23	- 5	- 31	- 35
184	84·44	130	54·44	76	24·44	22	- 5·56	- 32	- 35·56
183·2	84	129·2	54	75·2	24	21·2	- 6	- 32·8	- 36
182	83·33	128	53·33	74	23·33	20	- 6·67	- 34	- 36·67
181·4	83	127·4	53	73·4	23	19·4	- 7	- 34·6	- 37
180	82·22	126	52·22	72	22·22	18	- 7·78	- 36	- 37·78
179·6	82	125·6	52	71·6	22	17·6	- 8	- 36·4	- 38
178	81·11	124	51·11	70	21·11	16	- 8·89	- 38	- 38·89
177·8	81	123·8	51	69·8	21	15·8	- 9	- 38·2	- 39
176	80	122	50	68·2	20	14	- 10	- 40	- 40
174·2	79	120·2	49	66	19	12·2	- 11	- 41·80	- 41
174	78·89	120	48·89	66·4	18·89	12	- 11·11	- 42	- 41·11
172·4	78	118·4	48	64	18	10·4	- 12	- 43·60	- 42
172	77·78	118	47·78	64·6	17·78	10	- 12·22	- 44	- 42·22
170·6	77	116·6	47	62	17	8·6	- 13	- 45·40	- 43
170	76·67	116	46·67	62·8	16·67	8	- 13·33	- 46	- 43·33
168·8	76	114·8	46	60	16	6·8	- 14	- 47·20	- 44
168	75·56	114	45·56	60	15·56	6	- 14·44	- 48	- 44·44
167	75	113	45	59	15	5	- 15	- 49	- 45
166	74·44	112	44·44	58	14·44	4	- 15·56	- 50	- 45·56
165·2	74	111·2	44	57·2	14	3·2	- 16	- 50·80	- 46
164	73·33	110	43·33	56	13·33	2	- 16·67	- 52	- 46·67
163·4	73	109·4	43	55·4	13	1·4	- 17	- 52·60	- 47
162	72·22	108	42·22	54	12·22	0	- 17·78	- 54	- 47·78
161·6	72	107·6	42	53·6	12	- 0·4	- 18	- 54·40	- 48
160	71·11	106	41·11	52	11·11	- 2	- 18·89	- 56	- 48·89
159·8	71	105·8	41	51·8	11	- 2·2	- 19	- 56·20	- 49
								- 58	- 50



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102	3 inches	12	2	10	0					
103	2 inches	10	1	10	0	22	36	67	90	112
104	2 inches	17	2	10	0					
105	$1\frac{1}{2}$ inch	23	2	10	0	30	48	90	120	150
106	$\frac{2}{3}$ inch	25	2	0	0	70	112	210	280	350
107	$\frac{2}{3}$ inch	32	2	10	0					
108	$\frac{1}{2}$ inch	45	2	10	0	100	160	300	400	500
109	$\frac{4}{10}$ inch	65	4	0	0	125	200	375	500	625
110	$\frac{4}{10}$ inch	95	5	0	0	150	240	450	600	750
111	$\frac{1}{4}$ inch	75	3	10	0	200	320	600	800	1000
112	$\frac{1}{5}$ inch	120	4	10	0	250	400	750	1000	1250
113	$\frac{1}{8}$ inch	130	5	0	0	400	640	1200	1600	2000
114	$\frac{1}{10}$ imm.	180	5	5	0	500	800	1500	2000	2500
115	$\frac{1}{15}$ imm.	180	8	0	0	750	1200	2250	3000	3750
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152	1 inch	18	1	5	0	46	61	106
153	$\frac{1}{2}$ inch	38	1	5	0	90	116	205
154	$\frac{1}{4}$ inch	80	1	5	0	170	220	415
155	$\frac{1}{6}$ inch	110	2	5	0	250	330	630
156	$\frac{1}{8}$ inch	110	3	10	0	350	450	800
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JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

APRIL 1890.

TRANSACTIONS OF THE SOCIETY.

III.—*The President's Address on some Needless Difficulties in the Study of Natural History.*

By C. T. Hudson, LL.D., F.R.S.

(*Annual Meeting*, 12*th February*, 1890.)

A little while ago I read in a preface to a work on natural history that the book was "of little value to the scientific reader, but that its various anecdotes, and its minute detail of observation, would be found useful and entertaining."

What then may the "Scientific Reader" be expected to desire? He must be, in my opinion, a most unreasonable man, if he does not thankfully welcome anecdotes of the creatures he wishes to study, when those anecdotes are the result of patient and accurate observation. For it is precisely such information that is conspicuously absent from many scientific memoirs and monographs, the author generally spending his main space and strength in examining the shape and structure of his animals, and in comparing one with another, but giving the most meagre details of their lives and habits.

Which, then, is the more scientific treatment of a group of animals—that which catalogues, classifies, measures, weighs, counts, and dissects, or that which simply observes and relates? Or, to put it in another way, which is the better thing to do, to treat the animal as a dead specimen, or as a living one?

Merely to state the question is to answer it. It is the living animal that is so intensely interesting, and the main use of the indexing, classifying, measuring, and counting is to enable us to recognize it when alive, and to help us to understand its perplexing actions.

But it may be objected, that because the study of the living animal is the more interesting, it is not necessarily the more scientific; indeed, that the amount of entertainment which we may get out of the pursuit of natural history has nothing to do with the question at all; that by science we mean accurate knowledge presented in the most suitable form; that shape, structure, number, weight, comparison, are the fundamental notions with which sciences of every kind have to deal; and that scientific natural history is more properly that which takes cognizance of a creature's size, form, bodily organs, and relations to other creatures, than that which concerns itself with the animal's disposition and habits.

I can fancy that I already hear some of my audience say, "But why set up any antagonism between these two ways of studying a creature? Both are necessary to its thorough comprehension, and our text-books should contain information of both kinds; we should be told how an animal is made, where it ought to be placed among others of the same group, and also how it lives, and what are its ways."

Precisely; that is just what memoirs and text-books ought to do, but what too often they do *not*. We read much of the animal's organs; we see plates showing that its bristles have been counted, and its muscular fibres traced to the last thread; we have the structure of its tissues analysed to their very elements; we have long discussions on its title to rank with this group or that, and sometimes even disquisitions on the probable form and habits of some extremely remote, but quite hypothetical ancestor—some "archi-rotator,"—to take an instance from my own subject—who is made to degrade in this way, or to advance in that, or who is credited with one organ, or deprived of another, just as the ever-varying necessities of a desperate hypothesis require; but of the living creature itself, of the way it lives, of the craft with which it secures its prey or outwits its enemies, of the home that it constructs, of its charming confidence or its diabolical temper, of its curious courtship, its droll tricks, its games of play, its fun and spite, of its perplexing stupidity, coupled with actions of almost human sagacity, of all this—this, which is the real natural history of the animal, we too often hear little or nothing. And the reason is obvious, for in many cases the writer has no such information to give; and even when he has, he is compelled by fashion to give so much space to that which is considered to be the more scientific portion of his subject, that he has scant room for the more interesting. Neither ought we to be surprised, if a writer is "gravelled for the lack of matter" when he comes to speak of an animal's life; for the study of the lives of a large majority is a difficult one. It requires not only abundant leisure, but superabundant patience, a residence favourably situated for the pursuit, and an equally favourable condition of things at home. The student, too, must be ready to adopt the inconvenient hours of the creatures that he watches, and be indifferent to the criticisms of those that watch *him*. If his enthusiasm will not carry him, without concern, through dark nights, early mornings, vile weather, fatiguing distances, and caustic chaff, the root of the matter is not in him. Besides, he ought to have a natural aptitude for the pursuit, and know how to look for what he wants to see; or, if he does not know, to be able to make a shrewd guess; and above all, when circumstances are not favourable, to have wit enough to invent some means of making them so. And yet when the place, the man, the animals, and the circumstances, all seem to promise a rich harvest of observations, how often it happens that some luckless accident, a snapped twig, a lost glass, a hovering kestrel, a sudden gust of wind, a roving dog, or a summer shower robs the unlucky naturalist of his due; nay, it sometimes happens that, startled by some rare sight, or lost in admiration of it, he himself lets the happy moment slip, and is obliged to be contented with a sketch from memory, when he might have had one from life.

But I have not yet got to the bottom of my budget; the heaviest trouble still remains, and that is, that the result of a day's watching will often go into a few lines, or even into a few words; and so it happens that the writer of the history, of a natural group of animals, is too frequently driven to fill up his space with minute analyses of structure, discussions on classification, disputes on the use of obscure organs, or descriptions of trifling varieties, which, exalted to the rank of species, fill his pages with wearisome repetitions: for were he, before he writes his book, to endeavour to make himself acquainted with the habits of all the creatures he describes, his own lifetime might be spent in the pursuit.

We will now take a different case, and suppose that many years have been spent in the constant and successful study of the animals themselves; and that the time has come when the naturalist may write his book, with the hope of treating, with due consideration, the most interesting portion of his subject. He is now beset with a new class of difficulties, and finds that publishers and scientific fashion alike combine to drive him into the old groove: for the former limit his space by naturally demurring to a constantly increasing number of plates, and an ever-lengthening text; while the latter insists so strongly on having a complete record of the structure and points of difference of every species, however insignificant, that it is hardly possible to do much more than give that record—a mere dry shuck, emptied of nearly all that makes natural history delightful.

And so we come round again to the point that I have already glanced at, viz. "Ought natural history to be delightful?"

Ought it to be delightful! Say, rather, ought it to exist? What title has the greater part of natural history to any existence, but that it charms us? It is true that this study may help—does help many—to worthier conceptions of the unseen, to loftier hopes, to higher praise; that it gives us broader and sounder notions of the possible relation of animals, not only to one another, but also to ourselves; that it provides us with the material for fascinating speculations on the embryology of our passions and mental powers; and that it may even serve to suggest theories of the commencement and end of things, of matter, of life, of mind, and of consciousness—grave questions, scarcely to be dealt with successfully by human faculties, but in a condition to be discussed with infinite relish.

When I speak, then, of the pleasure we derive from the study of natural history, I include these graver and higher pleasures in the word.

Here and there, too, no doubt, the knowledge of the powers and habits of animals is materially useful to us; and, indeed, in the case of some of the minuter organisms may be of terrible importance; but in that of the large majority of creatures we might go out of the world unconscious of their existence (as indeed very many people do), and yet, unlike the little jackdaw, not be "a penny the worse." For what is a man the better for studying butterflies, unless he is delighted with their beauty, their structure, and their transformations? Why should he learn anything about wasps and ants, unless their ways give him a thrill of pleasure? What can the living plumes of the rock zoophytes do for us, but witch our eyes with their loveliness, or entrance us with the sight of their tiny fleets of medusa-buds, watery ghostlets, flitting away laden with the fate of future generations?

When, at dusk, we steal into the woods to hear the nightingale or watch the nightjar, what more do we hope for than to delight our ears with the notes of the one, or our eyes with the flight of the other? When the Microscope dazzles us with the sight of a world whose inhabitants and their doings surpass the wildest flights of nightmare or fairy tale, do we speculate on what possible service this strange creation may render us? Do we give a thought to the ponderous polysyllables that these mites bear in our upper world, or to their formal marshalling into ranks and companies which are ever being pulled to pieces, to be again rearranged? No! it is the living creature itself which chains us to the magic tube. For there we see that the dream of worlds peopled with unimagined forms of life, with entient beings whose ways are a mystery, and whose thoughts we cannot even guess at, is a reality that lies at our very feet; that the air we breathe, the dust that plagues our nostrils, the water we fear to drink, teem with forms more amazing than any with which our fancy has peopled the distant stars; and that the actions of some of the humblest arouse in us the bewildering suspicion, that even in these invisible specks there is a faint foreboding of our own dual nature.

If, then, we make some few exceptions, we are entitled to say that the study of natural history depends for its existence on the pleasure that it gives, and the curiosity that it excites and gratifies; and yet, if this be so, see how cruelly we often treat it. Round its fair domain we try to draw a triple rampart of uncouth words, elaborate yet ever-changing classifications, and exasperatingly minute subdivisions, and we place these difficulties in the path of those whose advantages are the least, those who have neither the vigorous tastes that enable them to clear such obstacles at a bound, nor the homes whose fortunate position enables them to slip round them. For modern town-life forces a constantly increasing number of students to take their natural history from books; and too often these are either expensive volumes beyond their reach, or dismal abridgments which have shrunk, under examination pressure, till they are little less than a stony compound of the newest classification, and the oldest woodcuts. But the happier country lad wanders among fields and hedges, by moor and river, sea-washed cliff and shore, learning zoology as he learnt his native tongue, not in paradigms and rules, but from mother Nature's own lips. He knows the birds by their flight and (still rarer accomplishment) by their cries. He has never heard of the *Œdicnemus crepitans*, the *Charadrius pluvialis*, or the *Squatarola cinerea*, but he can find a plover's nest, and has seen the young brown peewits peering at him from behind their protecting clods. He has watched the cunning flycatcher leaving her obvious and yet invisible young in a hole in an old wall, while she carries off the pellets that might betray their presence; and has stood so still to see the male redstart, that a field-mouse has curled itself up on his warm foot and gone to sleep. He gathers the delicate buds of the wild rose, happily ignorant of the forty-odd names under which that luckless plant has been smothered; and if, perchance, his last birthday has been made memorable by the gift of a Microscope, before long he will be glorying in the transparent beauties of *Asplanchna*, unaware that he ought to crush his living prize, in order to find out which of some half-dozen equally barbarous names he ought to give it.

The faults, indeed, of scientific names are so glaring, and the subject is altogether so hopeless, that I will not waste either your time or my patience by dilating on it. But, while admitting that distinct creatures must have different names, and very reluctantly admitting that it seems almost impossible to alter the present fashion of giving them, I see no reason why these, as well as the technical names of parts and organs, should not be kept, as much as possible, in the background; and not suffered to bristle so in every page, that we might almost say with Job, "there are thistles growing instead of wheat, and cockle instead of barley."

We laughed at the droll parody in which the word *change* was defined as "a perichoretical synechy of pamparallagmatic and porroteroporeumatical differentiations and integrations"; yet it would not be a difficult matter to point out sentences in recent works on our favourite pursuits, that would suggest a similar travesty. No doubt new notions must often be clothed in new language, and the severer studies of embryology and development require a minute precision of statement, that leads to the invention of a multitude of new terms. Moreover, the idea that the meaning of these terms should be contained in the names themselves is excellent, but I cannot say that the result is happy; I might almost say that it is repulsive; and if we suffer this language to invade the more popular side of natural history, I fear that we shall only write for one another, and that our scientific treatises will run the risk of being looked at only for their plates, and of being then bound up with the Russian and Hungarian memoirs.

The multiplication of species, too, is a crying evil, and the exasperating alterations of their names in consequence of changing classifications, is another. The former, of course, is mainly due to the difficulty (no doubt a very great one) of determining what shall be a species and what a variety. How widely experts may differ on this question, Darwin has shown, by pointing out that, excluding several polymorphic genera and many trifling varieties, nearly two hundred British species, which are generally considered varieties, have all been ranked by botanists as species; and that one expert has made no fewer than thirty-seven species of one set of forms, which another arranges in three. Besides, even in the cases where successive naturalists have agreed in separating certain forms, and in considering them true species, it happens now and then, as it did to myself, that a chance discovery throws down the barriers and unites half-a-dozen species into one.

Under these circumstances one would have expected that the tendency would have been to be chary of making new species; and no doubt this is the practice of the more experienced naturalists, but among the less experienced there is a bias in the opposite direction; and all of us, I fear, are liable to this bias when we have found something new; for even if it is somewhat insignificant, we are inclined to say with Touchstone, "A poor thing, sir, but mine own!" Now were this fault mended, much would be avoided that tends to make monographs both expensive and dull; for though the needs of science require a minute record of the varieties of form, which are sometimes of high importance from their bearing on scientific theories, yet the description of them, as varieties, may often be dismissed in a line or two, when nothing further is set forth than their points of difference; whereas if these forms are raised to the rank of species, they are treated with all the spaced-out dignities of titles, lists of synonyms, specific characters, &c., &c., and so take up a great deal of valuable room, weary the student with repetitions, and divert his attention from the typical forms.

But when everything has been done that seems desirable, when names and classification have been made both simple and stable, and the number of species reduced to a minimum, there will still remain the difficulty that monographs must, from the nature of the case, generally be grave as well as expensive books of reference, rather than pleasant readable books, within the reach of the majority. I would suggest then that, if it be possible, each group of animals should be described, not only by an all-embracing monograph to be kept for reference on the shelves of societies like our own, but by a book that would deal only with a moderate number of typical, or very striking forms; that would describe these fully, illustrate them liberally from life, and give an ample account of their lives and habits.

Such a book should give as little of the classification as possible, it should avoid the use of technical terms, and above all it should be written with the earnest desire of so interesting the reader in the subject, that he should fling it aside and rush off to find the animals themselves. By this means we should not only get that active army of out-of-door observers which science so greatly needs, but by bringing the account of each group into a reasonable compass, we should enable students of natural history to get a fair knowledge of many subjects, and so greatly widen their ideas and multiply their pleasures.

For why should we be content to read only one or two chapters of Nature's book? To be interested in many things—I had almost said in everything—and thus to have unfailing agreeable occupation for our leisure hours, is no bad receipt for happiness. But life is short, and its duties leave scant time for such pursuits; so that to acquire a specialist's knowledge of one subject, would often be to exchange the choice things of many subjects, for the uninteresting things of one. And how uninteresting many of these are! How is it possible for any human being to take pleasure in being able to distinguish between a dozen similar creatures, that differ from one another in some trifling matter;—that have a spike or two more or less on their backs, a varying number of undulations in the curve of their jaws, or differently set clumps of bristles on their foreheads? Why should we waste our time and our thoughts on such matters? The specialist, unfortunately, must know these things, as well as a hundred others equally painful to acquire and to retain, and no doubt he has his reward; but that reward is not the deep delight that is to be found in the varied study of the humbler animals; of those beings "whom we do but see, and as little know their state, or can describe their interests or their destiny, as we can tell of the inhabitants of the sun and moon:—creatures who are as much strangers to us, as mysterious, as if they were the fabulous, unearthly beings, more powerful than man, yet his slaves, which Eastern superstitions have invented."

Those, then, who are blest with a love of natural history, should never dull their keen appreciation of the wonders and beauties of living things, by studying minute specific differences; or by undertaking the uninteresting office of finding and recording animals, that may indeed be rare, but which differ from those already known in points, whose importance is due solely to arbitrary rules of classification.

This eagerness to find something new, errs not only in wasting time and thought on matters essentially trivial and dull, but in neglecting things of the greatest interest which are always and everywhere within reach. Take for instance the case of *Melicerta ringens.* What is more common, what more lovely than this well-known creature? And yet how much there remains to be found out about it. No one, for example, has ever had the patience to watch the animal from its birth to its death; to find out its ordinary length of life, the time that it takes to reach its full growth, the period that elapses between its full growth and death, or, indeed, if there be such a period. And yet even these are points which are well worth the settling. For if *Melicerta* reaches its full growth any considerable time before the termination of its life, it would seem probable that, owing to the constant action of its cilia, it would either raise its tube far above the level of its head, or else be constantly engaged in the absurd performance of making its pellets and then throwing them away. Who has ever found it in such a condition, or seen it so engaged? Yet the uninterrupted action of the pellet-cup would turn out the six thousand pellets, which form the largest tube that I am acquainted with, in about eight days, and those of an average tube in less than three, while the animal will live (according to Mr. J. Hood *) nearly three months in a zoophyte trough, and no doubt much longer in its natural condition. It is true that the creature's industry, in tube-making, is not continuous. It is often shut up inside its tube, when all ciliary action ceases; and, moreover, when expanded, it may be seen at times to allow the formed pellet to drift away, instead of depositing it: but, allowing for this, there is no little difficulty in understanding how it is that, with so vigorous a piece of mechanism as the pellet-cup, the tube at all ages, except the earliest, so exactly fits the animal. I am aware that it has been stated that the whole of the cilia (including those of the pellet-cup) are under the animal's control, and that their action can be stopped, or even reversed, at pleasure. But this I think is an error. Illusory appearances, like those of a turning cog-wheel, may be produced by viewing the ciliary wreath from certain points, and under certain conditions of illumination; and these apparent motions are often reversed, or even stopped, by a slight alteration either in the position of the animal, in the direction of the light, or in the focussing of the objective. When, however, under any circumstances, the cilia themselves are distinctly seen, they are invariably found to be simply moving up and down; now lashing sharply towards the base, and now recovering their erect position. Even the undoubtedly real reversal of the revolution of the pellet in its cup, which is constantly taking place, can be easily explained by purely mechanical considerations, and consistently with the continuous up and down motion of the cilia. Moreover, of the absolute stoppage of the cilia, in the expanded rotiferon, I have never seen a single instance. In all cases, on the slightest opening of the corona, the cilia begin to quiver, and they are always in full action, even before the disc is quite expanded; while, should

* Mr. Hood, of Dundee, has kept in his troughs *Melicerta ringens* for 79 days, *Limnias ceratophylli* for 83 days, *Cephalosiphon limnias* for 89 days; the *Floscularię* usually lived about 50 days, but *F. Hoodii* died, before maturity, in 16 days.

a portion of the coronal disc chance to be torn away, its cilia will continue to beat for some time after its severance: so that there is good reason for believing that the ciliary action is beyond the animal's control.

It is possible, indeed, that *Melicerta* may continue to grow (as Mr. Hood says, that the Floscules appear to do) as long as it lives; or it may adopt the plan of some species of *Œcistes*, which, to prevent themselves from being hampered by their ever-growing tubes, quit their original station at the bottom of the tube, and attach themselves to it above, creeping gradually upwards as the tube lengthens. At any rate it would be interesting and instructive to watch the growth of a *Melicerta*, and the building of its tube, from the animal's birth to its death. An aquarium, in which *Melicerta* would live healthily and breed freely, could easily be contrived; and a little ingenuity would enable the observer to remove any selected individual to a zoophyte trough, and back again, without injury; and his trouble perhaps would be further repaid by such a sight, as once delighted my eyes at Clifton; where I picked from one of the tanks of the Zoological Gardens some *Vallisneria*, whose ribbon-like leaves were literally furred with the yellow-brown tubes of *Melicerta*. I coiled one of these round the wall of a deep cell, and thus brought into the field of view, at once, more than a hundred living *Melicertæ* of all ages and sizes, and all with their wheels in vigorous action —a display never to be forgotten.

Such a tank, so stocked and managed, would probably enable a patient and ingenious observer to decide several other points, about which we are at present in ignorance: to say whether the same individual always lays eggs of the same kind, or whether it may lay now female eggs, now male, now ephippial eggs; and to say what determines the kind of egg that is to be laid; whether it is the age of the individual, or the supply of food, or the temperature, or sexual intercourse that is the potent cause. It would, too, hardly be possible for the male to escape the observation of a naturalist, who possessed a tank, in which were living, hundreds of *Melicertæ*; and the male is as yet almost unknown.

Judge Bedwell found in the tubes of the female, in the winter, a small rotiferon resembling the supposed male, that I had seen playing about *M. tubularia*; only the former had a forked foot, and sharp jaws, that were at times protruded beyond the coronal disc. Its frequent occurrence in the tubes in various stages of development, and the nonchalance with which the female suffered it to nibble at her ciliary wreath, inclined the observer to conclude that the animal was the long sought-for male. Unfortunately it was only observed when in motion, so that its internal structure was not made out; and the matter therefore still rests in some doubt.

No doubt it is a strong argument, that the female would suffer nothing but a male to take such liberties with her; but it would seem, from the following account, that it is possible for such freedoms to be pushed too far.

Mr. W. Dingwall, of Dundee, was on one occasion watching a male Floscule circling giddily round a female, and constantly annoying her by swimming into her fully expanded, coronal cup. Again and again she darted back into her tube, only to find her troublesome wooer blocking up her cup and sadly interfering with, what to a Floscule, is the very serious business of eating; for these animals will often eat more than their own bulk in a few hours. It was clear, at last, that the lady would not tolerate this persistent interference with her dinner; for when, after waiting rather a longer time than usual closed up in her tube—so as to give him every chance—she once more expanded, only to find him once more in his old position, she lost all patience, and effectually put an end to his absurdities, by giving one monstrous gulp, and swallowing her lover. It will not surprise you to hear that he did not agree with her, and that after a short time she gave up all hope of digesting her mate, and shot him out into the open again, along with the entire contents of her crop. He fell a shapeless, motionless lump; the two score and ten minutes of a male rotiferon's life cut short to five; but, strange to say, in a minute or two, first one or two cilia gave a flicker, then a dozen; then its body began to unwrinkle and to plump up; and at last the whole corona gave a gay whirl and the male shot off as vigorous as ever, but no doubt thoroughly cured of his first attachment.

I have taken *Melicerta ringens* as an example of what yet remains to be done, even with an animal which is as common in a ditch, as a fly is in a house; but almost every other rotiferon would have done equally well; for there is scarcely a single species, whose life-history has been thoroughly worked out.

To me, natural history, in many of its branches, seems to resemble a series of old, rich mines, that have been just scratched at by our remote ancestors, and then deserted. Our predecessors did their best with such feeble apparatus as they had; it was not much, perhaps, but it was wonderful that they did it all with no better appliances; and it irks me to think that we, who are equipped in a way which they could not even dream of, should turn our backs on the treasures lying at our feet, and go off prospecting in new spots, contented too often with a poor result, merely because it is from a new quarter.

Besides, the love of novelty is a force too valuable to be wasted on a mere hunt for new species in any one group of animals, especially unimportant ones. It should rather be used to make us acquainted with the more striking forms of many groups. Let us have no fear of the reproach of superficial knowledge; every one's knowledge is superficial about almost everything; and even in the case of those few who have thoroughly mastered some one subject, their knowledge of that must have been superficial for a great portion of their time. Indeed, the taunt is absurd. I can imagine that a superficial knowledge of law, or surgery, or navigation may bring a man into trouble; but what possible harm can it do himself, or any one else, that he is content with knowing five Rotifera instead of five hundred? And yet if any naturalist were to study only *Floscularia*, *Philodina*, *Copeus*, *Brachionus*, and *Pedalion*, it would give him the greatest possible pleasure, as well as an excellent general notion of the whole class. Let any tyro, at the sea-side, watch the ways and growth of a *Plumularia*, or of a rosy feather-star; his knowledge of the groups to which they belong could certainly not be dignified even with the term "superficial"—"linear," or "punctiform," would be more appropriate—but the pleasure, that he would derive from such a study, could not be gauged by counting the number of animals that he had examined. It would depend on the man himself; and might, I should readily imagine, far exceed that derived by the study of a hundred times the number of forms in books; especially when such a study had been undertaken, not from a natural delight in it, but from some irrelevant reason, such as to support a theory, to criticize an opponent, to earn a distinction, or to pass an examination.

In truth, that knowledge of any group of animals, which would rightly be called superficial, when contrasted with the knowledge of an expert, is often sufficient to give us a satisfactory acquaintance with the most interesting creatures in it; to make us familiar with processes of growth and reproduction too marvellous to be imagined by the wildest fancy; and to unfold to us the lives of creatures who, while possessing bodily frames so unlike our own, that we are sometimes at a loss to explain the functions of their parts, yet startle us by a display of emotions and mental glimmerings, that raise a score of disquieting questions.

Moreover, there is another excellent reason why we should not confine our attention to one subject, and that is that even the most ardent naturalist must weary at times of his special pursuit. Variety is the very salt of life; we all crave for it, and in natural history at all events we can easily gratify the craving. If we are tired of ponds and ditches, there are the rock-pools of our south-western shores, and the surface of our autumn seas. A root of oar-weed torn at random from a rocky ledge, an old whelk-shell from deep water, a rough stone from low-water mark, the rubbish of the dredge, each and all will afford us delightful amusement. It is wonderful too, what prizes lurk in humble things, and how often these fall to beginners. The very first time that I tried skimming the sea with a muslin net, I picked a piece of green seaweed off the muslin, intending to throw it away; but, seeing a little brown spot on it, I dropped the weed (not a square inch) into a bottle of sea-water instead. At once the brown speck started off and darted wildly round the bottle. It was too small to be made out with the naked eye, but by the time I had brought my lens to bear, it had vanished. I hunted all over the bottle and could see nothing; neither with the lens nor without it. I was half inclined to throw away the water; but as I was certain that I had seen something in it two minutes before, I corked up the bottle and took it home. When I next looked at it, there was the little brown creature flying about as wildly as ever. I soon found out, now, that I had caught a very tiny cephalopod—something like an octopus, and with a pipette I fished it out and dropped it into a glass cell. At least I dropped the water from the pipette into the cell; but the animal itself had vanished again; I could not see it either in the bottle, or the cell. I was not going to be tricked again; so I pushed the cell under the Microscope, and there was my prize, motionless, but for its panting, and watching me, as it were, up the Microscope, with its big blue-green eyes. It was almost colourless, and was dotted at wide intervals with very minute black spots, set quincunx fashion—spots absolutely invisible to the sharpest unaided sight.

As I looked it began to blush—to blush faint orange, then deeper orange, then orange-brown; a patch of colour here, another there, now running across one side of the body, now fading away again to appear on a tentacle; till at last, as it recovered from its alarm, each black spot began to quiver with rapid expansions and contractions, and then to spread out in ever varying tints, till its wavering outlines had met the expansions of its neighbouring spots; and the little creature, regaining its colour and its courage at the same moment, rushed off once more in a headlong course round the cell.

I was the merest beginner when I saw this, but I had the good luck, knowing nothing whatever about it, and never having given the subject a thought, to see with my own eyes, how effectually cuttle-fishes are protected by their loss of colour, and also to see how the loss takes place.

No doubt the sea-side of our south-western coasts—I mean its creeks, not "the thundering shores of Bude and Bos"—is a paradise for microscopists; but there is no need that we should travel so far afield. Our inland woods, our lanes and pastures will yield to us a thousand beauties and wonders. The scarlet pimpernel will show its glorious stamens, the flowers of the wound-wort glow like a costly exotic; wild mignonette will rival in its fantastic shape the strangest orchid; the humblest grass will lift a tuft of glistening crystals, the birch and salad burnet shake out their crimson tassels; the Jungermanns will display their mimic volcanoes, the mosses unfold the delicate lacework of their dainty urns. But the time would fail me to name one tithe of those sources of wonder and delight that lie all around us; and most of which, as in case of the Rotifera, contain numberless points on which we are all happily ignorant, and therefore in the best of all possible conditions for deriving endless pleasure and instruction from them. Besides, my time and your patience must, I think, be drawing to a close; I would then only once more suggest that we should not only explore for ourselves all these "pastures new"—no matter how imperfectly—but that we should encourage those, who can be our most efficient guides, to indulge us with the main results, in the simplest language. Surely one of the most charming subjects that can interest human beings, admits of being so treated; and there can be no good reason why the Muse of Natural History (for no doubt there is such a Muse) should resemble that curious nymph among the *Oribatidæ*, whom Mr. Michael found lying under the moss of an old tree, half smothered in a heap of her cast-off skins, admirable types of successive classifications and abandoned nomenclature.

Happily, however, books in such matters are of little importance; and names and classifications of still less: both these latter, indeed, are of ephemeral interest; they are the pride of to-day and the reproach of to-morrow. It is to the living animals themselves that we must turn, fascinated not only with their beauty and their actions, but with the questions which the contemplation of them perpetually provokes, and very rarely answers.

For, in the long procession of the humbler creatures, who can tell where life first developes into consciousness, and why it does so; where consciousness first stretches beyond the present so as to include the past, and why that happens; or at what point, and why, memory and consciousness themselves are lighted up by the first faint flashes of reason?

We know nothing now of such matters, and probably we never shall know much; but the mere fact, that the study of natural history irresistibly draws us to the consideration of these questions, gives to her pleasant features an undoubted dignity, and raises the charming companion of our leisure hours to the rank of an intimate sharer of some of our gravest thoughts.

IV.—*On the Variations of the Female Reproductive Organs, especially the Vestibule, in different species of Uropoda.*

By Albert D. Michael, F.L.S., F.Z.S., F.R.M.S., &c.

(*Read* 19*th March*, 1890.)

Plate IV.

In January 1889 I read, before this Society, a paper upon the internal anatomy of *Uropoda Krameri.** In that paper I described, *inter alia*, the female reproductive system, which on the whole agreed fairly well with that of the *Oribatidæ;* but in which the long ovipositor

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EXPLANATION OF PLATE IV.

ov, ovary. *od*, oviducts. *e*, egg. *va*, vagina. *n*, neck of same. n^1, terminal part gathered round the heel of the perigynum. *pg*, perigynum. *ves*, folded and flexible membrane attached round the edge of the perigynum above, and round the edge of the genital aperture below; this membrane and the perigynum form the walls of the "vestibule." *gp*, genital plate (epigynum). gp^1, thin projecting portion at the anterior end of same. ch^1, chitinous strengthening-pieces along the lateral edge of the perigynum. *rs*, receptaculum seminis. *ag*, accessory glands. m^1, occlusor muscles of genital plate. t^1, tendinous attachment of same. m^2, levator muscles of the perigynum. m^3, depressor muscles of the lower edge of the neck of the vagina. t^3, tendinous attachment of same. *vp*, portions of the chitinous ventral plate.

Lettering applicable only to the figures of *Uropoda ovalis.*—m^4, retractor muscles of receptaculum seminis. *f*, fold of *ves*. *fr*, fringe round edge of perigynum on the ventral side. ch^2, chitinous strengthening-piece round the heel of the perigynum. *co*, collar of clear chitin attached to same. a^2, chitinous strengthening-piece partly round the edge of the receptaculum seminis. *gm*, membranous spatulate piece lying within the hollow of the genital plate.

Lettering applicable only to figures of *Uropoda vegetans.*—*si*, sigmoid piece.

Fig. 1.—*Uropoda ovalis* Koch ♀. Whole genital system seen from the dorsal surface (above), × 65.
" 2.—Ditto. Anterior portion of same, side view, × 100.
" 3.—Ditto. Perigynum and surrounding parts, and neck of the vagina, seen from the dorsal surface (above), × 150.
" 4.—Ditto. Perigynum and portion of the other parts of the vestibule seen from the ventral surface (below), × 150.
" 5.—Ditto. Side view of the perigynum, vagina, &c.; the accessory glands, fringe, and membranous portion of the vestibule have been removed in order to show the attachment of the muscle and tendon m^3 t^3 to the lower edge of the neck of the vagina, which is drawn backward, × 150.
" 6.—Ditto. Opening of the neck of the vagina, seen from the anterior end of the creature, showing the insertion of the heel of the perigynum into the opening, × 200.
" 7.—Ditto. Perigynum detached; three-quarter view to show the shape, × 100.
" 8.—Ditto. Receptaculum seminis from below, × 150.
" 9.—Ditto. Genital plate (epigynum), × 60.
" 10.—Ditto. Thin projecting end of same, × 150.
" 11.—Ditto. Sagittal section, nearly median, × 60. *mo*, mouth-aperture. *œ*, œsophagus. *v*, ventriculus. *c*, colon. *r*, rectum (cloacal). *a*, anus. *mg*, portions of the Malpighian vessels (cut through by the section). *dp*, dorsal chitinous plate with lining membrane. *ep*, epistome joined to dorsal plate by a median chitinous lamina. *ot*, chitinous walls of the oral

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* This Journal, 1889, pp. 1–15.

of the last-named family was entirely absent, being to some extent replaced by the curious and elaborate organ which I called the "vestibule"; there was, however, this essential difference, viz. that the ovipositor of the *Oribatidæ* is a long, protrusible organ, which, when in action, is almost wholly outside the body, like the ovipositors of Insects, although it is withdrawn into the abdomen at ordinary times; while the vestibule of the *Uropodinæ* is merely a passage leading from the vagina to the exterior; and is, at all times, wholly within the body and entirely incapable of protrusion; it is, however, not a simple chamber, but is of an elaborate nature, and has more or less complex organs surrounding it.

In the autumn of 1889 I had opportunities of obtaining some species of *Uropoda* in considerable numbers, and I thought this would be a favourable opportunity for ascertaining whether the vestibule in the females of other species of the genus were similar to that of *U. Krameri*. On investigation I found that, although the ovary, oviducts, and vagina varied but little, yet that the vestibule and surrounding organs did not really agree in any two species; the differences were often very marked, the type of *U. Krameri* not being repeated anywhere. It is a few of the more remarkable of these variations which I propose to describe in this paper.

The two principal species which I have examined have been those which I call *U. ovalis* Koch, and *U. vegetans* de Geer. In

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tube. m^5, retractor muscles of the same. *md*, mandibles. m^6, retractor muscles of same. *p*, palpus. *ge*, great œsophageal ganglion (so-called brain). m^7, distensor muscles of œsophagus.

Fig. 12.—*Uropoda vegetans* ♀. Whole genital system seen from the dorsal (upper) surface, × 80. This figure is turned in the reverse direction from the others.

„ 13.—Ditto. Vestibule and surrounding parts, seen from the ventral surface, looking upward through the genital aperture, the genital plate having been removed. In order to make this figure clearer the receptaculum seminis and sigmoid piece have been removed from the right-hand side of the figure (proper left of the creature), and the accessory gland from the left-hand side (proper right of the creature). *df*, depressed marginal border of thin chitin forming a stop for the genital plate, against which it rests.

„ 14.—Ditto. A small portion of the left side of the same organs seen from the dorsal surface, to show the entry of the duct of the receptaculum seminis into the upper part of the neck of the vagina, × 160.

„ 15.—Ditto. Left sigmoid piece and some of the surrounding organs, partly side view, from below, × 160.

„ 16.—Ditto. Epigynum, &c., seen from dorsal surface, × 100.

„ 17.—Ditto. Sigmoid piece detached and seen from a nearly dorsal direction, × 200.

„ 18.—Ditto. A small portion of the heel of the perigynum, × 350, to show the nature of the spines.

„ 19.—Ditto. Thin chitinous piece supporting the membranous continuation of the lower edge of the vagina, × 180.

„ 20.—Ditto. A few spermatozoa released from the receptaculum seminis, × 200.

„ 21.—Ditto. One receptaculum seminis and duct detached.

„ 22. *Uropoda cassidea* ♀. Perigynum and surrounding organs, seen from the upper (dorsal) side, × 160.

studying the former of these I have had the assistance of Mr. M. J. Michael, who has also cut some excellent sections, from one of which fig. 11, plate IV., is drawn.

I say above, "which I call *U. ovalis* Koch and *U. vegetans* de Geer." I use that expression because there has been, and still exists, great confusion about the synonymy of these two species; and although this is entirely an anatomical paper, it seems necessary to enter into the question in order that biologists may be able to identify the creatures I am talking about. *U. ovalis* is a name first used by C. L. Koch.* He calls it *Notaspis ovalis*, following an error of Hermann's,† who mistook his species of the genus *Uropoda*, viz. *U. cassidea*, for one of the *Oribatidæ*. Koch, in the same work,‡ describes another species, which he calls "*obscurus*." The most striking differences are, that *ovalis* is almost pointed at the hinder end, and is stated to be one of the largest species; *obscurus* is rounded at the hinder end, "mit regelmässig gerundetem Hinterrande," and it is not stated to be large. Julius Muller was the next who used the name.§

In 1876 Mégnin‖ described a species which he called *Uropoda scutata;* he did not figure it, and I do not see how it is possible to identify anything from his extremely short description; nevertheless Haller,¶ in 1881, described and figured what he called the *U. scutata* of Mégnin. Haller's figure was certainly drawn from the creature which I have been dissecting, and which I believe to be the *U. ovalis* of Koch.

In 1876 Kramer** described as *U. ovalis* a species with a rounded posterior margin, which does not appear to me to agree with Koch's figure or description; but which, as will be seen below, I think may probably be identical with what must be considered to be *U. vegetans* of de Geer.

In 1877 Canestrini and Fanzago†† simply followed Kramer.

In 1881 Berlese ‡‡ described the species with the nearly pointed posterior margin which I have been dissecting, and in 1884 he published a good figure of it.§§ In both of these works he calls it *Uropoda* (or *Notaspis*) *obscura* Koch, which in my opinion is an

* 'Deutschlands Crustaceen, Miriapoden und Arachniden,' Regensburg, 1835–41, Heft xvii. fig. 21.

† 'Mémoire Aptérologique,' Strasbourg, 1804.

‡ Heft ii. fig. 5.

§ "Insecten Epizoen der Mährischen Fauna," Jahresheft der Naturwiss. Sektion der Mähr-Schles. Ges., 1859, pp. 157–84.

‖ "Mém. sur l'Organisation, &c., des Acariens de la famille des Gamasides." Journ. de l'Anat, et de la Physiol. (Robin's), May 1876.

¶ "Acarinologisches." Archiv für Naturges., 1881, p. 185.

** "Zur Naturg. einiger Gattungen aus d. Familie d. Gamasiden." Archiv für Naturges., 1876, p. 78.

†† "Intorno agli Acari Italiani." Atti d. R. Ist. Ven. d. Sci. Let. ed Arti, 1877, p. 59.

‡‡ "Indagini sulle metamorfosi di alcuni Acari insetticoli." Op. cit., 1881.

§§ 'Acari Miriapodi e Scorpioni Italiani," fasc. xi. pl. viii., Padua, 1884.

error. He also identifies it with *Notaspis marginatus* and *N. immarginatus* of Koch; this, I think, is also a mistake; but he identifies it with *Uropoda scutata* Mégnin-Haller, which is correct, and also with Kramer's species of the same name, which is more doubtful. In his last-named work * he describes a different species as *ovalis.*

In 1885 Canestrini † follows Berlese.

The result of all this is that the synonymy is as follows:—

The species with the abdomen nearly pointed posteriorly, and which I refer to, is

Uropoda ovalis of Koch, but not of Kramer, Canestrini, nor Berlese.

Uropoda scutata of Mégnin and Haller, but probably not of Kramer.

Uropoda obscura of Berlese and Canestrini, but not of Koch.

The best published drawing of the species is that by Berlese in his 'Acari &c. Ital.'

This species is probably the one treated of by Winkler in his 'Anatomie der Gamasiden';‡ he calls it "*Uropoda obscura* Koch?" If, as is probable, he identified his species from Berlese's drawing, the ? may well have been introduced on comparing it with Koch's original drawing and description; his paper is strictly anatomical, and I imagine that we have been dissecting the same species from the agreement of his description of the alimentary canal and other internal parts with what I found, although they differed from *U. Krameri*, which I before dissected. Winkler does not describe the parts which I shall deal with in this paper.

As to the synonymy of the other species, which I call "*U. vegetans*" in this paper, it is not possible to speak with any confidence. The only thing which, I think, may be relied on is that the creature spoken of is identical with the *U. ovalis* of Kramer, which, as above stated, I do not think is really Koch's *ovalis*. *U. vegetans* was originally described by de Geer,§ who calls it "*Acarus vegetans*," the genus *Uropoda* having been originated by Latreille.‖ De Geer's figure and description were probably taken from immature specimens; they are not sufficient to identify the species, but they do indicate a creature the shape of Kramer's *ovalis*, and the immature forms of which attach themselves to insects in the singular mode so well known in this genus. De Geer does not say whether the first pair of legs are terminated by a sucker and claw, or by hairs only; nor can this be gathered from the figures. Numerous early writers practically simply quoted de Geer, without throwing much further light on the subject.

* Fasc. xl. pl. ix.

† Prosp. d. Acarofauna ital., Padua, 1885, p. 103.

‡ Arbeiten d. Zool. Inst. Wien, t. vii. Heft 3, 1888.

§ 'Mémoires pour servir à l'Histoire des Insectes,' Stockholm, 1778, t. vii p. 123, pl. vii. figs. 15–19.

‖ 'Genera Crustaceorum et Insectorum,' Paris, 1806–9, genus 62.

In 1876 Mégnin * described and figured a creature under the name of *U. vegetans;* his description is so slight, that it is not possible to make any use of it. There is, however, a large and well-drawn plate, which shows a species without any claws or suckers to the first pair of legs. I am not aware that any other acarologist has found any creature which really corresponds in all respects to Mégnin's *U. vegetans*, the known species in which the same shape exists having claws and suckers on the first pair of legs.

In 1881 Haller † asserted that Kramer's *U. ovalis* was really the *U. vegetans* of de Geer. In 1882 Kramer replied, pointing out that his *U. ovalis* could not be identical with *U. vegetans*, because *ovalis* had suckers and claws to the first leg, and a genital plate (female) of a different shape. This is undoubtedly true if Mégnin's figure be taken to represent the true *U. vegetans* of de Geer, but I am not aware of anything to show that it does, and as others do not find what Mégnin has drawn, it seems unlikely that it can have been de Geer's species. It seems to me far more probable, as Haller supposed, that Kramer's *ovalis* is the original *vegetans;* at all events, in my opinion it is not Koch's *ovalis*, and therefore if it be not *vegetans* it is nameless. If Dr. Kramer likes to treat it as being so, and to give it a new name, I am not wedded to the idea of its being *vegetans*, and should readily follow him; in the meantime I call it *U. vegetans*, and I think that that name is probably correct; at any rate, for the identification of the species called *vegetans* in this paper I refer to Dr. Kramer's *ovalis*. It is as well to state that all my specimens of this species for the present investigation come from the nest of one of the wild social bees (a *Bombus*). I have frequently obtained the species elsewhere, but not in such abundance.

Anatomy.

Uropoda ovalis Koch.

If an adult female *Uropoda ovalis* be laid on its back the large genital plate (epigynum of Berlese) will at once be conspicuous, exactly filling up the genital opening in the ventral plate. The form of this genital plate, which is a good specific character in *Uropoda*, may be judged of from plate IV. fig. 9. It will be seen that at its anterior termination, in the median line, is a bifid projection, like a two-pronged fork; one prong of the fork is usually a little longer than the other. This projection is shown on a large scale in fig. 10. It is composed of clear, almost colourless chitin, while the rest of the genital plate is dark, and is received in a very slight depression of the ventral plate. It springs from the extreme ventral edge of the genital plate, and is not nearly as thick as the edge of that plate; thus, although the genital plate enters the genital opening, and forms

* Op. cit. † Op. cit.

a door which closes it, yet this projection never enters, but always remains wholly external upon the ventral surface. A projection of the same nature exists in the same situation in almost all species of *Uropoda*, but the form differs greatly in the respective sorts; in some species the projection is so thin and transparent that it usually is not noticed when it lies against the body of the creature. As to the use of this projection, it might be suggested that it is to prevent the genital plate from passing too far into the genital opening; but this can hardly be so, because within that opening is a ledge (fig. 13, *d f*) running all round the opening except its posterior, or hinge, side, and which manifestly fulfils this office. The function of the projection, therefore, probably is to form a handle which may enable the genital plate to be pulled downwards from the exterior, turning on the ginglymus hinge at its posterior edge, and thus exposing the genital aperture.

Inside the upturned edge of the genital plate lies a membranous spoon-shaped piece (fig. 2, *g m*), which roughly follows the shape of the plate, but is not a lining in the sense of being attached by its whole surface.

When the genital plate has been removed, or turned down out of the way, it may be seen that the genital opening is the entrance to a chamber of which the genital plate, when closed, forms the floor; this chamber is the vestibule; a large portion of its roof, lying along the median line, is composed of the organ which I propose to call the perigynum (figs. 2, 3, 4, 5, &c., *pg*), and which, I think, has not previously been described. From the edge of the perigynum a flexible membrane extends outward, forming a dome, the lower edge of the membrane being attached round the genital opening. It must not be supposed, however, that the domed shape is the ordinary condition of the chamber; quite the contrary is the case. The perigynum is a stiff structure with chitinous strengthenings, the membrane is extremely flexible; thus the perigynum, when not drawn upward by muscles, falls until its lower surface approaches the genital plate, the membranes folding to allow it to do so; thus in its usual position the membrane runs upward from the edge of the perigynum, not downward. If a hair be introduced through the genital opening and pushed gently against the perigynum, then that organ will be raised, extending the membrane, and disclosing the true shape and nature of the vestibule. It will be seen hereafter that the perigynum is provided with muscles specially adapted to do what has been artificially done by the hair.

In addition to the great genital aperture there are two smaller openings into the vestibule, both from within; one is the entrance to the receptaculum seminis, the other the entrance to, or perhaps it should rather be said the exit from, the vagina; the latter is usually closed by, and always hidden by, the perigynum, until disclosed by dissection.

To commence with the receptaculum seminis. I did not describe or find such an organ in *Uropoda Krameri*, nor am I aware that it has been described in any *Uropoda*, or indeed in any of the *Gamasidæ*; nevertheless in *Uropoda ovalis* it is a large and unmistakable organ, which, in most of the numerous specimens that I dissected, was full of spermatozoa; and it will be seen further on that receptacula seminis exist also in *U. vegetans*, although they differ widely from the azygous organ of the present species.

The position of the receptaculum seminis in *U. ovalis* is shown in figs. 1, 2, *rs*, and the organ itself on a larger scale is drawn at fig. 8. It is placed longitudinally and horizontally in the median line, and runs below the vagina; it is long and sac-like, widest at its posterior extremity, with a concave hind margin and rounded posterior corners; it narrows gradually until near the mouth, when it widens again more rapidly, and its anterior edge is attached to a chitinous strengthening bar (fig. 8, *ar*). This bar is not straight; its shape may be best gathered from the figure; its central portion forms a pointed arch, which stands in a sloping direction upward and backward. The bar is sunk in the wall of the lower part of the posterior end of the vestibule, and the arch therefore forms an entrance from the vestibule to the receptaculum seminis, which is fairly accessible from the exterior after the genital plate has been got out of the way.

Above the opening of the receptaculum seminis, still in the median line, but near the top of the wall of the vestibule, is the opening of the neck of the vagina (fig. 2, &c., n^1). The vagina itself is a more or less globular organ, sometimes slightly constricted in the middle; it has thickish muscular walls, and is capable of considerable distension. It is quite of the type of the same organ in *U. Krameri* and in the *Oribatidæ*. The neck, however, exhibits some difference, viz. at the anterior end the vagina is suddenly contracted by powerful ring-muscles, so as to form a narrow neck *n*, which is also provided with longitudinal muscles. This neck finally expands again, still retaining its muscular and folded condition, and curves forward, its upper edge overhanging the lower (fig. 5, n^1); this upper edge overlies, and is attached to, the posterior end of the perigynum (fig. 3). The lower and lateral edges of the expanded neck of the vagina are not attached to anything, except that to each lower angle, near the edge of the opening, a tendon (fig. 6, t^3) is attached. This tendon is the termination of a muscle (m^3) which itself arises from the ventral plate, and, when in action, would draw the lower edge of the neck downward and backward.

The perigynum (fig. 7, and figs. 1, 3, 4, 5, &c., *pg*) is a very singular structure; it is best described as being somewhat of the shape of a shoe, concave on its dorsal and convex on its ventral surface. The heel of the shoe turns sharply upward (figs. 6, 7), and ends in a narrow portion (figs. 3, 4, 7). The upper edge, or framework, of the heel of the perigynum is composed of a strong chitinous bar, which extends about half-way along the edge on each side; thence nearly to what may be called the toe of the shoe it is continued by a much thinner bar, which, however, is not absolutely joined to the thicker. The whole space inclosed by this framework is filled by a moderately thick lamina of chitinized tissue, having the concavo-convex form before described. This lamina is transparent and colourless, but is not flexible; it retains its shape permanently, and a transverse section of the perigynum shows this most distinctly. The dorsal side of the lamina is smooth; the ventral side is thickly covered with spines of moderate length. When the organ is seen from the dorsal side the proximal ends of these spines are seen through the transparent material, giving a dotted appearance.

Round the chitinous bar at the upper edge of the heel of the perigynum is fitted a piece of clear colourless chitin (figs. 3, 4, ch^1), and it is here that the upper edge of the neck of the vagina rests upon, and is attached to the perigynum; the thin projecting portion of the heel of the perigynum actually enters the opening of the neck of the vagina (fig. 6).

A powerful fasciculus of muscles (figs. 2, 3, 5, 11, &c., m^2) is inserted in the chitinous framework on each side of the heel of the perigynum just after it has curved round and become lateral; these muscles arise from the dorsal surface, and serve to draw the heel of the perigynum upward.

The thin membranous walls of the vestibule, although attached all round the perigynum, do not in all parts run simply from that edge to the genital aperture; round the toe of the perigynum they make a large fold (figs. 2, 3, *f*), which, to continue the former homely simile, looks like the toe of a larger slipper projecting beyond the shoe.

Round the edge of rather more than the anterior half of the perigynum extends a membranous vandyked border (figs. 2, 3, 4, 7, &c., *fr*), the proximal edge of which is attached to the ventral side of the framework, while the whole of the remainder stands free inside the vestibule. This border is very conspicuous in stained dissections, as it takes stain readily; but I cannot at all suggest what is its office.

Two paired accessory glands (figs. 1, 2, *ag*) discharge close to the mouth of the vagina; they are sac-like organs of even diameter throughout, the diameter being small compared to the length; about the middle they are bent nearly at a right angle.

Having now described the whole of the parts, it remains to indicate what it appears to me is their action. Firstly, when the receptaculum seminis is being filled, and at ordinary times if the genital plate be opened, the heel of the perigynum would rest against the opening of the neck of the vagina, its spines probably interlocking with some spines which exist round the neck, and thus spermatozoa and foreign substances would be completely excluded. When it is necessary that spermatozoa should enter, then the action of the muscles m^4 would expel a sufficient number from the receptaculum, and the action of the muscles m^2 would raise the heel of the perigynum and allow the opening of the neck of the vagina to be entered. Again, when oviposition is to take place, the large egg would be forced from the vagina through the neck, the powerful muscles m^2 would raise the perigynum, carrying the top of the neck of the vagina with it; the opposed muscles m^3 would at the same time draw down the lower edge. Thus the neck of the vagina would be drawn from what may be termed its four corners and its opening widely expanded, while it would also be somewhat drawn away from the lower part of the heel of the perigynum. The egg would thus be allowed to pass through the neck of the vagina into the vestibule, slipping under the heel of the perigynum. From the vestibule it would reach the exterior through the genital aperture.

Uropoda vegetans.

The female genital organs in this species are on the whole of the same type as those of *U. ovalis*, but there are some very marked and singular differences. Fig. 12 will show that the central ovaries and oviducts are again of the usual form, and present little variety; the vagina also is similar in construction, but it is larger in proportion and more elliptical than the corresponding part in *U. ovalis*. The neck of the vagina is even more tightly constricted than in the last-named species, but the actual mouth of the organ is more expanded, and is not closed by the heel of the perigynum, as in *U. ovalis*. The apparent reason for this will be seen shortly. The perigynum exists in the present species, and considerably resembles that described above. In this case, however, the chitinous bar round the heel is very thin and delicate, the stronger portion of the framework being the anterior lateral; this consists, not of a rod, but of a blade on edge (on each side). The concavo-convex form is not nearly so marked, the organ being nearly flat in transverse section, nor does the heel curve in the manner shown in fig. 5; it is much more suddenly bent upward at an angle, and there is not any narrow portion projecting backward into the vagina. On the contrary, the top curls over slightly in a forward direction (fig. 12, &c.). The spines on the ventral surface of the perigynum are confined, in this species, to the heel; they are shorter than, and very different in form from those of *U. ovalis;* they are chitinous points, generally united at their bases into little transverse lines of three or four, each group standing well apart from the next. They remind me of the teeth on the radula of some Gasteropods; they are represented in fig. 18. The flexible walls of the vestibule are attached all round the edge of the perigynum, as in *U. ovalis*, but there is not any vandyked border at the juncture, nor anything substituted for it; nor is there any great fold of the membranous wall, such as *f* in fig. 3.

The first great difference between the two species which is noticed is the entire absence in *U. vegetans* of the large azygous receptaculum seminis found in *U. ovalis;* further examination shows that its place is supplied by two very small paired organs of a totally different form (fig. 21, and figs. 12, 13, 14, *rs*). They greatly resemble the corresponding organs of *Musca domestica*, as figured by Stein, and each consists of a quite small elliptical sac, which is placed at the distal end of a long narrow tubular peduncle, which is slightly constricted at regular intervals near the sac, so as to present a somewhat moniliform appearance. The peduncle has a larger diameter at its distal end than at the proximal, where it arises from the upper side of the expanded neck of the vagina. It is probably because of this position of the entrance to the receptacula seminis that the mouth of the vagina is not closed by the perigynum, as in *Uropoda ovalis*, the closing of the entrance to the vagina being apparently effected in *U. vegetans* by the tighter constriction of the neck. When the organs are dissected out, the receptacula seminis appear dark and chitinized, although the peduncle is comparatively light and transparent; if, however, the sac be torn, and its contents expelled by pressure, it will then be found that the apparent darkness and opacity arise from the receptaculum being (in all specimens which I have dissected) so densely crowded with spermatozoa that they form a solid mass, which may be pressed out and retain its elliptical shape; a drop of liquid, or a little disturbance with a fine hair, will, however, soon resolve the mass into its constituent parts, viz. spermatozoa, such as those represented by fig. 20. When the spermatozoa have been expelled the walls of the receptaculum are nearly transparent and smooth; while they are still contained in it the organ looks granular, from the closely packed spermatozoa showing through the walls.

There are two paired accessory glands in this species, as in *U. ovalis*, which discharge into the vestibule near to the mouth of the vagina, but instead of being sausage-shaped they are almost globular; their walls are thin and transparent, and have a few straight wrinkles arranged in a radiating manner; an extremely short duct leads from them to the vestibule. The glands of *U. ovalis* have generally been charged with secreted material when I have found them, while the more vesicle-like organs of *U. vegetans* have invariably been entirely empty. I fancy, however, that in consequence of the shortness and openness of the ducts their contents escape during dissection.

The accessory glands and the corner of the mouth of the vagina are supported on each side of the body by a singularly shaped chitinous piece, which is not present in *U. ovalis*, and which I will call the "sigmoid piece"; it is an S-shaped lamina, varying in width in different parts, and twisted also in a direction at right angles to the plane of the S, so that it becomes screw-like. It is difficult to give an idea of it in words; it will probably be understood better from figs. 13, 15, 17, *si*. The edge of the sigmoid piece is attached, at one place, to the lateral body-wall; the duct of the accessory gland discharges along the hollow formed by the lower turn of the S; the end of the upper turn supports the mouth of the vagina.

Uropoda cassidea.

I had only one specimen of this large and well-marked species to dissect, so that I was not able to carry on investigations nearly as satisfactorily as I was in the cases of the two species treated of above; it was, however, plain that considerable differences existed between the vestibule and surrounding organs of *U. cassidea* and those of any of the other species which I have dissected. The perigynum exists, and is large and conspicuous, but it consists of an almost flat plate, which is entirely surrounded by a broad chitinous band (fig. 22), nearly elliptical as regards its exterior margin, but retaining a little of the shoe-shape on its inner edge. The anterior part of the outer edge has a few large serrations projecting from it. The flexible wall of the vestibule is attached round the edge of the perigynum, as in the other species. The neck of the vagina is short, but is surrounded by a very powerful ring-muscle; the vagina itself is large, and is drawn out in a more or less triangular extension on each side, at the apex of which triangle the oviduct enters. In the single specimen which I had I was not able to detect any receptaculum seminis or accessory glands.

It now only remains to offer a possible explanation of the very considerable differences between the forms of the vestibule in all these species and that of the same organ in *U. Krameri*. In my paper on that species in this Journal * I suggested that the parts appeared eminently fitted to strip the shell from the egg as it emerged, and I called attention to the fact that the eggs found in the part of the oviduct near the vagina, in all cases which I had observed, contained larvæ fully, or nearly fully, developed; and in most cases apparently ready to emerge. It therefore seemed probable that the larva did emerge from the egg at the moment of oviposition, and that the vestibule removed the shell of the egg from it; cr, at all events, that this was the course at some periods of the year. In the species treated of in this paper the vestibule does not seem nearly as well fitted to perform this office as in *U. Krameri*, and it is an interesting fact that, although the eggs in the lower part of the oviduct had apparently attained their full size, and yolk-division had proceeded to some extent, yet not in one single instance among all my numerous dissections was there the least sign of a formed, or partially formed, larva in the egg. This may possibly be due to some difference of season or other cause, but the time of year did not differ much from that of the former investigation, the present being in August and September, the former in July and August; it seems probable, therefore, that in the species now considered the larva does not emerge from the egg until longer after its deposition, and this may well account for the differences in the structure of the vestibule.

* Loc. cit.

SUMMARY

OF CURRENT RESEARCHES RELATING TO

ZOOLOGY AND BOTANY

(*principally Invertebrata and Cryptogamia*),

MICROSCOPY, &c.,

INCLUDING ORIGINAL COMMUNICATIONS FROM FELLOWS AND OTHERS.*

ZOOLOGY.

A. VERTEBRATA:—Embryology, Histology, and General.

a. Embryology.†

Weismann's Theory of Heredity.‡—Professor A. Weismann has published an important explanation of his views, in answer to a recent criticism by Prof. Vines. The difficulty which led the critic to regard it as "absurd to say that an immortal substance can be converted into a mortal substance" is due to a confusion of two conceptions—immortality and eternity. It seems to Weismann to be incontrovertible that the Protozoa and the germ-cells of the Metazoa are in a certain sense immortal; though we have to do with individuals of indefinite duration, it by no means follows that this duration is eternal, for these individuals must have had a beginning. Eternity, to express it accurately, is merely the negation of the conception of transitoriness. As was said years ago, the immortality of these cells is not absolute, but potential; it is not that they must live for ever, as the gods of the ancient Greeks; they can die—the greater number do in fact die—but a proportion of them live on. Here, as elsewhere, life depends on metabolism, or a constant change of material; that, then, which is immortal is not the substance, but only a definite form of activity. The cycle of life is like the circulation of water, which evaporates, gathers into clouds, and falls as rain upon the earth, always to evaporate afresh. As in the physical and chemical properties of water there is no inherent cause for the cessation of the cycle, so there is no clear reason in the physical condition of unicellular organisms why the cycle of life, i. e. of division, growth by assimilation, and repeated division, should ever end; and this characteristic it is which Weismann has termed immortality.

If then this true immortality is but cyclical, and is conditioned by

* The Society are not intended to be denoted by the editorial "we," and they do not hold themselves responsible for the views of the authors of the papers noted, nor for any claim to novelty or otherwise made by them. The object of this part of the Journal is to present a summary of the papers *as actually published*, and to describe and illustrate Instruments, Apparatus, &c., which are either new or have not been previously described in this country.

† This section includes not only papers relating to Embryology properly so called, but also those dealing with Evolution, Development, and Reproduction, and allied subjects.

‡ Nature, xli. (1890) pp. 317–23.

the physical constitution of the protoplasm, why is it inconceivable that this constitution should be, under certain circumstances and to a certain extent, so modified that the metabolic activity no longer follows its own orbit, but after more or fewer revolutions comes to a standstill and results in death? Even if we cannot penetrate into the mysteries of the constitution of living matter, we may say that a rigorous and unceasing natural selection is unremittingly active in maintaining it at such an exact standard as to preserve its immortality, and every lapse from this standard is followed by death.

From the instant that natural selection relaxed its watch on this quality of immortality, the process of panmixia, which led to its abolition, began. When once individuals arose among monoplastids, in the protoplasm of which occurred such variations in chemical and molecular constitution as to result in a gradual check on the metabolic cycle, it would happen that these individuals died; a permanent variety could not grow out of such variations. But, if there arose among heteroplastids individuals with a similar differentiation of the somatic cells, the death of these cells would not be detrimental to the species, since its continuance is insured by the immortal germ-cells. After the differentiation into germinal and somatic cells natural selection was, speaking metaphorically, trained to bear on immortality in the germ-cells, but on quite other qualities in the somatic cells.

The recent observations of Klein on *Volvox* show that as soon as the germ-cells are ripe and emerge from the spheres, the ciliated somatic cells begin to shrivel up, and die in one or two days.

The immortality of living matter is not life without beginning or end, but life which, after its first commencement, can continue indefinitely with or without modification; it is a cyclical activity of organic material devoid of any intrinsic momentum which would lead to its cessation, just as the motion of the planets contains no intrinsic momentum which would lead to its cessation, although it has had a commencement and will some day, through the operation of extrinsic forces, have an end.

After pointing out the differences between "ideal" and "real" theories and the relation of his own theory to that of Darwin's theory of pangenesis, Prof. Weismann explains that his essays represent a series of researches, and urges that an early must not be set against a later expression of opinion. He does not recognize Prof. Vines' somatoplasm; his own idioplasm (or germ-plasm) of the first ontogenetic grade is not modified into the somatoplasm of Vines, but into idioplasm of the second, third, hundredth, &c., grade, and every one impresses its character on the cell containing it.

Our author is distinctly opposed to the rejuvenescence theory; he thinks we should not speak of the sexual elements as male and female, but as paternal and maternal; there is no opposition of the one to the other, they are essentially alike, and differ only so far as one individual differs from another of the same species. Fertilization is merely a union of the hereditary tendencies of two individuals, tendencies which are bound up with the matter of the nuclear loops; the cell-body of the ovum and spermatozoon is indifferent in this connection, and plays merely the part of a nutritive matter which is modified and shaped by the dominant idioplasm of the nucleus in a definite way, as clay in the sculptor's hand. The different appearance and function of ovum and spermatozoon and their mutual attraction rest on secondary adaptations, qualified to insure that they shall meet and that their idioplasmata shall come into contact; and as with the cells, so the differentiation of persons into male and female is also secondary; the so-called sexual characters are nothing but adaptations to insure the union of the hereditary tendencies of two individuals.

Boveri has recently shown that Weismann and Strasburger are right in considering that the sperm-nucleus can play the part of ovum-nucleus and *vice versâ*, for he removed the nucleus from an Echinoid egg by agitation, introduced spermatozoa, got a regular segmentation and a complete larva which lived for a week. Furthermore, if eggs of *Echinus microtuberculatus* be fertilized with the spermatozoa of *Sphærechinus granulatus* (*sic: ? granularis*), larvæ are developed with the true characters of the second species. Although Weismann's first interpretation of the polar body of the metazoan ovum is probably not correct, his idea—that the first dominant protoplasm is different to that of a later period—is justified by subsequent researches; the last word has, probably, not yet been said on this question. Prof. Vines is probably right in questioning whether sexual reproduction is the only factor which maintains Metazoa and Metaphyta in a state of variability; at the same time, no one will dispute that it is a most active means of heightening variations and of mingling them in favourable proportions. Sexual reproduction has arisen by and for natural selection as the sole means by which individual variations can be united and combined in every possible proportion.

As to the inheritance of acquired characters, it is pointed out that Boveri's observations prove that, among animals, the body of the ovum contributes nothing to inheritance; if acquired characters are transmitted, they must be so by means of the nuclear matter of the germ-cells—in fact, by the germ-plasm, and that not in its patent, but in its latent condition.

Divergent Evolution and Darwinian Theory.*—The Rev. J. T. Gulick discusses his theory of divergent evolution under the heads of (1) Some degree of local separation under different environments; (2) Darwin's theory of natural selection through the advantage of the divergence of character; (3) Darwin's theory that exposure to different environments is essential to diversity of natural selection; (4) divergent forms of sexual selection, and (5) Darwin's reference to the causes which check the crossing of varieties. He concludes that, though Darwin has not recognized segregation, which is the independent propagation of different variations, as a necessary condition for the production of divergent races and species, he has pointed out one process by which segregation is produced in nature; this is geographical or local separation under different environments. This process is an important cause of segregation resulting in divergent evolution, but this is not the only cause producing segregation and divergence, for in some cases the isolated portions of a species, while exposed to the same environment, acquires divergent habits in the use of it; in other cases, without

* Amer. Journal Science, xxxix. (1890) pp. 21-30.

exposure to different environments the very process producing the isolation brings together those of one kind, as when individuals of a special colour prefer to pair together.

Degeneration of Ova.*—Prof. G. Ruge describes the degenerative processes in the egg-follicles of Vertebrates, especially in the unexpelled ovarian ova of Amphibians (*Siredon pisciformis* and *Salamandra maculosa*). The death of the ovum is followed by changes in the surrounding blood-vessels, and by a proliferation of the elements of the enveloping membranes. The dead ovum is penetrated by elements either belonging to the epithelium of the egg-cell or to the blood. The invading cells loosen the yolk material which is then removed by the vessels. Finally, in the shrivelled ovum, there remains only the material which is not readily absorbed. The whole follicle has a certain unity, and is implicated in the degeneration of the egg-cell. Prof. Ruge also gives a summary of similar processes observed by numerous investigators in fishes, reptiles, birds, and mammals.

Professor Rabl's Memoir on the Theory of the Mesoderm.†—Dr. R. S. Bergh, under the title of "Ein moderner Theoretiker und seine Methodik" has, as the title may lead us to suppose, a severe criticism on Prof. Rabl's theory of the mesoderm.‡

β. Histology.§

Morphology and Physiology of Cell-nucleus.‖—Dr. E. Korschelt has investigated the nuclei of ovarian and of secreting cells. In discussing the former he describes the change of form of the nuclei and their relations to their surroundings, taking as his chief text *Dytiscus marginalis*, but also other Insects, as well as *Antedon* and *Spinther*. The change of position of the nuclei is described in various Insects and Cœlenterates, and the structural changes of the nuclei of a number of forms are discussed. Under the same heads the nuclei of secreting cells are treated.

His investigations had the object of showing that the cell-nucleus is not only active during the multiplication of cells, but that it also exhibits its influence on the cells during the performance of other functions. For example, the nuclei of ovarian cells send out processes towards the region in which the cell is taking up substance, and in secreting cells processes of the nuclei are directed to that part of the cell in which secretion is going on. From this we must conclude that the nucleus in one case affects the ingestive, and in the other the secreting activity of the cell. Moreover, the nucleus often loses its sharp boundary-line in such places, and its contents appear to pass over into the cell-protoplasm; this indicates an intimate relation between the substances of the cell and of the nucleus.

The disappearance of the cell-boundary and the closer connection between nucleus and cell-substance effected thereby calls to mind the disappearance of the nuclear membrane in karyokinesis—a process

* Morphol. Jahrb., xv. (1889) pp. 491–554 (4 pls.).
† Zool. Anzeig., xiii. (1890) pp. 17-24. ‡ See this Journal. ante, p. 16.
§ This section is limited to papers relating to Cells and Fibres.
‖ Zool. Jahrb., iv. (1889) pp. 1–154 (6 pls.).

which has certainly been seen by many observers. There is no doubt that in karyokinesis the nucleus has an essential influence on the cell. There is an indistinct boundary in most of the branched nuclei of the nutrient cells of the ovaries of Insects, and often also in those of the spinning-glands of caterpillars; here, too, we may conclude that the nucleus exercises a direct influence on the cell. In secreting cells the indistinctness of the nuclear boundary is often manifest. In the nutrient cells of Insects' ovaries, in the spinning-glands of the larvæ of Lepidoptera, Neuroptera, and certain Hymenoptera the nuclei, without distinct boundaries, extend through the whole cell, send out processes, and ramify. In this way they are brought into close contact with all parts of the cell, and can thus best exercise their influence.

We cannot doubt that the nucleus takes up and gives off substance when we see how the nucleus increases and diminishes in size; this can be best followed out in the ovarian cells of *Dytiscus marginalis*. A change in the structure of the nucleus is connected with the share it takes in the activity of the cell; these changes find expression in the heaping up of masses of chromatic substance which disappear again later on. Nuclear bodies may be present in or absent from the nuclei, and in the former case, they may vary both in number and form. The germinal spots have, notably, had especial significance ascribed to them. In the young ovarian nuclei of Insects, and in the nuclei of the secreting double cells of the ovaries of *Nepa* and *Ranatra* there are large bodies which, later on, partly disappear. The nuclei of the spinning glands have very different structures at different times; the plexus has various phases of closeness, and by the disappearance of the network the nuclei get to have an empty appearance, and have a large quantity of achromatic substance in their interior. The nuclei of the spinning gland of *Cladius difformis* present other characters; the nuclei of the glandular cells are at first spherical, but later on they branch, and at last appear only as thin filaments of homogeneous structure which stain deeply.

The author discusses the views of previous writers on the function of the nucleus, and comes to the conclusion that the separation of the nucleus from the cell-protoplasm is only apparent. In reality there are close connections between them; where there is a nuclear membrane, there may be diffusion, or there may be spaces in the membrane by which the two may communicate, or there may be no membrane when the network of the nucleus passes directly into that of the cell-protoplasm. At different times the nucleus has different relations to the plasma, and these are sometimes closer than at others; there is no doubt that this is connected with the functions of the cell in which the nucleus takes part. But the removal of the boundary does not always seem to be sufficient, for in some cases the nucleus changes its position, and makes its way to the part of the cell which is in the greatest activity. The change in form may be temporary or permanent. The influence of the nucleus does not appear to be requisite for all the manifestations of the activity of the cell—for example, the non-nucleated parts of Algar cells were found to be capable of assimilation, but they were, on the other hand, unable to form a new cell-membrane. Non-nucleated particles of Infusoria are incapable of replacing lost parts, while nucleated pieces do so easily.

Karyogamic Reduction in Oogenesis.*—M. A. Lameere publishes an abstract of a memoir which has for its object the demonstration of the view that the polar globules cannot represent the elements eliminated from the egg to be replaced by the nucleus of the spermatozoon. Prof. E. Van Beneden has lately shown that in the division of the spermatogonia of *Ascaris megalocephala* there is an expulsion of polar globules, and he comes to the conclusion that the ripe ovum and the spermatozoa are homodynamous. The author reports the discovery, in the narrowest portion of the ovary of the just-mentioned worm, of residual corpuscles, identical in structure and probably in origin with those of spermatogenesis. After a number of direct divisions the nuclei of the primitive ova exhibit kinesis, and two chromatic loops are expelled, which appear to together constitute a residual corpuscle. These bodies are at first hyaline. The author concludes, therefore, that the ovum and the spermatozoa undergo, in a parallel manner and under the form of the expulsion of residual corpuscles, the karyogamic reduction which indicates the formation of pronuclei.

Karyokinesis in Larval Amblystoma.†—Mr. J. A. Ryder reports that a species of this genus of Urodeles affords by its embryos exceedingly interesting subjects in which to study karyokinesis and indirect cell-division. Nuclear spindles could be easily detected in all the tissues of the body in the greatest variety of stages. This creature is an excellent subject for histological teaching, as it illustrates the fact that karyokinesis is universal and holds with respect to all the tissues during the early stages of development. As the cells are very large, the spindles are also so; the filaments of chromatin are very large, thick, and sharply defined, so that all the phases of nuclear metamorphosis may be readily traced with moderate powers.

To prepare the embryos, they were killed and hardened with corrosive sublimate or Kleinenberg's picro-sulphuric acid. After hardening and washing in alcohol, the embryos were stained *in toto* in a dilute solution of hæmatoxylin, Kleinenberg's or Delafield's answering admirably; the chromatin threads being deeply stained with the dye contrast with the rest of the substance of the cells. Sections should be made in transverse as well as in vertical and horizontal planes.

Leucocytes in Tail of Tadpole.‡—Herr A. Looss in a memoir discusses the share taken by leucocytes in the destruction of the tissues of the tail of the tadpole. It would appear that Metschnikoff's conclusions have been given too wide a bearing, for in the metamorphosis of the frog they play a much more subordinate part than in the Diptera and invertebrate animals generally. The leucocytes would seem to form a kind of reserve force for the animal body which only comes into prominent use if the organism is unable, with the ordinary means at its disposal, to perform certain extraordinary duties, or to struggle against special difficult relations. Herr J. H. List remarks that we have in the doctrine of Phagocytes another example of a generalization made without sufficient critical observations in Invertebrates and Vertebrates.

* Bull. Acad. Roy. de Belgique, lix. (1889) pp. 712–4.
† Amer. Natural., xxiii. (1889) pp. 827–9.
‡ Biol. Centralbl., ix. (1889) pp. 595–9.

Origin of the Red Blood-corpuscles.*—Sig. F. Sanfelice maintains that the red blood-corpuscles originate from leucocytes within the medulla of the bones in the four highest classes of Vertebrates, and within the lymphoid tissue of Elasmobranchs. In mammals the hæmatic transformation, invading the nucleus, occasions its disappearance. The giant cells of the medulla of mammals are due to the leucocytes of the matrix or to young nucleated red blood-corpuscles; both kinds are retrograde fusions of cells and nuclei. Bleeding or reduction of nutriment increases the karyokinesis of the leucocytes. In the non-functional medulla of the long bones of the fowl there are reserve lymphatic accumulations ready to be changed into red blood-corpuscles. The elements found in the lymphoid tissue at the sides of the œsophagus and in the gonads of Selachians are identical with the constituents of the medulla in higher Vertebrates.

γ. General.

Marine Phosphorescence.†—Dr. E. v. Marenzeller has published an instructive lecture on this always interesting subject; attention is drawn in it to the work of Prof. B. Ratziszewski, which, though published in 1880, is not widely known in this country.

Deep-water Fauna of Clyde Sea-area.‡—Mr. W. E. Hoyle has made a critical examination of the species collected, chiefly by Dr. John Murray, in an extensive series of dredgings in various parts of the Clyde area. The richest fauna is in those basins that are in closest proximity to the sea, and the wealth diminishes as we proceed into the more land-locked portions of the district. Most of the species are dispersed more or less widely over the north temperate regions of the globe, while the smaller half is very unequally divided between northern and southern species, the former being five times as numerous as the latter. It would seem that the bottoms of the remoter basins have a fauna which approaches the more seaward basin in respect of variety more nearly than do their faunæ taken as a whole. It is possible that, in these basins, there is, in addition to the fauna derived from the present outer seas, a fauna which has been in them for a much longer period. The Clyde deep-water fauna has marked Arctic and Scandinavian affinities.

B. INVERTEBRATA.

Fauna of Transcaspia and Khorasan.—Dr. O. Boettger and Dr. A. Walter report, the one on the Mollusca § and the other on the Galeodidæ ‖ and Crustacea ¶ collected by Dr. Walter in the land lying east of the Caspian and in Khorasan. Only forty-nine Molluscs were collected, and this number is too small to allow any faunistic comparisons which could be regarded as satisfactory. Dr. H. Simroth adds some notes on the anatomy of *Lytopelte* and *Parmacella*. Seven species of Galeodidæ were collected, among which is a new genus called *Karschia*.

* Bull. Soc. Nat. Napoli, iii. (1889) pp. 143–68 (2 pls.).
† 'Ueber Meerleuchten,' Wien, 1889, sm. 8vo, 27 pp.
‡ Journ. Linn. Soc., xx. (1889) pp. 442–72 (1 map).
§ Zool. Jahrb., iv. (1889) pp. 925–92 (2 pls.).
‖ T. c., pp. 1095–1109 (1 pl.). ¶ T. c., pp. 1110–23.

Of the Crustacea, the Isopoda and Amphipoda are alone reported on in this number.

Relationship of Annelids and Molluscs.* — M. A. Giard draws attention to a report of the Academy of Sciences in which M. Roule is credited with pointing out the relationship of Annelids to Molluscs; and he gives quotations from papers of his own, one as early as 1876, in which that affinity was urged. He found some difficulty in homologizing the schizocœle of the higher Gymnotoka (= Mollusca, Annelida, Brachiopoda, and Ciliata), with the enterocœle of such lower members as the Brachiopoda and *Sagitta*. Now, however, he feels he may generalize; he finds that when, in the development of allied animals, an organ sometimes arises by a process of invagination or folding and at other times by cleavage or hollowing out, the latter mode of formation is to be considered as a condensation of the former. M. Giard has not seen in any of the embryonic Annelids which he has studied, the syncytium described by Roule; indeed, the contours of the ectodermic cells may always be demonstrated by suitable reagents.

Mollusca.

Sensory Organs of Lateral Line and Nervous System of Mollusca.† —Dr. J. Thiele was led to investigate the sensory organs of the lateral line in Molluscs from a suspicion that the abdominal sensory organs of Lamellibranchs might be the homologues of those found in the Capitellidæ. In a small Mediterranean *Chiton*, which perhaps deserves to be placed, on account of its peculiarities, in a special genus, eye like organs were seen which presented considerable differences from those described by Moseley, and in addition, there were movable setæ at the sides of the body which appeared to be tactile organs. In the nervous system the swellings of the dorsal ring which are regarded as cerebral ganglia, the direct connection of the latter with the anterior visceral ganglia, and, above all, the numerous connectives between the ventral and lateral cords are of importance. The author has observed in a *Proneomenia* hypodermal processes, which are similar to those described by Hubrecht in *P. Sluiteri*, but they differ in having no spicules, and are regarded as sensory organs. Young specimens of *Arca Noæ* have in the anterior part of the mantle two proportionately large pigment cups, the concavity of which is directed to the sides. Lateral organs such as those known in *Fissurella* and *Trochus* have been discovered in *Haliotis*, and are described by the author; these are not limited to the epipodium, but are found also on other parts of the body. The cephalic tentacles are regarded as the anterior terminal tentacles of the epipodium.

The nervous system of *Haliotis* is described as having the upper œsophageal ring divided into three portions which lie one above the other; of these the lowermost becomes separated to form a commissure beneath the œsophagus, while the two others pass into the pleuropedal connectives.

Proofs are afforded by comparative anatomy that the upper œsophageal ganglia of Polyclads, Annelids, and Solenogastres are not

* Comptes Rendus, cx. (1890) pp. 90–3.

† Zeitschr. f. Wiss. Zool., xlix. (1889) [1890], pp. 385–432 (2 pls.).

homologous with the cerebral ganglia of Molluscs, but that these centres rather correspond to the lateral œsophageal ganglia of *Neomenia.* Structures homologous with the small œsophageal ring of Solenogastres are found in Annelids, *Chiton*, *Haliotis*, *Dentalium*, and *Meleagrina;* there are no anterior visceral ganglia in Solenogastres or Annelids, but they are to be found in all true Molluscs, except Lamellibranchs.

Homologues of the sensory organs of the lateral line of Chætopods are to be seen in the sensory organs found at the edge of the mantle of Lamellibranchs and in the epipodium of the Rhipidoglossa, while the gills of Chitons are derived from homologous cirri. It is in agreement with this that the ganglia of the lateral organs of Chætopods, the nerve of the edge of the mantle of Lamellibranchs, and the ganglia in the epipodium of the Rhipidoglossa are homologous with the lateral cords of the Amphineura, while the two ventral pairs of ganglia of Lamellibranchs, the anterior of which is the centre for locomotion, and the posterior for the protection of the animal, and the pedal ganglia of Gastropods correspond to the ventral cords of the ventral medullæ of Annelids.

It will be noticed that a distinction is drawn between the ventral cords, and the lateral cords and cerebral ganglia; this is justified by their modes of innervation, and largely also by the histological structure of the centres; the ventral cords and their homologues correspond, in their general characters, to the dorsal medulla of the Chordata.

α. Cephalopoda.

Tract of Modified Epithelium in Embryo of Sepia.*—Mr. W. E. Hoyle has found a trifid tract of peculiarly modified ectodermal cells near the posterior aspect of the body of embryos of *Sepia.* The three ridges are clearly visible by the naked eye in embryos 5 to 8 mm. long, and seem to have been noted by Kölliker who, however, gives an incorrect account of their origin. The cells are larger in all dimensions than those of the adjacent epithelium, so that the level of the body is slightly elevated where they are present; the contents of the cells are finely granular, and stain more deeply than those of the normal epithelium; the cell-boundaries become indefinite towards the superficies, and, in some cases, this part of the tract stains more deeply than the rest.

The presence of a similar organ has been observed in embryos of *Loligo* and *Ommastrephes*, but in them the median portion only was seen. The function of the patch is probably glandular; as to its homology the author can only suggest the shell-gland and the invaginated gland which has been described as existing at the posterior extremity of *Sepiella.*

Innervation of Arms of Cephalopoda.†—Sig. G. Jatta maintains the pedal nature of the Cephalopod arms, inasmuch as the brachial nerves originate, according to his investigation, from the pedal ganglion, to which the brachial ganglion may be considered accessory.

* Proc. Roy. Phys. Soc. Edinb., x. (1889) pp. 58–60.
† Boll. Soc. Nat. Napoli., iii. (1889) pp. 129–32.

β. Pteropoda.

Morphology, Classification, and Chorology of Pteropoda.*—Dr. J. E. V. Boas, from a close comparison of the thecosomatous and gymnosomatous divisions of Pteropods, comes to the conclusion that they ought to be regarded as two independent groups. They are both so close to the Opisthobranchiata that they may be regarded as suborders of that order of Gastropods; as the present names of Thecosomata and Gymnosomata are inconvenient, they may be respectively replaced by Eupteropoda and Pterota. As the groups are distinct, they must not be together compared with the Cephalopoda, but independently of one another; if the Thecosomata are compared with Cephalopods, they are seen to have no other point of comparison except the pallial cavity; and, if we consider the isolated position which the Cephalopoda hold in relation to the rest of the Mollusca, it becomes clear that this single point of resemblance cannot be regarded as an argument in favour of a closer connection between the two groups. The same considerations apply to the Gymnosomata—in a single point, the presence of suckers on their arms, they resemble the Cephalopoda. The author regards these resemblances as analogical only.

After discussing in detail the organization of the Thecosomata, Dr. Boas considers what place they occupy among the Opisthobranchiata. He thinks it obvious that they approach most closely to the Tectibranchiata. In a large number of these latter, as in the Thecosomata, there is a muscular gizzard, which is provided with a varying number of teeth or horny plates. In the Bullidæ, as in the Thecosomata, the liver is a compact organ, which opens behind the gizzard, and has two excretory ducts in the former and one in the latter. The genital organs, and especially the penis, are also very characteristic; in both the genital orifice is simple, the penis is a sac which can be evaginated, and only communicates with the genital orifice by a groove.

In the Thecosomata the cerebral ganglia are connected with one another by a long commissure, while all the other commissures are very short, so that all the large ganglia are placed near one another; of such Opisthobranchs as have had the anatomy of their nervous system adequately studied, the Bullinæ most resemble the Thecosomata. The existence of a well-developed shell and of an operculum in Limacina are further proofs of the author's position, for it is only in *Tornatella* (one of the Bullidæ) that there is an operculum. The Thecosomata are divided into the Limacinidæ, Hyaleidæ, and Cymbuliidæ, and their genera and species are described. The last-named family is the one which bears the strongest marks of adaptation to a pelagic mode of life—the "shell" is semi-gelatinous, the viscera are concentrated into a nucleus, the nuclei are reduced, the pigment is limited to the nucleus, and the rest of the body is transparent.

The Gymnosomata have their chief affinities also with the Tectibranchiata, as is shown by the characters of their generative apparatus; in other points there is not so close an agreement, but there is nothing to render it improbable. The characters which speak in its favour are the presence of a gill on the right side in some genera and the large number

* Skrift. K. Danske Vid. Selsk., i. (1886) 231 pp. (8 pls.).

of hook-like teeth in each row on the radula. Dr. Boas is not certain as to what members of the Tectibranchiata most resemble this group of "Pteropods"; the resemblance presented by *Gastropteron* may only be analogical.

The thecosomatous Pteropods have a very wide area of distribution, but may be separated into three groups: a small one found in cold northern waters, one limited to the temperate (and ? cold) seas of the south, while most of the species are found in all warm tropical and temperate seas in such a way that each species has its own northern and southern limit. Less is certainly known as to the geographical distribution of the Gymnosomata, but some species are very widely spread; in general their chorological characters appear to be similar to those of the Thecosomata.

γ. Gastropoda.

A Heteropod in British Waters.*—Prof. W. C. M'Intosh, by recording the capture of an *Atlanta* in St. Andrews Bay, has informed us of the presence of an example of a group of Molluscs formerly unknown in British seas. Hitherto they have been considered characteristic of the pelagic fauna of more genial waters. All recent investigations, however, tend to enlarge the area of truly pelagic types, and to raise the question whether temperature alone is the cause of the appearance in and disappearance from our seas of such types. Temperature certainly seems to have a marked effect on the vertical distribution of certain types and of the pelagic ova of fishes; but in the present case the influence of currents is probably of greater importance.

Reproductive Apparatus of Aplysiæ.†—M. E. Robert finds that this apparatus consists of five parts: the hermaphrodite gonad, the efferent duct, a complex organ to which he gives the general name of annexed genital mass, the common genital canal which opens on the right and in front of the gill, and the external genital groove. In the annexed mass the spermatozoa and ova become separated, and the latter are fertilized; albumen becomes added to the eggs, and shells are formed, each of which contains some scores of eggs, connected with one another and forming a continuous band arranged in heliciform shape, with closely approximated whorls; around these masses a cylindrical gelatinous sheath is formed. The efferent canal penetrates into the interior of the mass and opens into a cavity, which is a kind of vestibule or common chamber which communicates with several other organs. The albumen gland, which opens into this chamber, is hidden by the neighbouring parts, and can only be seen in the upper right region. To the left the common chamber is continuous with a glandular organ, which receives the name of "glande contournée"; its glandular walls are folded in such a way as to divide its cavity into a large number of small alveoli. The mucus-gland is formed by a very long hollow ribbon, provided in its interior with a double row of glandular lamellæ, between which there is a cavity. The common genital canal extends from the annexed mass to the genital orifice; it is divided into several special

* Ann. and Mag. Nat. Hist., v. (1890) pp. 47–8.
† Comptes Rendus, cix. (1889) pp. 917–9.

ducts, which are bounded by folds which project inwards. A large glandular duct formed of two applied folds extends from one extremity to the other, and divides the canal into two portions; the duct on the right is both oviduct and deferent canal, that on the left is the vagina, which terminates inferiorly in a cul-de-sac with which the terminal reservoir is connected; this is always filled with absolutely pure sperm. The external genital duct takes such a course as to make the vaginal orifice a special one, and this explains how it is that the animal which is playing the part of the female may be laying eggs at the same time that it has the penis of the male in the vagina.

It would appear that the organs function thus: the sexual products reach the common chamber, where the ova are fertilized by the sperm collected during copulation in the seminal reservoir; here, too, they get albumen. The products then pass into the twisted and mucus glands. When the animal emits the sperm follows the groove which is continued all along the erected penis and is introduced into the vagina of the female.

Glands of Aplysiæ.*—Sig. G. F. Mazzarelli describes the "opaline" or "grape-like," and the branchial or mantle glands in *Aplysiæ*. In *Aplysia limacina*, the glandular cells of the gill-cover emit a violet liquid only, while the opaline gland produces a white, or a purple, or a mixed white and purple secretion. In *A. depilans*, the opaline gland usually emits a white liquid only; the other gland produces the same, or plus a violet secretion. In *A. punctata*, the secretion of the opaline gland is white, or white and violet mixed, while that of the gill-cover gland is violet. There is thus no constancy in the origin of either liquid, nor has the observer discovered any reason why the secretion should be so variable. The secretion is protective, concealing the *Aplysia* in the exuded pigment, or disgusting enemies by the strong odour.

δ. Lamellibranchiata.

Nature of Byssus.†—Dr. R. Horst claims to have shown that the byssus-groove, in which the byssus-filament is formed, is continued into the byssus-cavity, into the wall of which it gradually passes; this cavity is, for its whole extent, surrounded by secreting gland-cells. When, therefore, a byssus-filament is formed, it is easy to understand that there is at the same time a secretion in the cavity, and in this cavity a lamella continuous with the byssus-filament is developed. As every successive lamella incloses its predecessor as in a sheath, and they all unite to form the byssus-stem, an increase in the number of byssus-filaments is connected with a growth in length and thickness of the byssus-trunk.

Hinge of Pelecypods and its Development.‡—Mr. W. H. Dall discusses the characters and development of the hinge of the shell of Pelecypods (more commonly known as Lamellibranchs), and attempts to form a better subdivision of the group than has been proposed hitherto. The author thinks that there can be but three fundamental types of hinge,

* Zool. Anzeig., xii. (1889) pp. 580-3.
† Tijdschr. Nederland. Dierk. Ver., ii. (1889) pp. 248-59 (1 pl.).
‡ Amer. Journal of Science, xxxviii. (1889) pp. 445-62.

which may be called anodont, prionodont, and orthodont. The last, in which the cardinal margin has become longitudinally plicate, hardly exists ; in nearly all forms traces of the prionodont characters are mingled with it. For those forms in which the archaic anodontism still persists as the characteristic of chief importance, though frequently modified by special mechanical contrivances which to a certain extent mark the type, the term of *Anomalodesmacea* is proposed. Forms in which transverse plication of the hinge is the chief characteristic may be called the *Prionodesmacea*, while those which have the various types of hinge harmoniously combined are called the *Teleodesmacea.* Thus these groups may be regarded as orders, and each, as it now exists, contains archaic and modern specialized types; each has a tendency towards an ideal of fitness to the environment which results in a certain parallelism of minor characters common to minor groups in each of the three orders. In each certain members show affiliations with members of the other orders, and in each there are certain groups which represent a relatively modern specialization carried so far as to be quite peculiar.

The suborders of the Anomalodesmacea are :—1. Solenomyacea ; 2. Anatinacea ; 3. Myacea ; 4. Eusiphonacea ; and 5. Adesmacea. Of the Prionodesmacea :—1. Nuculacea ; 2. Arcacea ; 3. Naiadacea ; 4. Trigoniacea ; 5. Mytilacea ; 6. Pectinacea ; 7. Anomiacea ; and 8. Ostracea. Of the Teleodesmacea :—1. Tellinacea ; 2. Solenacea ; 3. Mactracea ; 4. Carditacea ; 5. Cardiacea ; 6. Chamacea ; 7. Trinacreacea ; 8. Leptonacea (?) ; 9. Lucinacea ; 10. Isocardiacea (?) ; 11. Veneracea. The position of the Rudistes is uncertain, but they may be a specially modified and extraordinary branch of the Chamacea.

The author gives the reasons for preferring his views and classification to those of the late Dr. Neumayr, with whom, however, he is in agreement as regards many important points.

Fourth Pallial Orifice of some Lamellibranchs.*—Prof. P. Pelseneer finds that, when there are four openings in the mantle of a Lamellibranch, there is a relation between the fourth orifice and that of the byssogenous apparatus. In some forms in which the mantle is a good deal closed, and the foot as a locomotor organ reduced, while the byssus is considerably developed, the primitive pedal orifice is divided into two secondary orifices ; the anterior of these remains a pedal orifice, the other is only used for the passage of byssus ; such an arrangement was observed in *Lyonsia.* In Lamellibranchs with four pores, which are probably the descendants of forms organized like *Lyonsia*, the byssogenous apparatus is atrophied and the pallial orifice for the byssus has followed the retrogression ; it is reduced to a small hole which is generally found at the point occupied by the byssal orifice of *Lyonsia*, and opposite the spot where the byssogenous apparatus is normally developed in Lamellibranchs. This fourth orifice may then be considered as the remnant of the opening which served exclusively for the passage of the byssus.

* Comptes Rendus, cx. (1890) pp. 154–6.

Molluscoida.

β. Bryozoa.

Critical Notes on Polyzoa.*—The Rev. T. Hincks has published the second part of his critical notes on Polyzoa, in which he deals with classification; the paper is too critical and controversial to be abstracted, but it appears to be of great value in the present state of the classification of this difficult group.

Development of Bryozoic Colony in Fertile Statoblasts.†—Herr F. Braem describes the statoblast from which a colony of Bryozoa arises as a mantle of ectodermal cells, which inclose a yolk-mass in which there are a number of nuclei. This mass is the product of those funicular cells which constitute the young statoblasts. While the protoplasm contained in the yolk becomes bounded off into cells around the nuclei, which, for the most part, lie close to the ectoderm, the basis is laid down of an internal epithelium which spreads out between the ectoderm and the yolk-mass. It grows by the deposition of new cells as well as by the ingestion of yolk-substance. In one region the ectoderm of *Cristatella* shows a marked change; as its cells increase considerably in size and height they form a cylindrical epithelium which soon gives rise to a definite germinal disc; this covers the greater part of the shell, but with a tendency to lie on one side. This disc is the rudiment of the first polypide of the future colony; its peripheral margin becomes more and more contracted as a circular groove sinks in from without; at the point where the margins of the groove fuse with one another the cervical portion of the bud is developed, and it is by means of this that the bud remains in connection with the body-wall. A further series of changes result in the differentiation of an anal and oral region in the bud. In front of the anus the rudiment of the central nervous system appears in the form of a slight depression of the inner layer of the bud, which corresponds to the outer ectodermal layer of the wall of the statoblast. Still nearer the mouth there is the sharply marked incision between the arms of the lophophore, which does not yet reach the oral base of the central cone; here, too, is an invagination which will form the œsophageal portion of the digestive tract; it curves towards the closed end of the anal tube, which has already attained a considerable size. The later processes are essentially the same as those seen in budding in the stock.

The author promises a full account of his investigations.

Arthropoda.

α. Insecta.

Evolution of Papilionidæ.‡—Prof. G. H. T. Eimer has given a practical illustration of his conclusions as to the origin of species,§ in a treatise on the varieties and species of *Papilio*. Taking the four

* Ann. and Mag. Nat. Hist., v. (1890) pp. 83–103.

† Zool. Anzeig., xii. (1889) pp. 675–9.

‡ 'Die Artbildung und Verwandtschaft bei den Schmetterlingen. Eine systematische Darstellung der Abänderungen, Abarten und Arten der Segelfalterähnlichen Formen der Gattung Papilio,' 8vo, Jena, 1889, pp. 243 (23 figs.); also an atlas with 4 folio coloured plates.

§ See this Journal, 1889, pp. 31–3.

groups (1) *Podalirius*, (2) *Antiphates*, (3) *Leosthenes-Anticrates-Ajax*, and (4) *Ajax-Policenes*, he seeks to show how the variations exhibit orderly progress along definite lines of evolution. Thus the ground-colour tends to pass from yellow into green; in (1) green appears at the roots of the wings; in (2) likewise and also at the angles; in (3) green predominates, and that completely in the American forms; in (4) the same is true. The colouring depends upon a pigment, its alteration on constitutional and environmental conditions. But the regularity of variation is even more striking when the markings—bands, lines, and spots—are studied, the author's contention being that all the variations are definite and progressive, sometimes towards greater complexity, but as often towards simplification.

"All the details, even the minutest, show that the origin of variations, varieties, and species, depends throughout on orderly physiological changes in definite directions. Various characters change *pari passu* in correlative or kaleidoscopic modifications. There is nothing in the origin of new characters which can be referred to adaptation or sexual selection in the Darwinian sense." Nor will Eimer allow that a more than probable explanation of progressive variations can be found in the "principle of utility," still less in "fortuitous variation of the germ-plasma." Varieties and species represent forms which have remained (in "Genepistasis") at definite stages of a consecutive progress. The four groups have a common starting-point, and the two *Ajax* groups also spring from one root.

Ventral Glands of Caterpillars.*—Dr. C. Schäffer distinguishes four kinds of glandular organs in caterpillars. In *Vanessa Io* the ventral gland is very short and undivided; the wall of the tube has everywhere the same lattice-like appearance. In *Plusia gamma* the tube is longer than in *Vanessa*, but is still undivided; an efferent portion may be distinguished from the secreting; when in a state of repose the tube is twice folded. In *Hyponomeuta evonymella* the glandular apparatus consists of two portions, one of which is distinguished by a peculiar plasmatic structure and an investment of a setigerous cuticle. In *Harpyia vinula* the secretory median pouch has, near its opening, on either side two lateral lobed appendages, from the walls of which rather long setæ project into the lumen. The median pouch is not tubular in form.

Alimentary Canal of Lamellicorns.†—Dr. P. Mingazzini continues ‡ his account of the alimentary canal of phytophagous Lamellicorns, dealing now with the adult insects. Representatives of six genera (*Oryctes nasicornis*, *Phyllognathus silenus*, &c.) were studied. The œsophagus of *Oryctes* is described at length, with its internal chitinous cuticle, a stratum of matrix cells, a layer of large salivary cells, a slight layer of connective tissue supporting the secretory cells, and finally muscular fibres. As a second type Mingazzini describes the fore-gut of *Anoxia australis*, which is more primitive, there being no marked difference between matrix cells and salivary cells. The mid-gut is very uniform throughout its course and throughout the series. Internally the epi-

* Zool. Anzeig., xiii. (1890) pp. 9-11.
† MT. Zool. Stat. Neapel, ix. (1889) pp. 266-304 (3 pls.).
‡ This Journal, *ante*, p. 30.

thelium bears the functional secretory and small matrix cells, and there are also special accumulations of small cells forming "gastric follicles." Then follow a subepithelial connective layer, transverse muscles, more connective, longitudinal muscles, and ensheathing connective. The changes in the secreting cells are discussed; they conform with those described by Plateau, Frenzel, and others. The hind-gut varies not a little in different species; a slender portion, a sac, and a rectum are present as in the larvæ, and have similar functions. Indeed, the whole gut of the adult corresponds functionally and structurally with that of the larva. The gut of *Anoxia* and *Anomala* (and the Melolonthidæ generally) differs but slightly from that of *Cetonia* or *Tropinota*, but is more primitive than that of *Oryctes* or *Phyllognathus*, facts which agree with the systematic relations of these genera. The surface or the length of the mid-gut increases as the nutritive value of the food diminishes. Mingazzini compares the salivary glands of *Scarabæus* with the salivary cells in *Oryctes*, *Anoxia*, &c., to show the gradual differentiation of these secretory structures. He is unable to find the fibrillar structure of the chitin described by Minot, nor does he believe in the existence of a chitinous stratum in the mid-gut, as maintained by Schneider.

Coleopterous Larvæ and their Relations to Adults.*—From the abstract of Mr. H. W. Conn's paper we learn that he has arrived at certain conclusions; they are based on the study of the larvæ of beetles; this group was selected as it shows the greatest amount of variation within a single order. A Campodeoid form was taken as the starting point, as it is the most widely distributed and has frequently been regarded as the closest living representative of the ancestral insect.

With the exception of the Campodeoid type, which is found in a number of families, all beetle larvæ have secondary modifications which have been introduced during the larval life of the beetles, and have never been represented by any adult features. Though they do not represent ancestral stages they may teach relationship, since the presence of a similar larva may indicate a recent common ancestor.

Amid the immense variety of larvæ four somewhat distinct types may be recognized; there is the Campodeoid, a type slightly and variously modified from it, a Scarabid type, and a maggot-like type, like that of the weevils. In many cases it is possible to determine definitely the sort of conditions that have produced the present type.

The division of larvæ into types seems to have no relation to the classification of adult insects into suborders, but that of the families of larvæ does run parallel to the classification of the families of adults. The many exceptions to this rule may, in part, be easily explained by differences in habit, and are most common in the degraded types of larvæ. On the whole, the present larval types of beetles are about as old as the families, but not much older. If we adopt the present classification of adult beetles we must own that the amount of departure from the primitive larval type that any family of beetles present is no indication of the position in the scale of classification that the adults should occupy. It seems probable that the larva has been the first to modify its habits, and that the adult has subsequently acquired habits

* Proc. Boston Soc. Nat. Hist., xxiv. (1889) pp. 42–5.

related to it; the larval stage would seem, therefore, to be more important than the adult; at all events it is more thoroughly protected, and is the first to be adapted to suit its surroundings. The larvæ of beetles are much more diversified than the adults.

Although habits and conditions that surround the larvæ have been very important features in the production of the present larval forms, some other force—which is undoubtedly heredity—has been at work in retaining them. The characteristics used for classifying adults cannot be used for the larvæ—thus the antennæ have an almost uniform shape, and the mouth-parts seem to have but little value; no similarity can be traced between the mouth-parts of any particular family of larvæ and those of the adults of the same family, but the mouth-parts of all beetles are more like those of adult beetles than they are like those of any other order of Insects. This is probably a case of precocious inheritance. In beetle larvæ there are numerous cases in which a similar larval type has been independently acquired in two or more families. Some of the above generalizations will probably be found to be applicable to all orders of insects, while others are peculiar to beetles.

Structure of Retina of Blowfly.*—Prof. B. T. Lowne returns to a subject on which there has already been much discussion, and criticizes particularly the memoir of Dr. S. J. Hickson, whom he accuses of making "an egregious misstatement of Dr. Weismann's nomenclature." He points out how Dr. Hickson and M. Carrière disagree, and allows that the former is right when he says that the nuclei of Carrière are not cells; they are developed from cells, and each consists of a bundle of fusiform rods. Hickson's nervous elements are "undoubtedly fine tracheal tubes," and his "neurospongium" or terminal anastomosis, which is inadmissible on physiological grounds, is no nerve-plexus at all, but the tracheal plexus, the sustentacular framework of Prof. Lowne's "retina." The author states that if the optic nerve be traced, its fibres are observed to run in larger or smaller bundles, invested in a very transparent sheath; they terminate in the palisade layer by entering the fusiform elements. The sheath is continued over these last, and terminates on the inner surface of the basilar membrane. The tracheal vessels ultimately pierce this membrane, and run between the great rods.

Prof. Lowne states that in size and structure the elements of the retina of insects are almost identical with those of vertebrates; the optic nerve terminates in the protoplasmic inner segment, while the outer is transparent, resists stains, exhibits longitudinal striæ, and swells up with water in both groups. In both it is easily destroyed, and frequently exhibits vacuolation. One difficulty in accepting the author's views has been the structure of the great rods, and he owns that their appearance is in many sections perplexing. In life they are hollow tubes filled and distended with fluid; in bad preparations they appear to be stellate in transverse section, and present no central cavity; in radial sections they are separated from each other by wide spaces which are often filled by distended tracheal vessels.

The results of a long research are to confirm in the main the

* Journ. Linn. Soc., xx. (1889) pp. 436-17 (1 pl.).

observations of Weismann on the development of the compound eye. Prof. Lowne comes to the conclusion that the retina is entirely formed as an outgrowth from the central nervous system, while the dioptron is formed from the external epiblast which is more or less invaded by mesoblastic elements.

Structure and Development of Ovaries of Blowfly.*—Prof. B. T. Lowne states that the "ovarian eggs" in the blowfly, and probably in other Insects, are yolks and contain no germ, while the so-called germ-glands are really germ-glands in which the germ-ova are developed. These ova pass into the yolks during their passage through the oviducts either as naked germinal vesicles, or as female pronuclei. The author urges the evidence of the observations made by himself, and the statements of other authors, when examined critically, as supports for the startling conclusions at which he arrives.

Habits and Metamorphoses of Eucephalous Larvæ of Diptera.†—Mr. F. Meinert has made a study of *Culex*, *Anopheles*, *Corethra*, *Mochlonyx*, *Chironomus*, *Tanypus*, *Dixa*, *Simulium*, and *Ceratopogon*.

He finds that the epicranium varies in size and extent; for it may occupy the whole of the superior region of the head as in *Corethra*, or only a third or a fourth as in *Dixa* and *Simulium*. The eyes may be large and compound as in *Culex* or very small and simple as in *Chironomus* and others. Though the ocelli are small they are sometimes larger than the true eyes. As a rule, the antennæ are large, but in *Ceratopogon* they can be only just detected. The scutum of the third metamere is ordinarily well developed, though here, again, there are exceptions; that of the second metamere is rarely very distinct. The sides of this metamere often carry a tuft of setæ or plates (rotatory organ) which attains the highest development in *Simulium*, although of large size in *Culex*, *Anopheles*, and *Dixa*. The first metamere (as opposed to the mouth) is always poorly developed or even rudimentary, and especially is this the case with the labrum. The labium is always devoid of palps, and has often the form of a strongly cornified layer, the anterior edge of which is denticulated. The maxillæ generally have only one large lobe; it is rare that there are two which are distinct. The palps are always distinct, except in *Ceratopogon*, where the maxillæ are altogether rudimentary. The mandibles may be simple, and have few or many rows of setæ, together with a large multifid tooth or a fan of dorsal plates.

The segments of the thorax are sometimes free and distinct; sometimes the anterior segment is alone free, and sometimes all three are almost fused. The nine segments of the abdomen are quite distinct; the eighth often carries two stigmata, either directly on the back or at the end of a rather long tube—the respiratory tube. In a larger number of cases the stigmata are completely wanting. Some species of *Chironomus* may push out two long tubular protuberances from the eighth segment. The ninth segment often carries a natatory fan. As a rule there are four anal papillæ, and a more or less large number of anal setæ at the extremity of this segment. *Corethra* and *Mochlonyx*

* Journ. Linn. Soc., xx. (1889) pp. 418–41 (1 pl.).
† Skrift. K. Danske Vid. Selsk., iv. (1886) pp. 373–493 (4 pls.).

have anal hooks. Pro-legs are sometimes found on the lower surface of the first thoracic, and of the last abdominal segments, but those of the former are often more or less fused. In *Simulium* they are completely fused and have the form of a cone, while the posterior pair is reduced to two feeble projections with a large number of microscopic hooks.

The respiratory apparatus varies greatly in the extent to which it is developed. In some genera there are two large longitudinal trunks which extend through the whole of the body of the larva and end by two open stigmata, while in other genera the apparatus is quite closed. The long trunks are divided into pieces which correspond to the segments of the body; in *Mochlonyx* the trunks keep their septa as a "souvenir de leur anastomose." Eight or nine pairs of solid lateral cords, ordinarily very delicate, pass from the epidermis to the longitudinal trunks. The tracheæ are at first full of serum, but later on become filled with air. When the tracheæ are renewed after ecdysis the old tubes are expelled to the exterior with a little air by the lateral cords, while the new tracheæ, which may be entirely filled with serum, have the serum only gradually driven out by the air in the body.

The trumpet-shaped organs of the nymph are at first filled with serum, but whether they have clefts or other openings, or whether they are closed, they become filled with air by the body. They are essentially hydrostatic organs or air-reservoirs, which serve to facilitate the last metamorphosis. The abdomen of the nymph ends in a pair of wide swimming-plates, and the last segment is wide and deeply incised; and this segment can scarcely be said to be a true respiratory organ.

The author concludes that the respiratory apparatus of Insects cannot be considered as a pure and simple formation of the epidermis, nor as resulting merely from the invagination of this layer. The connective tissue takes a more or less large part in the formation of the apparatus. In the larvæ here described the lateral cords essentially represent invaginations of the epidermis.

Ugimyia-Larva.*—Dr. F. Meinert gives an account of his own observations on the life-history of this larva, which imbeds itself in the Silkworm. He agrees with Prof. Sasaki, whose paper on the subject we noticed some time since,† in thinking that the eggs of the *Ugimyia* find their way into the body of the silkworm through its mouth, and he thinks it likely that other caterpillars are infested in the same way. The Ugimyia-maggot is only for a time located immediately inside one of the stigmata of the silkworm, and certainly does not form its bed "by heaping up fats and muscular fibres," for the bed is a widening or swelling of the trachea itself. This fact is fully in accordance with what is known of the parasitic life of many *Tachina*-larvæ. The plates of the spiracles or stigmata of the parasitic larva are quite closed, as is the case also in other *Musca*- and *Œstrus*-larvæ, with the exception only of *Gastrophilus*.

New Cattle-pest.‡—Mr. S. W. Williston has some remarks on a new cattle-pest in the United States which has been found on the horns of

* Ann. and Mag. Nat. Hist., v. (1890) pp. 103-12.
† This Journal, 1887, p. 579.
‡ Amer. Natural., xxiii. (1889) pp. 584-90 (1 pl.).

cattle, and in the hair along the flanks. After some time it was found to be identical with *Hæmatobia serrata* Robineau Desvoidy, from the south of France; it is suggested that its vernacular name should be "Horn-fly." It is distinguished from the common cattle-fly by its smaller size, and more especially by its long palpi; it has for its immediate allies some of the most vexatious of flies indigenous to various continents. It is very probable that the largest number of cosmopolitan insects are found among the Diptera, for they furnish the greater number of our domestic pests, and their eggs or larvæ are constantly mingled with our food-material or common objects of commerce. *Musca domestica* abounds even on the uninhabited plains of America. Some of such species are not, however, importations to America, as the Colorado Beetle and the Hessian Fly are sufficient to bear witness. Of the parasitic family of bot-flies, it is probable that all the (eight) species common to Europe and America have been introduced into the latter with the domestic animals, with the exception of the circumpolar reindeer bot-fly.

Anatomy of Ant-Lions.*—Dr. F. Meinert gives an account of his examination of the digestive tract of some larvæ of *Myrmeleon* which he found in Algeria. The mouth is not, as Hagen supposed, closed, but is merely compressed. The stomach is completely closed posteriorly, and the first part of the small intestine is a compact mass, with no lumen. There are eight Malpighian vessels, two of which are free, while the other six are connected with the small intestine; these vessels are ordinarily converted into silk-secreting glands, and the swollen part of the cæcum becomes the reservoir for this secretion. The remnant of the food of the larva is collected in the stomach, and is not expelled till the creature becomes a perfect insect; it is made up of an internal amorphous mass and an outer layer which contain phosphate of calcium and a large quantity of uric acid.

Prosopistoma variegatum.†—M. A. Vayssière gives an account of some larvæ of this species, which was regarded by its discoverer, Latreille, as an insect. These larvæ were aquatic and somewhat advanced in development, as the possession of wings showed. The species is much larger in size than its European congener, and the author was able, therefore, to extend his anatomical studies. There are six pairs of tracheal gills in the large respiratory cavity which is situated beneath the posterior half of the carapace; but the sixth, which are wanting in the European form, are much reduced, and cannot take any active part in respiration. As there are six abdominal segments and four caudal, we have the ten rings which are found in all larvæ of other genera of Ephemeridæ.

Studies in Pond Life.‡—Mr. C. M. Weed gives an account of some rather scattered observations on a series of particularly rich ponds in Ohio. The first deals with the life-history of the larger Typha-borer (*Arzama obliquata*); the larva, which is rather handsome, and swims readily by an undulating snake-like movement, is especially interesting on account of the peculiar position of two of the spiracles, which are

* Overs. K. Danske Vid. Selsk., 1889, pp. 43-66 (2 pls.).
† Comptes Rendus, cx. (1890) pp. 95-6.
‡ Bull. Ohio Agricult. Experiment Station, i. (1889) pp. 4-17 (2 pls.).

placed on the caudal margin of the eleventh segment. The tooth-horned fish-fly (*Chauliodes rastricornis*) belongs to a genus which has been little studied in the United States. The larvæ live in rude cells gnawed out of soft bark and wood; they ordinarily move by crawling along weeds, but, when alarmed, can swim rapidly by suddenly doubling the body up, bringing the head in contact with the abdomen. They have also a peculiar habit of walking on the surface of the water, body downward, and can thus move along quite rapidly. When handled the larvæ occasionally eject from the mouth a considerable quantity of a blackish fluid.

The most important element of food for the lesser water-bug (*Zaitha fluminea*) appears to be the larvæ and nymphs of dragon-flies; the undulating back-swimmer (*Notonecta undulata*) lives mostly on May-fly larvæ; they appear to have the power of ejecting a poison into their victims, as the author twice found that the insertion of their beaks into his skin produced a pain very much like that of a bee-sting. The aquatic beetle, *Donacia subtilis*, evidently plays an important rôle in effecting the pollenization of *Nuphar advena;* it is interesting to note that Müller found that a congeneric species in Europe aids in the pollenization of the European representative of the American yellow pond-lily. The thirteen-spotted ladybird was found to have a decided preference for aquatic plants. The paper concludes with some notes on the eggs of the giant water-bug (*Belostoma americanum* of Leidy or *Benacus griseus* of Say). Technical descriptions of larvæ, pupæ, and imagines are in many cases given.

Dorsal Gland in Abdomen of Periplaneta and its Allies.*—Mr. E. A. Minchin, who recently described † a pair of glands lying between the fifth and sixth abdominal terga of *Periplaneta orientalis*, has since dissected other allied species, in which he has found interesting variations of this organ. *P. americana* does not, so far, differ from *P. orientalis;* in *P. decorata* the glandular pouches are a little shallower and of greater lateral extent, and there is an additional gland which extends forward into the body-cavity; this gland and its ducts are proliferations of the hypodermis, and there is no invagination of the cuticle. *Blatta germanica* exhibits the greatest complication of structure, though the female seems to have no trace of the organ. In the male it is relatively of enormous size, projecting far into the body-cavity, and being quite visible externally. The sixth tergum is much larger than those in front of it, and has two very large oval depressions of considerable depth; each of these is further divided into two by a transverse ridge. The seventh tergum is still larger than the sixth, and emarginate in the middle line posteriorly; just under the projecting edge of the sixth tergum there is a large median opening, divided into two by a median longitudinal septum; these openings lead into large tubular invaginations of the cuticle and hypodermis. All the depressions and invaginations are lined by a tough brown cuticle of some thickness. Two kinds of hairs are present; some are stiff, straight, and pointed, and are of the kind found all over the body; others are very minute, short, and fine sensory hairs, which appear to be confined to the ridges

* Zool. Anzeig., xiii. (1890) pp. 41-4. † See this Journal, 1889, p. 204.

which divide the depressions of the sixth somite, and each is connected with a nerve-filament. The hypodermis between the cuticle and basement-membrane is enormously thickened in the organs of both the sixth and seventh somites; it contains a layer of small nuclei, which lie close under the cuticle, and each of which belongs to a narrow elongated cell; other nuclei belong to large, elongated granular cells, which rest on the basement-membrane, and interspersed there are numerous slender nerve-filaments, with elongated fusiform nuclei at intervals.

β. Myriopoda.

Myriopod producing Prussic Acid.*—Herr E. Haase calls attention to *Paradesmus gracilis* C. L. Koch, which is found endemic in many parts of the world, and has become established in some gardens in Europe. The formation of the acid was first demonstrated by C. Guldensteeden-Egeling, and the anatomy of the secreting organs made out by E. Weber.

γ. Prototracheata.

Movements of Peripatus.†—Herr E. Haase gives an account of some observations on the movements of *Peripatus capensis.* Speaking generally, they call to mind the movements of the Diplopoda, and especially of the Craspedosomata. Before beginning to move, the animal often raises its head and the next one or two succeeding segments and puts its tentacles in movement; if they are withdrawn quickly there is often a simultaneous contraction of the body. Like the Chilopoda, and especially *Geophilus*, *Peripatus* can move as well backwards as forwards. The line of movement on blackened paper is quite straight, whereas in Chilopods the body makes distinct lateral curves. When moving, the feet touch the ground at a much sharper angle than, for example, in *Lithobius.* The movements of *Scolopendrella* appear to be quite similar to those of *Peripatus.* As in Myriopods, the legs of a small group of segments alone move, while the others remain still; if a young *Peripatus* is repeatedly touched it rolls up, like the larva of one of the Tenthredinidæ; a young specimen was able to climb up vertical glass walls, but it could not hold on to the lower surface, a proof that its power of attachment is not due to the secretion of a sticky material. These creatures are able to move very quickly.

When the movement was slow, Herr Haase observed five waves of movement through the series of legs, just as he had observed in Chilognatha; when the young moved rapidly the movements of the legs were so rapid as to recall galloping movements, such as are made by caterpillars. In the larger specimens there are alternate movements, legs 1, 4, 7 of one side being often followed by 2, 5 of the other.

δ. Arachnida.

Development of Hydrachnida.‡—Herr F. Koenike finds that the sexes of Hydrachnids may, during the developmental stages, be recognized by differences in size. After the last ecdysis increase in size occurs in all parts except the maxillary organs, palps, epimera, feet, and

* SB. Gesell. Naturf. Freunde, 1889, p. 97. † T. c., pp. 148–51.
‡ Zool. Anzeig., xii. (1889) pp. 652–5.

genital area. The porous chitinous carapace of *Arrenurus* is only gradually developed after the final ecdysis. The appendage of the body of the immature male of the same genus is in a rudimentary condition after the last ecdysis. All eight-footed *Nesæa*-larvæ have four genital acetabula, which are arranged by pairs.

Unrecorded British Parasitic Acari.*—Mr. A. D. Michael describes three species of parasitic Acari which appear to be new:—*Myocoptes tenax*, from the field-vole (*Arvicola agrestis*), is the second member of its genus; both species live on rodents among the hairs, to which the females of the new species cling so tenaciously that the grasp is often not relaxed even in death. *Symbiotes tripilis* is parasitic on the hedgehog, along and between the quills of which it runs up and down with great rapidity; unfortunately, the male of this species has not yet been discovered. The third form is the representative of a new genus—*Goniomerus musculinus*—which it is very difficult to define accurately, as the present form is so extremely minute; it was found on the surface of, or very slightly buried in a depression of the skin lining the inner side of the external ear of the short-tailed field-vole (*Arvicola agrestis*). The author gives detailed accounts of these three new forms.

Types of Metamorphosis in Development of Crustacea.†—Mr. I. C. Thompson made this the subject of his last (1890) address to the Liverpool Microscopical Society; as he well remarks, the student of minute pelagic forms often meets with immature forms, many of which are crustacean larvæ, and their study is by no means easy.

Brachyura and Anomura.‡—Sig. G. Cano describes the crustaceans of these orders collected on the "Vettor Pisani" expedition. The list includes a dozen new species, and two new genera—*Podohuenia* in the family Periceridæ, and *Euryetisus* in the family Cancridæ.

Excretory Organs of Gammarus.§—Sig. A. Della Valle having sprinkled carmine powder on the water tenanted by young forms of *Gammarus pulex*, found after several days that the pigment-granules had accumulated within the animals in the antennary gland, and at the bases of the maxillary, thoracic, and abdominal appendages. The granules in the antennary gland were very numerous, minute, and altered in colour; those at the bases of the appendages remained bright red. His experiments, though not sufficiently extended, suggest the excretory significance both of the antennary gland, and of those on the thoracic and abdominal appendages.

Paracopulation in Eggs of Daphnids.‖—Prof. A. Weismann and Mr. C. Ischikawa formally apply the term of paracopulation to the processes of which they have already given some account. These processes consist essentially in the presence in the egg of a cell other than the sperm-cell, which at first takes no share in the formation of the embryo, but in an early stage of cleavage unites with one of the cleavage-cells in such a way that we are compelled to speak of copulation of the

* Journ. Linn. Soc., xx. (1889) pp. 400-6 (1 pl.).
† Liverpool, n.d., 8vo, 19 pp.; reprint from 'Research,' Feb. 1890.
‡ Boll. Soc. Nat. Napoli, iii. (1889) pp. 169-268 (1 pl.). § T. c., pp. 269-72.
‖ Zool. Jahrb., iv. (1889) pp. 155-96 (7 pls.).

two cells. As the phenomena of copulation are not the same in all the genera, it is necessary to deal with each set of observations separately; *Moina rectirostris* and *M. paradoxa; Daphnia pulex* and *D. longispina; Sida crystallina; Bythotrephes longimanus; Polyphemus oculus;* and *Leptodora hyalina* are treated of in succession.

Two series of phenomena are dealt with in this memoir, and though both are concerned with the winter-egg of the Daphnida, they have no direct connection with one another. One has to do with the history of the conversion of the germinal vesicle into the egg-nucleus, and the other with the origin and fate of the copulation-cell.

The conversion of the germinal vesicle, and the formation of the polar globules is effected in essentially the same way as in other eggs which require fertilization. This fact is more important than its determination in other groups since Daphnids are capable of parthenogenetic as well as of sexual reproduction. The law of numbers of the polar globules is confirmed. Dealing with the exceptional cases lately described by Platner and by Blochmann, the authors point out that, in both cases, the eggs are arranged for sexual development; they are capable of fertilization, to effect which their germ-plasm must be halved, or, in other words, a second polar globule must be formed.

With regard to paracopulation the facts are, shortly, these. In the winter egg (or egg requiring fertilization) of six species of Daphnida, belonging to four genera, a cell is formed in the egg-cell during the ovarial development of the egg. In the still young and yolkless egg of *Moina* a part of the nuclear substance actively passes out from the germinal vesicle into the surrounding mass of protoplasm, organizes itself into a real nucleus (paranucleus), and at the same time surrounds itself with a cell-body.

When the egg is laid the copulation-cell is quite passive. After fertilization by a sperm-cell, the process of cleavage begins and goes on through a varying number of stages; the copulation-cell moves towards one of the cleavage-cells, which are sunk in the interior of the yolk, sends out short processes, and fuses with it; first the cell-bodies and then the nuclei unite.

Though the authors discuss at some length the significance of these phenomena they are at present unable to give an explanation of them. It may, however, be supposed that we have here to do with a very general process. At any rate it would be very strange if it occurred only in Daphnids.

New Entoniscan parasitic on the Pinnotheres of Modiola.*— MM. A. Giard and J. Bonnier describe *Pinnotherion vermiforme* g. et sp. n., a parasitic crustacean which lives on a crab (*Pinnotheres*) which is itself parasitic on a Mollusc (*Modiola*). It was detected in the form of a violet-grey mass, which resembles an egg-mass of *Grapsion Cavolinii;* this was the incubatory cavity of the female. The generic and specific characters are described. Only two males, and those degraded, were found; they resemble the males of *Grapsion* and *Portunion*, but are almost entirely destitute of pigment; the spermatozoa present the

* Comptes Rendus, cix. (1889) pp. 914–6; Ann. and Mag. Nat. Hist., v. (1890) p. 124.

complex structure of those of the Thoracostraca. The embryo partly resembles that of *Grapsion* and *Portunion*, and, notwithstanding the darkness of the medium in which it is developed, it is strongly pigmented with brown and green; the eyes are large. The genus, though closely allied to *Grapsion*, may be clearly distinguished by the form of the first incubatory plate and the ovary of the female, and by the arrangement of the median ventral hooks of the male.

New and little-known Semiparasitic Copepoda.*—Prof. C. Claus treats chiefly of the Lichomolgidæ and Ascomyzontidæ. As a result of his researches he offers a revised diagnosis of the genus *Lichomolgus*, eight species of which may be certainly recognized; in addition to this a new species found on sea-anemones and called *L. Anemoniæ* is described. The genera *Sabelliphilus* and *Anthessius* are re-defined, and a new genus *Paranthessius* is described; it is known only from female forms of a new species *P. Anemoniæ*. *Pseudanthessius* g. n. (with a new species *P. gracilis*) is distinguished by the peculiarities of its gnathites, and the unjointed inner branch of its fourth pair of feet. The Lichomolgidæ appear to form a definitely limited group of the Corycæidæ, and the Notodelphyidæ, which live with Ascidians, may be regarded as closely allied to, and having a common ancestry with them. A revised definition of the group is given.

The author next deals in similar fashion with the Ascomyzontidæ, of which *Dermatomyzon* (*D. elegans* sp. n.), *Echinocheres* (*E. violaceus* and *E. minutus* spp. nn.) are new genera. A new group will, when our knowledge is more advanced, have to be made for *Calagidium vagabundum*.

Gastrodelphys.†—Dr. J. H. List has a monographic account of this perplexing genus, the anatomy of which is described in detail. He cannot agree with Graeffe in associating it with the Notodelphyidæ, and thinks it is necessary to make a special group for it which will connect the Notodelphyidæ, which have biting mouth-parts, with the Siphonostomata, of which it is a family. The species live parasitically on the gill-filaments of tubicolous worms, have a short conical suctorial proboscis provided with teeth, a pair of mandibles, no maxillæ, and two pairs of maxillipeds. Of the two pairs of antennæ the anterior have five joints, and the hinder three hooks and a stalked sucker on their terminal joint. There is a median eye. Four of the thoracic segments have rudimentary swimming feet. The matricial cavity is a fold of the fourth thoracic segment. The abdomen is short, and has a furca. In addition to *G. Clausi* of Graeffe the author describes *G. Myxicolæ* sp. n. found on *Myxicola infundibulum*.

Vermes.

Texture of Central Nervous System of Higher Worms.‡—Herr B. Haller, in his investigations into the texture of the central nervous system of the carnivorous Polychæta, made especial use of *Lepidasthenia elegans*. He finds that the mode of origin of the ventral medullary

* Arbeit. Zool. Univ. Inst. Wien (Claus), viii. (1889) pp. 327–70 (7 pls.).
† Zeitschr. f. Wiss. Zool., xlix. (1889) pp. 71–146 (4 pls.).
‡ Arbeit. Zool. Univ. Inst. Wien, viii. (1889) pp. 175–312 (5 pls.).

nerves is of the following character: there are the usual peripheral nerve-bundles, the separate fibres of which either arise directly from ganglionic cells or from the central nervous plexus, which, on its part, is formed from the processes of the ordinary ganglionic cells. Two colossal fibres are present, one of which always arises directly from a colossal ganglionic cell of the opposite side; this cell is connected with the central nervous system as well as with its fellow of the opposite side by branches which break up in the central nervous plexus. Another and larger peripheral fibre, which is a branch of a central colossal fibre, has its origin in the central nervous plexus. The author's observations on the tubicolous Polychæta were not extensive. Of the Oligochæta he gives a fuller account; each pair of nerves arises thus: in the first place the nerve has fibres from the same and from the opposite side of one and the same ganglion. It also contains fibres which arise from the preceding and the succeeding ganglia of the same half of the cord, and also fibres from the corresponding ganglia of the opposite half of the cord. In this way the very closest connection is insured between each pair of nerves and the whole ventral medulla. All the ganglionic cells in the medulla of *Lumbricus* are more or less multipolar, and this is true of even the largest cells. These last are pyriform in shape and appear to have been seen by Friedländer, who places them in connection with the median colossal fibre. The author will only remark that these cells are very large in comparison with the others, and always possess several processes. The largest of these processes is always directed upwards, while the others are very small and are lost in the nervous plexus. He is able to confirm and extend Friedländer's statements as to the peculiar chemical characters of these cells. The double mode of origin of the peripheral nerve-filaments in *Sipunculus* from the ganglionic cells on the one side, and the nerve-plexus on the other, was distinctly seen.

The result of Herr Haller's work is to show that the nerve-trunks of the Nemertinea show very archaic characters, and that the central nervous system of Annelids is, histologically, very different from that of the Vertebrata. There is ample histological evidence to support the view of Gegenbaur and Haeckel that the Annelids generally are not to be regarded as stem-forms. The Nemertinea appear, on the contrary, to be very old stem-forms, from which, on the one side, the Mollusca, and, on the other, the Annelida, Hirudinea, Arthropoda, and Vertebrata, can be derived. On these points the author enlarges somewhat.

We have only space to note some of the results regarding more minute points; Herr Haller finds a distinct basal membrane under the hypodermis which separates the latter from the perineural plexus and therefore from the neurilemma, while forming an organic whole with them both. The perineural plexus round the ventral medulla has different chemical characters from that in the brain. In the free-living Polychæta there are, within the central fibrous mass, two intercoiled but not connected plexuses; one of these is coarser and belongs to the neuroglia, while the other is much more delicate and is related to the processes of the ganglionic cells and to the peripheral nerve-fibres. The neuroglia itself consists of an outer and an inner plexus; the former is wide-meshed and surrounds the whole of the nervous parts of the brain and ventral medulla, and contains the ganglionic cells in its interspaces.

Externally to this there is in the brain an inclosing membrane which the author compares with the "Glyahülle" described by Gierke in the Vertebrata, and which may be regarded as a product of the outermost parts of the perineural neuroglial plexus. In the ventral medulla this membrane is only found in the dorsal region.

In *Lumbricus* the neuroglial envelope does not send processes into the central nervous plexus, and there is not, therefore, a neuroglial plexus in the central nervous system as there is in the free Polychæta. In *Sipunculus* there is an outer and an inner neuroglial plexus, but there is no glial plexus in the central fibrous substance; in this point the Sipunculaceæ differ from the free and resemble the tubicolous Polychæta. The wide-meshed plexus of the Nemertinea is not identical with the neuroglia of other worms, which neuroglia is merely represented by a membrane which lies between it and the ganglionic cells. In *Cerebratulus* the neuroglia is in a very primitive condition.

α. Annelida.

New Pelagic Annelids.*—Herr G. M. R. Levinsen has established a new genus *Corynocephalus* in the family Alciopidæ. The body has few segments; the head-lobe is subdisciform in front, convex above, and furnished with four leaf-like antennæ; the dorsal cirri are also leaf-like, large, and imbricate; the parapodia have no cirriform processes on their apices; the setæ are mostly simple and hair-like, mixed with some of a rougher and more rigid type; the ventral papillæ are depressed at the base of the parapodia; the segmental organs are small and somewhat dorsal. This genus includes *C. albomaculatus* sp. n. from the South Atlantic. Another new species described is *Rhynchonerella longissima*. In a new family Typhloscolecidæ Uljanin, near the Opheliidæ, the author places *Travisiopsis* g. n., with *T. lobifera* sp. n. In the new family there are two segments in front of the mouth. Of these the first has an unpaired antenna, and the second (as well as the two next segments) a single nodiform "parapodium," which is not, however, comparable with the ordinary structure known by that name. The other parapodia are disposed in a double row on each side. The nodiform "parapodia" are drawn out into leaves containing fascicles of little rods and without setæ. Simple, acicular setæ (2–3) are borne on the segments with biserial parapodia, between the dorsal and ventral series. Above the pharynx is a blind protractile proboscis. The geographical distribution of *Sagitta* is also discussed.

British Species of Pachydrilus.†—Mr. F. E. Beddard thinks that two species of *Pachydrilus* are to be found at Rum Bay. One of these, which is much larger than the other, appears to be *P. verrucosus* of Claparède, while the other does not seem to be a representative of any of the other four British species described by that author, but to be *P. nervosus* of Michaelsen; this is the only form in which the peculiar perivisceral corpuscles which are so characteristic of these worms do not appear to be present.

The present state of our knowledge regarding the male gonads and

* Spolia Atlantica, K. Danske Vid. Selsk., iii. (1885) pp. 327–44 (1 pl.).
† Proc. Roy. Phys. Soc. Edinb., x. (1889) pp. 101–6 (1 pl.).

the sperm-sacs is unsatisfactory, owing to the contradictory statements that have been made regarding them. Mr. Beddard finds that the testes are largest in individuals that are not sexually mature; in them they form a bunch of divergent finger-like processes attached to both sides of the septum; and the bunches are paired. In *P. verrucosus* there were two pairs of testes, but there may be individual variation in the number. The author agrees with Michaelsen in denying the presence of sperm-sacs, and he suggests that the large size of the testes and the stout peritoneal investment render their development unnecessary.

Pachydrilus subterraneus.*—Prof. F. Vejdovsky gives a description of this new species, which has been found both at Prague and Lille. It is about 20 mm. long, is of a bright red colour, and is almost constantly in movement in the water in which it dwells.

β. Nemathelminthes.

Respiration of Entozoic Worms.†—Herr G. Bunge, who has already shown that *Ascaris mystax*, which is found in the intestines of the cat, will live four or five days in media quite free from oxygen, has continued his investigations with other Nematodes. *A. acus*, from the pike, which has no respiratory apparatus, was found to live from four to six days, and exhibit movements in similar media.

In the ultimate respiratory processes of these animals there must be a formation of energetic reducing substances (nascent hydrogen and easily oxidizable organic matter) which unite with one atom of the oxygen-molecule, even to a greater extent than in animals which breathe oxygen. Larger varieties of *Ascaris* were also examined. *A. megalocephala* of the horse lived, however, only for two days; *A. lumbricoides* of the pig, from four to seven. The gas given off was found to be not only free from hydrogen, but from other reducing substances also.

Developmental Cycle of a Filaria of the Dog.‡—Prof. B. Grassi describes the adult form of *Filaria recondita* Grassi, a specimen of which was examined by him and also by Dr. S. Calandruccio. The specimen, the only one obtainable, was a not quite mature female, and was found rolled up but unencapsuled on the fatty tissue close to the hylus of the right kidney. It is about 3 cm. long and 178 μ broad.

It would seem that this Filaria passes through four larval stages. In the first of these it exists in the blood of the dog, from which it is sucked out by the flea (*Pulex serraticeps*). The second stage is passed in the cells of the fat-bodies, the principal change being that it increases in size very much, the general shape being retained. In the third stage it not only increases in size, but the various parts and organs become more highly differentiated. In the fourth stage it exists in the encapsuled condition, being found rolled up within the cell of the fat-bodies.

Inoculation experiments with the object of infecting dogs by means of fleas were without success. This failure is ascribed to the fact that the authors were obliged to use larvæ in the third stage of development.

* Rev. Biol. du Nord de la France, i. (1888-9) 3 pp. (sep. copy) 1 pl.
† Zeit. Physiol. Chem., xiv., pp. 318–24. See Journ. Chem. Soc., 1890, p. 274.
‡ Centralbl. f. Bakteriol. u. Parasitenk., vii. (1890) pp. 18-26 (17 figs.).

They claim as the result of their observations to have shown with certainty that there exist Filariæ which are propagated normally by the intervention of blood-sucking parasites, and they call attention to the resemblance of the larvæ described by them to the Filaria found by Manson in *Culex*.

Helminthological Notes.*—Prof. M. Stossich catalogues and makes notes on fifteen parasitic worms from Croatian animals. The list includes *Distomum croaticum* Stossich, *Cosmocephalus papillosus* Molin, and *Echinorhynchus globocaudatus* Zeder.

γ. Platyhelminthes.

Anatomy of Derostoma unipunctatum.†—Herr K. Lippitsch has had an opportunity of investigating the anatomy of this Turbellarian. The cells on the surface of the integument are connected by a cementing substance, are more or less polygonal in form, and have their side-walls distinctly ribbed; these cells vary considerably in size and form. No special deposits were seen in the epithelium, save some rods which lay at the anterior end of the body. The dermomuscular tube is well developed and consists of outer circular, internal longitudinal, and other fibres, which lie between and cross the outer and inner layers. The structure of the connective tissue of the body-parenchyma is very similar to that of *Graffilla*.

The œsophageal pouch, which lies between the mouth and pharynx, is not muscular; the axis of the pharynx lies at an angle of 120° to the long axis of the body; its muscular fibres have no nuclei, and are smooth; the author describes their arrangement in detail. The pharyngeal glands have efferent ducts, which all open at the anterior end of the pharynx below the sphincter and on a kind of papilla; the orifices of all the ducts form a circle. The glands themselves are of some size, and of an elongate pyriform shape; the protoplasm of their cells is either plexiform or granular, but it cannot as yet be decided whether these represent two kinds of gland or the same gland in two different stages of its activity. The pharynx is moved by two protractors and two retractors, the former of which are much more fully developed than the latter. An œsophagus, such as has been described by various authors in different freshwater and marine Vorticidæ, could not be made out. In many cases the enteric cells were so filled with crystalloids, and often also with quite homogeneous discs, of elliptical or circular contour and with brown concretions, that the structure of the cells could not be distinctly made out. In a number of important points the gonads and their appendages appear to present essentially the same characters as in allied forms already described.

The nervous system is well developed, and consists of two ganglia, connected with one another by a strong commissure; the largest of the nerves appears to be the optic; the dorsal and ventral nerves described by Böhmig have been made out, but the former presented some difficulties; the generative nerve does not appear to be present. The author

* Glasnik hrv. nar. druztva, God. iv. (Soc. hist.-nat. Croatica), pp. 8 (1889) (2 pls.).

† Zeitschr. f. Wiss. Zool., xlix. (1889) pp. 147–67 (2 pls.).

concludes with an account of the anatomy of the excretory organs, and remarks that the crystalloids have not the pentagonal dodecahedral form described by Hallez in Mesostomida.

New Land Planarian.*—Prof. F. Vejdovsky gives the name of *Microplana humicola* to a new genus of Land Planarians which he has discovered in Bohemia. One of its chief characters is the absence of the auricular appendages which are so common on the anterior part of the body in most of the Dendrocœla indigenous to that country. However much it may be contracted, its anterior part always remains rounded, as in rhabdocœlous Turbellaria. It is quite transparent, but less so when young than when adult, owing to the former retaining in their intestine the débris of vitelline cells. The animal is ciliated on the ventral surface only, and the cilia are very short; in this point it resembles *Geodesmus*, as described by Moseley. The cuticle is very fine, elastic, and so resistent as to allow for some time the pressure of a cover-glass. The epidermis is of the same thickness throughout its whole extent, and the elements of which it is composed are generally filled with a clear, almost hyaline protoplasm; at the hinder end of the body some of the cells appear to be glandular. It is by the aid of the secretion produced by these glands that the animal fixes its hinder end. The secretion is of a mucous nature. The rhabdites vary in size and disposition, according to the part of the body examined. The larger rods found at the anterior end are so closely packed that it is impossible to make out the true structure of the epidermis. Their arrangement, in fact, recalls that found by Iijima in the American *Geoplana*. This conversion of the epidermis into a sort of cuirass affords support to the view that the rods are organs of sustentation which strengthen the fine and delicate skin.

The eyes are situated over the anterior lobe of each half of the cerebral ganglion; they are very small, black spots, situated below the epidermis. Young individuals have no lateral diverticula to their stomach; and these only appear gradually. In the adult the diverticula are sharply separated from one another. The excretory organs, or pronephridia as the author calls them, belong to the second of the two types of these organs which the author recognizes; in the first, the terminal part has no vibratile flame-cells, while in the second the pronephridiostomata have such cells. In the new genus these are to be found in the peripheral region of all parts of the body; they are unicellular organs, the enlarged upper end of which is provided with a nucleus surrounded by protoplasm; the narrower part is drawn out into a fine canaliculus, the course of which could not be followed were it not for its ciliated lining. This canaliculus is formed of a series of cells set end to end, each of which has a vibratile flame, and corresponds to a pronephridiostome.

Microplana has two pairs of testes, which are rounded in form and situated between the thirteenth and fifteenth diverticula of the stomach; the animals are almost mature in September; the author is unable to speak definitely of the relation of these gonads to their ducts. The penial apparatus is pyriform and much simpler than that of *Planaria subtentaculata* or other freshwater Dendrocœla. On its outer surface the

* Rev. Biol. du Nord de la France, ii. (1889–90) 20 pp. (sep. copy) 2 pls.

muscular apparatus is invested by large, clear epithelial cells; in some examples there were seen two groups of large glands, the elements of which appear to be modified cells of the epithelial layer. At the distal extremity the epithelial cells become invaginated to form a narrow canaliculus, which is well ciliated in young individuals. This cavity swells, and so forms a kind of large space into which the constricted extremity of the seminal vesicle opens. The walls of the cavity are glandular. There are circular but no longitudinal muscles in the penis; this is a somewhat abnormal arrangement, and the author marks the differences by giving an account of the penial apparatus of *Planaria subtentaculata*. In *Microplana* some other organ is probably the copulatory, and the author thinks that the function is effected by a tubercle, the relations of which with the muscular apparatus he was, unfortunately, unable to determine. The position of the ovary and the course of the oviduct could not be made out; the cavity of the "uterus" is small, and is filled by a special hyaline liquid. In conclusion, Prof. Vejdovsky gives a review of the Dendrocœla already met with in Bohemia; five genera and eleven species have been found.

Structure of Cestoda.* —Dr. T. Pintner commences his investigation of the structure of the Cestoda by an examination of *Echinobothrium*, which appears to be a generalized type. A detailed account is given of *E. musteli* sp. n., and shorter notices of *E. typus* Van Ben., *E. affine* Dies., and *E. brachysoma* sp. n.

The nervous system appears as a large ganglion placed directly below the rostellum, and having a central cellular mass and peripheral nerve-substance, which radiates out into four short frontal trunks superiorly, and into two large primary nerves inferiorly; the two sets differ considerably from one another in their histological structure. The attaching lobes and the rostellum appear to be supplied by special nerves. The rostellum may have the form of an ellipse, the much longer main axis of which lies in the median plane, but in other stages of contraction a transverse section may be biscuit-shaped, with a similar orientation of the longer diameter. In the most anterior region it is not possible to say definitely what belongs to the rostellum and what does not; but in succeeding sections the boundary is clearly marked by a membrane with a sharp double contour.

This organ has several points in common with the rostellum of *Tænia;* it is placed in the middle of the frontal surface above the nervous system and the cephalic loops, it is made up of several systems of muscles adapted to the various relations of the head and hooks, and is connected with an apparatus of hooks. But, while the rostellum of *Tænia* is four-rayed, that of *Echinobothrium* is only two-rayed; and the same is true of the hook-apparatus. At the same time, the latter must be regarded as completely homologous with that of *Tænia*, for the hooks have exactly the same structure, being only more delicate and having much less distinct root-processes; they are arranged alternately in two layers, just like the rostellar hooks of *Tænia*. The head-stalk of *Echinobothrium* is quite round, and slightly increases in thickness from before backwards. Most externally there is a specially thick homogeneous cuticle,

* Arbeit. Zool. Inst. Univ. Wien (Claus), viii. (1889) pp. 371–420 (3 pls.).

and underneath this is the cutis, which is very indistinctly broken up into radial fibres; the internal cavity is divided by lamellar cross-sections of the root-processes of the hooks into eight sectors, and is filled by the plasmatic meshwork of the parenchyma and the nuclei of the cells that form it; in it there lie the four equal cross-sections of the water-vascular and the two cross sections of the nervous system.

A full consideration of this part of the body shows that the head-stalk is an integral part of the head.

The Echinobothria do not live boring deeply in the wall of the intestine, like other Cestoda, but rather in the looser, superficial, partly-shed epithelia of the intestine and in its mucus, where they continually perform the most lively movements. One is almost led to believe that we must correlate with this the fact that the general structure of the head does not approach the four-rayed type so closely as that of the head of *Tænia*. On the whole, *Echinobothrium* appears to be what has been called a synthetic type; by its double lobes of attachment and its head-stalk it has distinct relations to the Tetrarhynchidæ, but by its rostellum it leans to the Tæniidæ, by the generative organs (plan and form of yolk-stocks, and germ-stocks, closed uterus, and complete development of the proglottis), and partly by the hooks on its head-stalk, it is allied to the Tetrabothriidæ; at the same time it must remain in a distinct family.

Helminthological Notes.*—Sig. F. S. Monticelli separates the genus *Tetraonchus* Diesing from *Gyrodactylus* and *Dactylogyrus*, supplies a revised generic diagnosis, and describes three species. He also describes † *Tristomum uncinatum* sp. n., and a remarkable *Distomum*,‡ already named by Lopez *D. richiardii*, from the body-cavity of *Acanthias*. Its testes are numerous, and disposed in two lateral groups; the internal *receptaculum seminis* is exceedingly large; the vagina or canal of Laurer is absent; the yolk-glands which lie beside the testes are small in proportion to the size of the animal; their ducts meet in the middle of the body in a large vitelline receptacle.

Bucephalus haimeanus.§—M. Huet has a few notes on this somewhat rare parasite, which he found in *Cardium edule*. Such specimens as are infested have an unhealthy appearance, as Lacaze-Duthiers has already remarked. The lacunar tissue contains an enormous number of white filaments, which are sporocysts. In the interior of these there are *Cercariæ* in various stages of development; the author has been unable to find the œsophageal tube described by Lacaze-Duthiers. An attempt was made to follow the life-history of this parasite, but all that can yet be said is that it seems to cause the death of its host and then escapes into the surrounding water.

New Sporocyst from Cardium edule.||—M. Huet also describes a new sporocyst from *C. edule*. It is short, spherical, or pyriform in shape, and swims freely by means of the cilia with which it is invested. Forms were found in various stages of development, and even *Cercariæ*

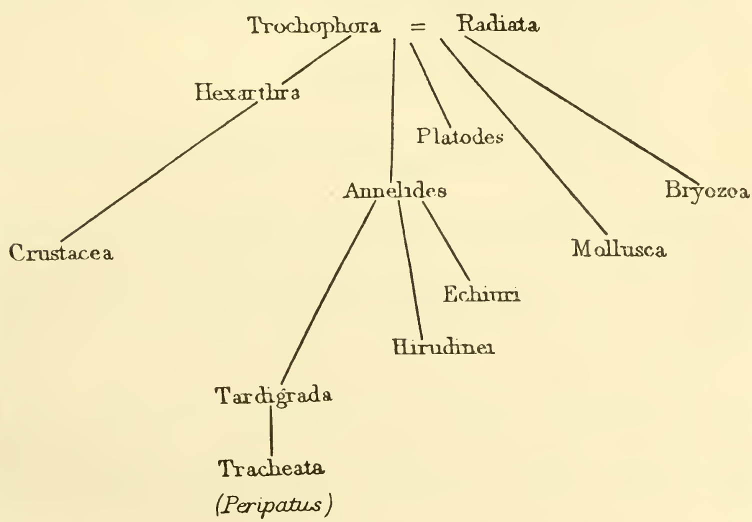
* Boll. Soc. Nat. Napoli, iii. (1889) pp. 113–6.
† T. c., pp. 117–9 (1 pl.). ‡ T. c., pp. 132–4.
§ Bull. Soc. Linn. de Normandie, ii. (1889) pp. 145–9 (1 fig.).
|| T. c., pp. 149–51 (6 figs.).

were seen which only wanted their generative apparatus to be young *Distoma.* The author was not able to trace the parasite beyond the body-cavity of its host.

δ. Incertæ Sedis.

Rotifers of Gulf of Bothnia.*—In addition to describing the rotifer-fauna of the Gulf of Bothnia, Dr. L. H. Plate makes some observations on the anatomy of the Philodinidæ and the systematic position of the Rotifera. About a dozen species were observed, three of which—*Synchæta monopus*, *S. apus*, and *Asplanchna syringoides*—are new.

The author's views as to the systematic position of the Rotifera will be best understood from his own diagram.



Dr. Plate gives an account of his recent observations on the anatomy of *Rotifer vulgaris*, which appears to be still incompletely known. The most important points on which exact information is required are the structure of the cloaca and contractile vesicle, the question of the mode of escape of the embryos, and the structural arrangements of the peripheral nervous system. The two lateral water-vessels open into the bladder, at its anterior and ventral margin, in a way which has not been observed as yet in any other Rotifer. The two canals unite to form a glandular body, which has the same structure as the enlargement formed by each water-vessel in the anterior end of the body; a finely and closely granulated mass of protoplasm is traversed by a wall-less lumen which forms coils within it. It is possible that this common tract of the excretory canals in *Rotifer* has been already seen by other observers, and regarded by them as being a vesicle in a state of systole.

The cord which extends from the hinder end of the gonad is either connective or muscular tissue, but it is not a rudimentary oviduct; it

* Zeitschr. f. Wiss. Zool., xlix. (1889) pp. 1–41 (1 pl.).

forms a quite solid cord, the homogeneous protoplasm of which is not rarely filled by a more or less large number of granules; nuclei may be assumed to be present, though they were not seen. The cord is extraordinarily contractile. It appears to be attached to the sides of the hind-gut, at about the end of its anterior third. There does not seem to be even a very thin-walled uterus, for the embryos are seen to move about in the body-cavity. Shortly before birth the proboscis of the embryo appears to be feeling about in all the tegumentary region surrounding the anus. When it has found the anal cleft it seems to feel that there is here no great resistance to its pressure, and the embryo forcibly breaks through the hindermost part of the cloaca, and reaches the exterior through the anus.

Herr Plate thinks that there are three natural groups of Rotifers, which may be arranged thus:—

I. Digononta; with paired gonads.
  (1) Philodinidæ (= Aductifera);
  (2) Seisonidæ.

II. Monogononta; gonads unpaired. These may be arranged in families on the classification proposed by Messrs. Hudson and Gosse.

Anatomy of Stephanoceros Eichhornii.*—Mr. R. Vallentin remarks that, although this Rotifer has been known to exist for nearly one hundred and thirty years, much still remains to be learnt concerning its anatomy. He has tried to determine some of the disputed points by means of serial sections, and states that his results, though good, leave considerable room for improvement.

The tube appears to be formed from mucous cells. There are four pairs of muscles, which terminate anteriorly in a sphincter; when a living specimen retracts, the bases of the arms are brought together by the contraction of this muscle, and the longitudinal muscles being almost simultaneously brought into play, the animal retreats rapidly into its tube. The "brain" is a somewhat cylindrical organ, the walls of which are composed of irregularly shaped oval cells; each cell is wholly or partially filled with granular protoplasm, and as the secretion present in the central space is also granular, it may fairly be assumed that the granules originated from the cells and that the cells were in an active state at the time of the death of the animal. The protrusile tongue or taster, described by Dr. Hudson as connected with this organ, is considered to be a duct, while the "brain" is a salivary organ.

The true nervous elements appear to be the large, oval, nucleated cells which are placed close to the cuticle on either side of the collar; these have a marked resemblance to unipolar ganglion cells. What are generally regarded as eyes are of a chitinous nature and have a central opaque mass; their function is unknown, but it may be safely assumed that it is not visual.

Owing to the large size of the embryos and the comparative smallness of the cloacal opening, Mr. Vallentin thinks that the embryos are liberated by the death of the parent. In one series of sections an ovum was seen that had formed a gastrula by epiboly.

* Ann. and Mag. Nat. Hist., vi. (1890) pp. 1–11 (2 pls.).

New and little-known Rotifers.*—In continuation of his previous notes Dr. W. B. Burn gives, first, a description of *Furcularia tenuiseta* found in a pool at Tooting Common; it is one-fortieth of an inch long; the body has a loose glassy integument which is extremely flexible. Though delicate in appearance it burrows through dense flocculent masses with ease, for the purpose of hiding itself in the dark. He adds some notes to Mr. Gosse's account of *Diplois propatula* which was found in a pool on Esher Common, where many rare rotifers are to be taken.

The Gastrotricha.†—Dr. C. Zelinka monographs the enigmatical Gastrotricha. His diagnosis is as follows:—There is no retractile wheel-apparatus at the anterior end; there are two ciliated bands along the entire ventral surface; two coiled water-vascular canals, each bearing long rod-like ciliated lobes, open separately in the middle of the ventral surface; a simple brain-ganglion lies in part still within the ectoderm; the muscle-cells are simple; the ovaries are paired; the fore-gut is muscular, without jaw-apparatus, and like that of Nematodes; the mid-gut is straight and without glands; the hind-gut is pear-shaped, with a rectum and dorsal anus; there is a primary body-cavity.

After a discussion of the numerous opinions as to the systematic position of the Gastrotricha, Dr. Zelinka concludes that they have diverged from the ancestral line of the Rotatoria, and that they have developed parallel to the latter, but at a lower level. From the ancestors of Gastrotricha, *Echinoderes* and the Nematodes may also have arisen, but the Gastrotricha are further from *Echinoderes* than from the Rotifers. As the nearest descendants of the Trochophora, they may be ranked as Trochelminthes, among the Protonephridozoa, and before the Rotifers.

The size of these organisms varies on either side of the limit of naked-eye vision. Many are about 0·2 mm. in length, while *Chætonotus schultzei* measures 0·4 mm., and dwarf forms as little as 0·07 mm. They feed on small plants and animals, or on their remains. They swim by means of the two ventral bands of cilia, unlike Infusorians in never going backwards. One form, *Dasydytes saltitans* Stokes, is able to jump forcibly forwards by the aid of four long bristles on the ventral surface. They seem to occur in all fresh-water basins, especially in those with such aquatic plants as duckweed, *Potamogeton*, and Characeæ, most abundantly in sunny ponds, but not in rapidly flowing water.

The different forms of Gastrotricha are classified as follows:—

I. Sub-order. Euichthydina, with a forked tail.
  1. Family. Ichthydidæ, without spines.
    Ichthydium Ehrbg., 2 sp.
    Lepidoderma n.g., 4 sp.
  2. Family. Chætonotidæ, with spines.
    Chætonotus Ehrbg., 18 sp.
    Chætura Metschn., 1 sp.
II. Sub-order. Apodina, without a forked tail.
    Dasydytes Gosse, 3 sp.
    Gossea n. g., 8 sp.

* Science-Gossip, 1890, pp. 34–6 (4 figs.).
† Zeitschr. f. Wiss. Zool., xlix. (1889) pp. 209–384 (5 pls. and 10 figs.).

Dr. Zelinka has discovered the true ovaries, which lie close to the ventral and lateral wall of the beginning of the hind-gut. The mature ovum is relatively of enormous size, occupying a large part of the body-cavity, and crushing the gut and the other ova to the side. The mode of expulsion remains obscure. Like other observers, Zelinka failed to discover the summer-ova described by Metschnikoff. The laid eggs are ellipsoidal; the embryo lies bent within the shell, and when mature bursts it by main force. The sexes are probably united, but the organ described by Ludwig as testis cannot be certainly regarded as such.

Echinodermata.

Ludwig's Echinodermata.*—Prof. H. Ludwig continues and concludes his account of the water-vascular system of Holothurians; he points out that the contents of the vessels are in no way identical with water, and that they contain a small admixture of coagulable albuminoid materials; in a few cases the fluid is coloured, and cells are to be found in it. The digestive organs are next considered under the heads of (1) mouth and oral region; (2) anus and anal region; (3) divisions of the enteric tube and its macroscopical structure; (4) histology of the tube; (5) the course of the tube in the body-cavity; this is rendered more intelligible than it is often found by the aid of three explanatory diagrams; and (6) attachments of the enteron. The arborescent gills are next described; the presence of more than two trees is merely due to the basal separation of a stronger branch; an account is given of the minute structure of these organs. The part before us concludes with the early pages of the description of the interesting Cuvierian organs.

Revision of Genera and Great Groups of Echinoidea.†—Prof. P. Martin Duncan has performed a very useful work in revising the genera and great groups, fossil as well as recent, of Echinoidea. Six divisions, two hundred and fifty-five genera, and fifty subgenera are recognized; of these twelve genera and seven subgenera are new. One hundred and eight genera are regarded as synonymous with recognized types and abolished, and forty-two are made subgenera. Two subclasses are formed—that of the Palæechinoidea, all the members of which are extinct, contains four orders—the Bothriocidaroida, the Perischoechinoida, the Plesiocidaroida, and the Cystocidaroida; the two last are represented respectively by *Tiarechinus* and *Echinocystites;* the Euechinoidea contains five orders, the Cidaroida, the Diadematoida, the Holectypoida, the Clypeastroida, and the Spatangoida. The Diadematoida are divided into those with flexible and those with firm tests; the former, or Streptosomata, contains the single family Echinothuri[i]dæ, with the two subfamilies Pelanechinæ and Echinothuri[i]næ, but in an addendum, the author expresses his opinion that Prof. Jeffrey Bell's account of the characters of *Phormosoma* requires the formation of a new subfamily for that genus, as distinguished from *Asthenosoma;* the second suborder, that of the Stereosomata, contains a large number of families and subfamilies, *Salenia*, *Diadema*, *Arbacia*, *Temnopleurus*, *Echinometra*,

* Bronn's Klassen u. Ordnungen, ii. 3, Echinodermata, 1889, pp. 129-76 (pls. vi.-viii.).

† Journ. Linn. Soc., xxiii. (1889) pp. 1-311.

and *Echinus* being all included. The Spatangoida contain the two sub-orders of Cassiduloidea, and Spatangoidea. A useful explanation of the terms used is appended to the paper.

Cœlenterata.

Development of the Septa in Pteroides.*—Herr G. von Koch describes two stages in the development of *Pteroides spinulosus.* The longitudinal septum arises from the central fusion of the most oral pair of radial parietes. They cease to lie radially, and come to lie in a straight line. The cells of the septum probably originate from the endoderm, but the relation of septum to œsophagus admits of their ectodermic origin. The cavity of the larva is divided by the septum into two portions, of which one corresponds to the single interparietal space between the two radials above mentioned, and the other to the remaining seven interparietal spaces.

Arrangement of Mesenterial Septa in Peachia hastata.†—M. L. Faurot finds that there are ten distinct pairs of mesenterial septa in *Peachia hastata.* Twelve of these are large, of equal size, and set round the œsophagus; eight are very small and not fixed to the œsophagus, and there are, also, two pairs of directive septa. Below the œsophagus the septa may be divided into three groups, which differ in size and in their relations to the generative organs; in those of the first and second size the organs appear at the same level, a little below the œsophagus; with the exception, however, of the directive septa where the organs are only developed below the unpaired organ. The septa of the third or smallest size are sterile for their whole extent.

Occurrence of Ctenophores throughout the year.‡—Prof. W. C. M'Intosh brings forward evidence to show that Ctenophores may be obtained throughout the year. L. Agassiz considered that they were generally annual animals, laying their ova in the autumn and then dying—the young brood making its appearance in the spring. On the eastern coast of Scotland the most abundant Ctenophore is *Pleurobrachia*, and the presence of small as well as large examples shows that the ranks are being gradually recruited, as well as by-and-by supplanted, by the younger forms. *Pleurobrachia* seems to spawn in summer and attains a maximum size the following year, the adults gradually disappearing after shedding their ova; at no period, however, is the water devoid of them, and throughout the greater part of the year small forms are mingled with the larger. *Beroë* is seldom absent. *Lesueuria*, also, is to be found in greater or less abundance throughout the year, being another species whose spawning-period appears to be of extended duration.

Eleutheria.§— Dr. C. Hartlaub has rediscovered the species of *Eleutheria* which Claparède described some thirty years ago, and which differed essentially from those described by other authors; he proposes to call it *E. claparedii.* From the account now given it is clear that this

* Morphol. Jahrb., xv. (1889) pp. 646–9 (1 fig.).
† Comptes Rendus, cx. (1890) pp. 52–4.
‡ Ann. and Mag. Nat. Hist., v. (1890) pp. 43–7.
§ Zool. Anzeig., xii. (1889) pp. 665–71.

form is quite different from the other species of the genus. It is much larger than *E. dichotoma*, and has a much larger number of tentacles, of which there may be as many as fourteen. The tentacles are characteristic in form, for they are very long and only divide at the end; their number is always greater than that of the radial canals, and the two structures have no regular topographical relation to one another. The most interesting point in *E. claparedii* is the example it affords of the change of function of an organ; its rudimentary bell which has ceased to serve as a swimming organ has taken on a new function, for it shuts off a space into which the young Medusæ enter, and where they, protected from injuries of all kinds, pass through an undisturbed development. Dr. Hartlaub gives the specific characters of this species and also of the *Eleutheria dichotoma* of Quatrefages.

Abnormal Hydromedusæ.*—Prof. W. C. M'Intosh gives an account of some abnormal, mouthless, Hydromedusæ which were obtained in St. Andrews Bay. In considering how they manage to exist he refers to Mereschkowsky's suggestion that "the Medusa can nourish itself by means of its ectoderm by absorbing the organic material dissolved in the sea-water." The remarkable tenacity of life exhibited by certain marine animals confined in pure sea-water lends some countenance to the notion. As the Hydromedusæ are generally somewhat voracious forms, it is possible that mouthless examples may, by contracting the disk, fold themselves over prey of various kinds, and thus directly absorb nourishment through the ectoderm.

Porifera.

Physiology of Sponges.†—Dr. R. von Lendenfeld gives a detailed account of his experimental investigations on the physiology of Sponges. He first made a series of feeding experiments with carmine, starch, and milk, which were introduced into the sea-water in small quantities, and kept mixed with it by a constant stream of air. Fresh living sponges were put into these mixtures and removed after a time, which varied from $1\frac{1}{2}$ to 36 hours; they were then prepared in various ways and afterwards cut into series of sections; by these means it was possible to follow the ingestion of the food-substances and their course in the sponge-body. The action of various poisons was next investigated. In all, 149 experiments are described.

The first result of the suspension of solid bodies, such as carmine or starch, in water, is the contraction or closure of the dermal pores; this may be regarded as a reflex movement of the sphincters at the pores. Later on, the pores widen again somewhat in consequence either of the sponge being unable to forego the stream of water for more than two or three hours, or to the fatigue and relaxation of the sphincters. The soft milk spheres, which may be regarded as fluid, do not usually affect the sphincters so powerfully as the grains, and there is, consequently, no reflex movement to close the pores.

The results are set out in tables and are critically considered; their study leads the author to conclude that:—

(1) The ingestion of nutriment goes on in the interior of the sponge

* Ann. and Mag. Nat. Hist., v. (1890) pp. 40–3.

† Zeitschr. f. Wiss. Zool., xlviii. (1889) pp. 406–700 (15 pls.).

and not at its outer surface, for neither carmine nor milk-globules remain attached to the outer surface of healthy sponges, and the stream of water has clearly the function of introducing nutriment and oxygen into the interior of the sponge.

(2) It is clear that the collared cells normally take up the material contained in the water that streams through.

(3) No observation supports the theory of Metschnikoff and Sollas that the collared or epithelial cells, filled with food, sink down into the intermediate layer.

(4) Carmine is only rarely found in wandering cells, and it may be supposed that such granules as are so found passed in at points of injury and not in a normal way. Dr. Lendenfeld does not believe that the collared cells give up carmine-grains to the wandering cells.

(5) With milk, however, it is otherwise; the globules are taken up by the collared cells and then passed on to the wandering cells.

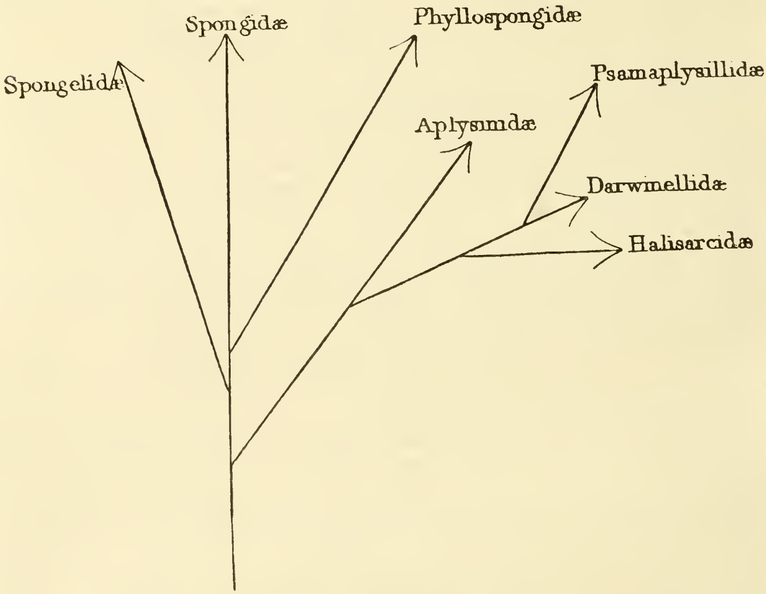
The method of nutrition of Sponges may, therefore, be thus described. The moving flagella on the pavement and (?) collared cells produce a stream of water which traverses the canal system of the Sponge, so long as it is in a healthy state. Various substances are dissolved and suspended in this water. The larger suspended solid bodies do not enter the interior of the sponge, as they cannot pass through the small pores of the skin; some, however, do enter by injury of the skin, and such are sand-grains, foreign siliceous needles and the like which are used by many horny sponges in building up their skeleton. Smaller suspended particles such as arise from the decomposition of organic substances in water, as well as all substances dissolved in the water, enter the sponge, and are all, so far as is physically possible, absorbed by the flagellate cells in the chambers.

The collared cells appear at first to have no power of selection; this is effected by the skin and its pores, which keep out injurious matters; the substances taken up by the collared cells are partially digested, and pass, in a more or less assimilated state, into the cells of the intermediate layer, which acts as the means of transport for the nutrient material. The collared cells excrete what is useless in the food, while the carbonic acid formed in the tissue is probably given up by diffusion to the surrounding water.

The Sponge may be regarded as a living filter which removes from the percurrent water, by means of its collared cells, all matters useful to them. These cells, in siliceous sponges, have the property of retaining the siliceous salts contained in the water; and calcareous salts are similarly treated by calcareous sponges. The collared cells of the Horny Sponges cannot hold back either lime or silex.

Although the author's physiological experiments have not proved the existence of a nervous system, they have made its absence more than doubtful, for the extraordinary sensitiveness of the skin speaks to the presence therein of differentiated sensory cells. The sensory and ganglionic cells are spindle-shaped or pyriform, give off one longer process to the surface, or a group of three or more. Aristotle was correct in saying that Sponges could contract; this contraction is the result of harmful influences, and is especially observed when poison is dissolved in the water in which the Sponge lives—we have here a reflex movement to hurtful external stimuli. The pores of the skin, which always contract when the water contains poison, are most sensitive in this direction. As a rule, it is not merely the dermal pores that contract under the influence of the poisons, but also the superficial canals and chambers. Of all animals, Sponges are, physiologically, most similar to plants.

Sponge-Fauna of Red Sea.*—Dr. C. Keller gives an account of the Sponges found in the Red Sea. He commences with the Keratosa, and gives a description of the horny skeleton and of the general and minute organization of these forms. In discussing systematic questions he gives the following table, which will explain itself:—



Full details as to the characters of these groups are appended.

The Monactinellidæ are next considered, and are divided into the two suborders of the Oligosilicina and the Oligoceratina; the former have distinct spongin-fibres, which are either connected together in retiform fashion or are arborescent; monaxial siliceous spicules are inclosed in these fibres, and vary in quantity. Free flesh-spicules may also be present. In the Oligoceratina the spongin-substance is rare, and there are no distinct fibres; the spicules are connected by spongin or lie freely in the mesoderm. The classification given by Messrs. Ridley and Dendy in their 'Challenger' Report is regarded as the most complete yet made, although it does not in all respects correspond to the true genetic classification. The author again gives a phylogenetic table illustrative of his own views, and an account of genera and species. Of the latter a number are new.

* Zeitschr. f. Wiss. Zool., xlviii. (1889) pp. 34–405 (6 pls.).

Metamorphosis of Sponge-Larva.*—Dr. G. C. J. Vosmaer has a short account of the metamorphosis of a species of sponge, which probably belongs to the genus *Myxilla.* The free larva has an inner mass of cells of various kinds, covered all over by cylindrical epithelium. The latter soon exhibits two very distinct portions, one-seventh to one-eighth of the circumference having non-ciliated cells, which are more or less cubical in form, while the ciliated cells are very slender. There is no indication whatever as to what germinal layer the cells belong. In the central mass are a number of silicoblasts. After one or two days the freely-swimming larva becomes fixed. The point of fixation is at first in the region of the cubical cells, and the gland-cells of that region are active. The base of attachment gradually becomes larger; the flagella disappear and gland-cells become developed. The larval epithelium does not disappear, but is simply modified cell by cell. The gland-cells which, in the larva, helped to fix the animal, secrete, in the adult, the slimy substance which covers the whole surface and is characteristic of *Myxilla* and some other sponges. The subdermal cavities begin as fissures, which gradually become wider. A little later, other canals and the flagellated chambers appear in the same way.

Protozoa.

The Genus Conchophthirus.†—Dr. A. Schuberg describes *Conchophthirus anodontæ* Stein, and *C. steenstrupii* Stein, which he maintains to be the only known species of the above genus. The peristome of Heterotricha and Hypotricha had its origin in a non-ciliated groove extending from the anterior end to the mouth, and bordered laterally by undulatory membranes or the adoral zone. The absence of the adoral zone, and the author's interpretation of the secondary "pre-oral groove" (not a "peristome" *sens. strict.*) in *Conchophthirus*, lead him to remove the genus from the family Plagiotomina, and indeed from the group Heterotricha, to a position within Bütschli's family Isotrichina. Schuberg is inclined to regard the "pre-oral groove" of *Conchophthirus* as homologous with the so-called "gullet" of Isotricha.

Notes on Heliozoa.‡—M. E. Penard has found Wiesbaden a locality very rich both in species and individuals of Heliozoa. The skeletal mucilaginous zone of Acanthocystids is perfectly active, and behaves physiologically like the vacuolated ectosarc of *Actinophrys*, and the author is inclined to regard it as the true ectosarc. The skeleton may be well studied in the large *Acanthocystis turfacea* Carter; it is composed of three forms of skeletal elements—some of them are thick, very short, tangential scales which are so arranged as to give the appearance of a continuous membrane; others are large radial spicules, which are nearly as long as the diameter of the animal itself, and yet others are smaller radial spicules, which are exceedingly fine and are intercalated among the larger spicules. From his study of the constitution of these bodies the author concludes that the spicules of *Acanthocystis* are clothed with a mucilaginous varnish, within which they are formed;

* Tijdschr. Nederl. Dierk. Ver., ii. (1889) pp. 287–9.
† Arbeit. Zool.-Zoot. Inst. Würzburg (Semper), ix. (1889) pp. 65–88 (1 pl.).
‡ Arch. Sci. Phys. et Nat., xxii. (1889) pp. 523–39.

they grow simultaneously at base and apex. *Ac. albida* appears to take three months at least to arrive at the adult stage.

M. Penard's independent observations on the pseudopodia appear to confirm Hertwig and Lesser's description of a Heliozoon as "rolling after the fashion of a ball, and by the contraction of the pseudopodia."

The food of the Heliozoa appears to vary with the medium in which they find themselves, but they prefer an animal to a vegetable diet. An interesting new form, of small size (15 μ) and reddish tint, is briefly described; the ectosarc, a thin light band, is traversed by a line of very small tangential spicules, but none radial in direction; the pseudopodia are hyaline, excessively long, and not numerous; it is by their means that the animal runs like a spider, leaping to one side or straight forwards with surprising agility, so that it progresses almost as rapidly as a Flagellate. It is a true Heliozoon, which resembles some *Amœbæ* in the plasticity of its body, and in the character and small number of its pseudopodia. A new form of true Monad is also described as having filiform rigid pseudopodia similar to those of Acanthocystids, by means of which the animal attaches itself to the ground and moves slowly; it can feed equally by the whole of its surface, and is, on the whole, a Flagellate with some well-marked Heliozoic characters.

Anatomical Peculiarity of a Vampyrella.*—Herr W. Wahrlich describes a peculiar anatomical structure in a *Vampyrella*, which he believes to be unique. In its amœba-condition the *Vampyrella* is indistinguishable from *V. vorax* Cnk., but in the encysted condition presents the remarkable peculiarity of the digestive vacuole being surrounded by a cellulose-membrane. When it has fully passed from the amœba to the encysted condition, a large central vacuole is discernible in the interior of the protoplasm which has taken up all the food-material, the original small vacuoles having gradually disappeared. When treated with alcohol, a distinct membrane could be detected surrounding this vacuole, which showed with chlor-zinc-iodide the characteristic reaction of cellulose. It follows that the digestion of the food can only be effected by an enzyme which dissolves the protein-substances, and these must then pass by diffusion through the membrane. The formation of this membrane seems to be constant in the *Vampyrella* examined; but as the peculiarity appears to have a physiological rather than a morphological value, the author proposes to treat it merely as a variety under the name *Vampyrella vorax* Cnk. var. *dialysatrix*.

Spores of Myxosporidia.†—M. P. Thélohan finds that the spore of the Myxosporidia contains a small mass of protoplasm in which is differentiated a vesicle filled with a special substance, which resists colouring matters. There are present, moreover, nuclei which result from the division of a primitive nucleus; the number of these varies in different forms of Psorosperms. The author is as yet unable to point out the significance of these facts, but it is certain that the appearance of the plasmic mass of these spores of Myxosporidia, with the vesicle that refuses to stain and the nuclei scattered in the protoplasm, recalls in a striking way certain phases in the development of the spores of

* Ber. Deutsch. Bot. Gesell., vii. (1889) pp. 277–9 (1 pl.).

† Comptes Rendus, cix. (1889) pp. 919–22.

Gregarines. A study of the development of these organisms will, the author hopes, afford a solution to the problems presented.

Classification of Gregarines.*—Dr. P. Mingazzini describes *Didymophyes gigantea*, one of the two species for which Stein established the family Didymophyideæ. This family was excluded by Schneider, Balbiani, and others, under the impression that the three segments were merely the result of the union of two individuals. Bütschli ignores the family altogether. Mingazzini, however, has studied the above species in the mesenteron of the larvæ of *Oryctes* and *Phyllognathus*, and believes that it represents the highest morphological grade among Gregarines. There are indeed two individuals in a sense, but the union has become intimate, and the posterior individual is virtually a sac-like segment of the anterior portion. His classification is therefore as follows:—

A. *Monocystideæ*, with a single unicellular segment; the individuals are separate, or united (in "apposition") by similar ends.

B. *Polycystideæ*, with two segments, of which the anterior bears a head; the individuals are separate, or united (in "opposition") by dissimilar ends.

C. *Didymophyideæ*, with three segments, of which the foremost bears a head; the individual is the result of intimate conjugation by "opposition."

Monads in the Blood in Influenza.†—Prof. Klebs, of Zurich, gives the results of his examination of the blood in cases of influenza. He finds a large number of highly refractile, mobile bodies, in size, form, and motility resembling bodies which he has met with in pernicious anæmia, but in far less quantity. No microcytes, such as occur in the latter disease, were to be seen. In a fatal case of influenza some blood was removed from the heart, with every precaution to avoid contamination, and the "monads" were detected therein; they varied somewhat in size, being oval in shape, and not only had vibratory movement, but were also capable of locomotion. They were often attached to the margin or imbedded in the substance of the blood-corpuscles. The organisms were distinctly flagellated, and in stained preparations their intimate connection with the corpuscles could be plainly shown. Provisionally, Prof. Klebs would assign them a place among the Rhizomastigina of the Monadineæ, according to Bütschli's classification of these protozoic forms. The Professor remarks that in other diseases in which similar Hæmatozoa have been discovered, as ague and pernicious anæmia, there is a tendency to intermittency in the type of fever; and since influenza shows a like tendency—commonly styled relapse—he thinks it quite possible that such "relapse" is associated with stages in the development of the micro-organism. The pandemic spread of influenza is analogous to that of some forms of malaria, and this is quite conceivable when one recalls the atmospheric effects which ensued after the volcanic eruption of Krakatoa. Prof. Klebs suggests that much light might be obtained by analysis of the air during the prevalence of influenza on the method of Miquel.

* Atti R. Accad. Lincei—Rend., v. (1889) pp. 234–9 (3 figs.).
† English Mechanic, 1890, p. 525.

BOTANY.

A. GENERAL, including the Anatomy and Physiology of the Phanerogamia.

a. Anatomy.

(1) Cell-structure and Protoplasm.

Nuclear Origin of Protoplasm.*—M. C. Degagny now discusses the nuclear origin of protoplasm, and also the origin of diastases in the digestion of the nucellus. The facts which have been observed in the nucleus of the mother-cell of the embryo-sac of the fritillary and lily, and in the mother-cells of pollen, are only an exaggeration of a general phenomenon, the production of hyaloplasm in the interior of the nucleus. This production is clearly shown in the nucleus of the mother-cell of the fritillary by this interesting circumstance, that the hyaloplasm produced in excess and eliminated from the side of the funicular bundle coagulates on the wall of the nucleus as a substance which leaves a residue on a filter. In the embryo-sac of *Helleborus niger* (the Christmas rose) the difference is remarkable in the quantity of the products of reabsorption not used up in the sac; the appearance of the products of reabsorption coinciding exactly with the cessation of assimilation in the embryo-sac. All the evidence goes to show that the diastases arise as the result of the disorganization of the parietal cells of the embryo-sac.

Behaviour of the Nucleus in the lower Plants.†—M. P. A. Dangeard has determined by observation that in the lowest plants in which sexual reproduction takes place, the act consists in a fusion of the nuclei of the male and female cells, whether the male and female elements possess only a single nucleus, as in *Synchytrium Taraxaci*, or several, as in *Ancylistes Closterii*. The same result was obtained in *Vampyrella*.

(2) Other Cell-contents (including Secretions).

Calcium phosphate in Sphærocrystals.‡—Herr A. Hansen suggests that the purpose of calcium phosphate in the vital phenomena of plants, may be to render albumin and globulin soluble in water. The formation of sphærocrystals appears not to depend on a simple separation of the salt, but to be a result of the decomposition of protoplasm.

Colouring matter of the Integument.§—In continuation of the observations of Schimper and Courchet on the colouring-matters of flowers and ripe fruits, M. L. Claudel has made a series of similar observations on the nature of the pigments of the sporoderm (integument of the seed), in a number of Angiosperms belonging to many different orders. He finds that these pigments may either impregnate the cell-walls or fill the cell-cavity; and these latter again may be either solid substances or may be in solution in the cell-sap. In the

* Bull. Soc. Bot. France, xxxvi. (1889) pp. 346–54. Cf. this Journal, 1889, p. 239.
† Comptes Rendus, cix. (1889) pp. 202–4.
‡ Flora, xlvii. (1889) pp. 408–14. Cf. this Journal, 1889, p. 773.
§ Comptes Rendus, cix. (1889) pp. 238–41.

last case they differ from the corresponding colouring-matters of flowers and of fruits in being always derived directly from the protoplasm, and not from free-existing chlorophyllous leucites.

(3) Structure of Tissues.

Aerenchyme.*—Dr. H. Schenck describes the structure of a tissue to which he gives this name, especially characteristic of the submerged portions of aquatic and marsh plants, and particularly of those which are woody, herbaceous species being frequently destitute of it. It springs from the phellogen, and is therefore homologous in its origin with cork; it may be replaced by lenticels. Its cells are always thin-walled and not suberized, developing between them large intercellular spaces communicating with one another and filled with air; the cells themselves have an extremely thin parietal layer of protoplasm, and contain a small nucleus and minute leucoplasts, which sometimes develope into starch-grains, and a watery sap, but do not themselves contain air. In one type of structure these cells are elongated in a radial direction, and not arranged in regular zones; in a second type they form concentric strata, each composed of a single layer of cells, and connected with one another by radial trabecules. The air inclosed in the intercellular spaces contains a smaller proportion of oxygen than that of the atmosphere.

The author finds aerenchyme in species of Onagraceæ, Lythraceæ, Melastomaceæ, Hypericaceæ, Labiatæ, Euphorbiaceæ, Mimoseæ, and Papilionaceæ. Its function appears to be to facilitate the respiration of the parts of the plant in which it is found.

Structure of Dicotyledonous Stems.†—Dr. R. Raimann points out the existence of two types of structure in dicotyledonous stems. The first and simpler type occurs in most herbaceous and annual plants, and in a few woody stems, such as *Aristolochia*, *Clematis*, and *Atragene*. The increase in thickness here proceeds entirely from the cambium, which, being formed between the xylem and phloëm of the separate bundle-traces, gradually extends to the medullary rays, and thus becomes a closed thickening-ring, a portion of which in each new period of growth, as fascicular cambium, produces phloëm and xylem, while a portion, as interfascicular cambium, gives rise to the elements of the medullary rays, so that the bundle-traces have a separate course even in older stems. In the majority of dicotyledonous woody plants we find, however, a second and more complicated type. The leaf-trace-bundles do not here anastomose, as in the first type, but have blind endings in the stem; and, furthermore, the structure of the leaf-traces is different in different parts of the stem; while the leaf-traces of the upper leaves correspond in structure to the fascicular cambium, those of the lower leaves pass over into that of the interfascicular cambium. The interfascicular cambium is, therefore, not, as generally described, an exclusively cauline tissue.

Periderm.‡—M. H. Douliot has investigated the structure and origin of the periderm in plants belonging to a large number of natural orders,

* Jahrb, f. Wiss. Bot. (Pringsheim), xx. (1889) pp. 526–74 (6 pls.).

† SB. K. K. Zool.-Bot. Gesell. Wien, xxxix. (1889) pp. 52–6.

‡ Ann. Sci. Nat. (Bot.), x. (1889) pp. 325–95 (64 figs.). Cf. this Journal, 1889, p. 406.

the present paper being devoted to the stem of Dicotyledons. The following are his general conclusions.

The origin of the periderm may vary in the three following ways: it may be hypodermal, epidermal, or pericyclic. As a general rule it may be said to originate in the pericycle. It is both a protective tissue and a reservoir for food-materials. The central cylinder is always surrounded by a continuous ring of pericyclic fibres, and this ring is sometimes separated from the endoderm by a layer of cells, and the periderm then originates outside this layer. In the pericycle the periderm may either be in contact with the endoderm, or may be mingled with the fibres, or may spring from below the fibres; it is always outside the liber, and therefore outside the outermost sieve-tubes.

The position of the periderm is of but little value for purposes of classification; it may be characteristic of an order, tribe, genus, or species. It is more developed in parts exposed to light than in the shade. The cortex disappears only to serve as food-material for the deeper tissues. The foldings on the radial walls of the cells, hitherto considered as characteristic of the endoderm, may belong to a secondary formation.

Thickening-ring of Bark.*—Herr M. Koeppen discusses the activity of the bark of our dicotyledonous trees during the period of activity of the thickening-ring. The passage from wood to bark is formed by a layer in which the new tissue-elements of both wood and bark arise. This is termed the thickening-ring, and consists of three zones:—the outermost comprises the young cells of the bark, the innermost the young wood-cells, while between them lies the true cambium. The chief purpose of the cortex is the conduction and storing-up of the substances which undergo metastasis in the green parts of the plant, though new substances are also formed in it.

In the mode of growth of the secondary bark two types may be distinguished:—that of *Tilia*, in which the increase of girth is limited to the primary medullary rays, and that of *Quercus*, where the medullary rays usually consist permanently of one row of cells only, growth taking place in the rest of the parenchyme through the force of tangential traction. In the periderm are to be found cells which have more than doubled their length in the tangential direction without their walls having increased in thickness; and these cells always contain living protoplasm during the period of their increase in size. Beneath the epiderm there is often formed, for additional support, in the midst of the primary parenchyme, a ring of bast-cells and sclerenchyme-cells.

Free Vascular Bundles in Olyra.†—In a large Brazilian grass belonging to the genus *Olyra* Dr. F. Müller finds that the cylindrical cavity of the hollow haulm is frequently occupied by spiral or twisted perfectly free vascular bundles, which frequently coalesce with one another or with the wall of the cylinder. Their number mostly varies between one and ten, though there are sometimes over twenty, and they are seldom found in all the internodes of the same stem, as some internodes are usually entirely destitute of them. These free vascular bundles

* Nova Acta Acad. Cæs. Leop.-Carol., liii. (1889) pp. 441–96 (1 pl.).
† Flora, xlvii. (1889) pp. 414–20 (1 fig.).

appear to be confined to a single species of *Olyra*, and Dr. Müller is unable to assign to them any function in the life of the plant.

Anatomy and Histogeny of Strychnos.*—Dr. D. H. Scott and Mr. G. Brebner have endeavoured to clear up, as regards the anomalous genus *Strychnos*, some of the points which previous investigations have left obscure. The general structure of the stem, its development, and the development and structure of the phloem-islands, are all carefully described, and also the structure of the root. The authors recapitulate the results of their investigations as follows:—(1) The external phloem, though but little developed, contains sieve-tubes and companion-cells of normal structure, with the exception that nuclei are found in the mature sieve-tubes. The latter fact is perhaps an indication of their rudimentary character. (2) (*a*) The medullary phloem-groups, as shown by their development and by their course, form an integral part of the leaf-trace-bundles, which are therefore from the first of bicollateral structure. (*b*) These medullary groups grow by means of a special cambium lying on the outer side of each group. (3) (*a*) The phloem-islands, or interxylary phloem-strands, are formed centripetally by certain portions of the normal cambium. (*b*) The phloem-islands continue to grow after they are inclosed in the wood, by means of the cambium layer on their inner side. (4) The roots, in so far as they have a pith, possess medullary phloem-groups similar to, but smaller than, those of the stem, and increasing, like the latter, by means of a centrifugally active local cambium. The authors then conclude with various comparative considerations.

Floating-tissue of Nesæa verticillata.†—Mr. J. Schrenk states that *Nesæa verticillata* grows in stout clumps along the swampy borders of pools and lakes. In the months of July and August many of the slender wand-like stems sent up by the root-stock have attained considerable length, and begin to bend downward by their weight until the apex of the stem touches the surface of the water, when they curve up again. At the region of contact between stem and water a swelling will be noticed about 10 mm. below the apex. The apex continues to grow more or less rapidly, while the swelling below it increases, and extends over a distance of 20–40 cm. The epiderm of the stem at this region shows longitudinal fissures; and underneath a snow-white, soft, elastic, spongy tissue is seen, the function of which is to prevent the apex of the stem from sinking below the surface of the water and to keep the stem afloat. It consists of parenchymatous cells of peculiar shape and arrangement. The walls of these cells are very thin, and consist of cellulose; they contain a delicate lining of protoplasm, in which slow but distinct currents may be noticed, and also small rounded starch-grains.

The development of the floating-tissue is as interesting as its function, the meristem producing it being first noticed at the sides and upper part of the horizontal floating stem; and consequently at a later stage the aerenchyme ‡ is more copiously developed at those places than on the lower side where the roots grow.

* Ann. of Bot., iii. (1889) pp. 275–302 (2 pls.).

† Bull. Torrey Bot. Club, xvi. (1889) pp. 315–23 (3 pls.). Cf. this Journal, 1889, p. 779.

‡ Cf. *supra*, p. 197.

(4) Structure of Organs.

Podostemaceæ.*—In the third part of his monograph of this natural order, Prof. E. Warming describes eleven species, five of which are new. As regards the systematic position of the order, he regards it as most nearly allied to the Saxifragaceæ, with its vegetative structure modified by the habit of growing on a rocky bottom in rapidly running water. One of the most marked vegetative peculiarities of the order is the dorsiventral structure of the young shoots in all the species.

Morphology of the Lauraceæ.†—Herr C. Mez treats the morphology of this natural order from the following points:—Phyllotaxis, leaves, bud-scales, inflorescence, flowers, fruit. The dissemination of the fruits is effected largely by birds, rodents, and apes; pollination chiefly by the agency of insects.

Dichotypism.‡—Dr. M. Kronfeld distinguishes three kinds of dichotypism, viz. heteranthic, heterocarpic, and heterocormic, depending on variations in the development of the flower, the fruit, or the vegetative organs respectively. He further points out that, instead of regarding the characters of a hybrid as resulting from a combination of the characters of the parents, we should rather see in them an evidence of the polarity of the protoplasm in the germinal cell.

Stamens of Solanaceæ.§—Prof. B. D. Halsted states that in the order Solanaceæ there are three modes of the dehiscence of stamens; but that there is one character which is common to them, and limited to the order, viz. the presence of a cone or "columella" in each anther-lobe.

Development of Pollen.‖—M. L. Mangin has paid special attention to the nature of the walls of pollen-grains and their transformations. After giving the details of numerous observations, the author states that at first the membrane of the pollen-grain is homogeneous, and is formed of pure pectic compounds; soon this membrane differentiates towards the exterior, and is transformed into cutin; and a little later, internally, and in one part of its thickness it is found to consist of cellulose. Two layers can then be distinguished, the intine and extine; but these two layers must be considered as the progressive differentiation of a single membrane. The structure of the membrane of the pollen-grain presents a striking analogy to the external membrane of epidermal cells. The author obtained the best results with *Lilium candidum*, *Asparagus officinalis*, *Cephalaria tartarica*, and *Geranium pratense*.

Development of the Pollen-grains in Rosa.¶—M. F. Crépin gives details of an examination of the pollen of numerous members of the genus *Rosa*. In order to observe pollen a low-power objective only is necessary; when placed in water well-developed pollen-grains swell

* 'Familien Podostemaceæ,' Afh. 3, Copenhagen, 1888 (French résumé), 72 pp. and 12 pls.

† Verhandl. Bot. Ver. Brandenburg, xxx. (1888) pp. 1–31. See Bot. Centralbl., xl. (1889) p. 362.

‡ SB. K. K. Zool.-Bot. Gesell. Wien, xxxix. (1889) pp. 65–6.

§ Bot. Gazette, xiv. (1889) p. 260.

‖ Bull. Soc. Bot. France, xxxvi. (1889) pp. 386–93. Cf. this Journal, *ante*, p. 56.

¶ CR. Soc. Roy. Bot. Belgique, 1889, pp. 114–25.

rapidly and become spherical, while atrophied grains remain small and elliptical, or irregular in form. In the group *Synstylæ* the pollen was found to be abundant and perfect, while in the *Caninæ*, *R. canina* for example, the proportion of well-developed grains varied from one-third to two-thirds. In the groups *Carolinæ*, *Cinnamomeæ*, *Pimpinellifoliæ*, and *Sericeæ*, the pollen was generally found to be abundant and perfect.

Variations of Water in the Perianth.*—M. Emery gives the results of various experiments made to ascertain the amount of water in the perianth. The law of variations of the amount of water presents two cases for terrestrial plants, according as they grow under normal conditions or in a medium saturated with moisture. In the first case, the point of maximum imbibition corresponds with a middle phase of the life of the perianth; in the second case, the maximum point and relative weight of water increases without ceasing from the commencement of flowering to the fall of the perianth.

Extrafloral Nectaries.†—Herr F. Ludwig describes the structure of the extrafloral nectaries in a number of myrmecophilous plants, and the mode in which the ants are attracted to them. In *Impatiens balsaminea* they consist of a number of hairs containing a red pigment, closely adpressed to the stem and with their apex pointing upwards; while those which are intended as a protection against creeping insects have their apex pointing downwards. In *I. cristata* and *tricornis* the road to the dark-red extrafloral nectaries is indicated by a row of red dots, which, like the nectaries themselves, are serrations of the leaf, and sometimes also themselves develope a secretion. Even the young seedling is protected in this way from the attacks of ants. In *Sambucus racemosa*, *Viburnum Opulus*, and other plants, the nectaries themselves, attached to the leaf-stalks, are rendered conspicuous by a very bright colouring.

Tearing of the Leaves of Musaceæ.‡—Herr C. Lippitsch describes the mechanical principle on which this phenomenon, characteristic of all the families of the Scitamineæ, viz. the Musaceæ, Cannaceæ, Marantaceæ, and Zingiberaceæ, depends. He points out that this tearing inflicts no injury on the assimilating functions of the leaf, and that the plant is thereby spared any unnecessary consumption of energy in the production of strengthening tissue. The margin of the leaf is provided with small narrow wings, which serve, when young, as a reservoir for water. In older leaves these wings dry up, and it is the contraction connected with this desiccation which causes the rupture of the tissue of the leaf.

Leaves and Shoots of Euphorbiaceæ and Cactaceæ.§—Herr X. Wetterwald describes in detail the structure and development of the stem and leaves in the succulent species of *Euphorbia*, of which nineteen are named, and in several genera of Cactaceæ, viz. *Opuntia*, *Peireskia*, *Phyllocactus*, *Epiphyllum*, *Cereus*, *Echinopsis*, *Pilocereus*, *Echinocactus*, *Echinocereus*, and *Mammillaria*. In both groups there are forms with

* Bull. Soc. Bot. France, xxxvi. (1889) pp. 322–33.

† Humboldt, viii. (1889) pp. 294–7 (4 figs.). See Bot. Centralbl., xl. (1889) p. 79. Cf. this Journal, 1889, p. 543.

‡ Oesterr. Bot. Zeitschr., xxxix. (1889) pp. 206–10, 259–63 (1 fig.).

§ Nova Acta Acad. Cæs. Leop.-Carol., liii. (1889) pp. 377–410 (5 pls.).

ordinary foliage-leaves, and with rudimentary leaves; but in the Cactaceæ the suppression goes much further than in the Euphorbiaceæ. Both families are distinguished by a strong development of the base of the leaf; the spines of the Euphorbiaceæ are stipules or lateral shoots; those of the Cactaceæ are always foliar organs of the undeveloped lateral shoots. The Cactaceæ differ from the Euphorbiaceæ and from most other plants in the leaves which are in immediate proximity to the apex producing rudiments of shoots in their axes.

Glands in Echinops and Diervilla.*—Mr. T. Meehan describes the nectar-glands in *Echinops*, which is cultivated for bees, situated at the top of the corolla-tube, instead of the base, as is usually the case; and the epigynous glands of *Diervilla*, which he regards, from a comparison with those of *Lonicera*, as rudimentary branches.

Glands of Eichhornia.†—Herr V. A. Poulsen finds, in the leaf-stalk of *Eichhornia crassipes*, peculiar glands on the walls of the air chambers. Each gland has two heads which secrete an oily fluid containing a small quantity of tannin. They are formed from single cells, have a mulberry-like appearance, but are hollow and open at the apex.

Calcareous Scales and Epidermal Glands in Globularieæ and Selagineæ.‡—M. E. Heckel states that in the Globularieæ and Selagineæ calcareous epidermal glands are to be found similar to those existing in Plumbagineæ, Frankeniaceæ, and Tamariscineæ. There also exist in certain species non-calcareous epidermal glands, and these glands are peculiar to these two families. The latter are the rule within these families, while the former are the exception, being only a physiological adaptation of the calcareous glands. The two forms of gland are sometimes to be met with on the leaves of the same species (*Globularia ilicifolia*); or they may occupy different organs on the same individual, as in *Selago spuria*, where the leaves have calcareous while the stem bears non-calcareous glands.

Protuberances on the Branches of Biota.§—Herr O. Lignier has examined the peculiar warts found on the lower branches of *Biota*, and has found them to be undeveloped adventitious roots which have remained inclosed in the bark. The growing point of the root appears to be still active; around its apex is formed a phellogen, which developes phelloderm outwardly, periderm inwardly; the latter passes over gradually into the root-cap.

Floating Organs of Neptunia oleracea.‖—Dr. G. Ritter Beck v. Mannagetta describes the floating organs of this plant (*Desmanthus natans* W.) from Sumatra. All the cells of the cortical tissue are stellate, none of them round. There is no secondary cambium, nor any uninterrupted ring of bast-cells after the disappearance of the

* Bot. Gazette, xiv. (1889) pp. 258–9 (2 figs.).

† Vidensk. Meddel. Naturhist. Foren. Kjöbenhavn, 1888, p. 28 (1 pl.). See Bot. Centralbl., xxxix. (1889) p. 124.

‡ Comptes Rendus, cix. (1889) pp. 35–8.

§ Bull. Soc. Linn. Normandie, ii. (1889) pp. 118–24. See Bot. Centralbl., xl. (1889) p. 125.

‖ SB. K. K. Zool.-Bot. Gesell. Wien, xxxix. (1889) pp. 57–9.

floating organ. The spongy parenchyme of the latter is formed by the enlargement of the cortical layers, which are already present, but consist hitherto of closely packed cells. The medullary cells are stellate when young, but afterwards become rounded; among them are crystalliferous cells, which vary greatly in size.

Tubercles.*—M. A. Seignette applies the term tubercle to all those parts of the plant where an accumulation of reserve-material takes place, which is destined to aid in the perpetuation and multiplication of the plant. He treats first of tubercles formed by the stem, with few or no secondary formations; and as a good example of this may be instanced the case of *Stachys tuberifera*. In this plant the tubercles are formed by the internodes of the underground stems, and are very variable in size. They are white, and at each of the nodes which separate the swollen internodes two opposite scales are to be found. Occasionally, in certain tubercles, lateral buds give rise to new secondary tubercles, instead of a stem, and in a few days the reserve-materials which were in the original tubercle are localized in the secondary tubercles. If a transverse section be made of a tubercle it will be found to have been formed by a considerable development of the pith, accompanied by a relatively less augmentation of the cortex. The author compares *Stachys palustris* with *S. tuberifera*, and indicates many points of resemblance between these two plants.

In *Oxalis cornuta* the tubercles are produced by a development of the primary tissues of the cortex, pericycle, and pith. The reserve-material accumulated in the tubercle was found to consist of starch and glucose, with a small quantity of saccharose. In *Begonia* we find an external morphology closely resembling *Cyclamen europæum*. The tubercle of *Cyperus esculentus*, which is formed by the swelling of a large number of internodes, has a very complex structure, the material for the nourishment of the plant being accumulated in the greatly augmented cortex and pith.

The author then describes four cases in which tubercles are formed on the stem with the development of secondary formations. In *Apios tuberosa* the tubercle is constituted from the non-lignified elements of the wood, the exterior elements preserving their function of conduction, while the interior elements are transformed into reserve-tissue.

Tubercles which are formed by the roots may be classed into two groups, depending on the amount of secondary formation. In the first group, where there is little or no secondary formation, the tuberization is produced by a large development of the cortex and pith (*Ranunculus asiaticus*, *Asphodelus albus*, *Asparagus officinalis*, &c.). In the second group, where the secondary formations are much developed, nearly all the tuberization consists of secondary parenchyme (*Spiræa Filipendula*, *Campanula barbata*, *Lathyrus tuberosus*, &c.).

In *Bryonia dioica* the tubercles are formed by the swelling of the underground stem, and towards their base by the swelling of the root. In a transverse section of the upper part of a young tubercle, four primary woody bundles will usually be found arranged in a single circle.

* Rev. Gén. de Bot. (Bonnier), i. (1889) pp. 415–29, 471–86, 509–36, 558–81, 611–29 (115 figs.).

The pericycle is much developed, and the pith much reduced ; and a cortex will be found, the cells of which are larger than those of the pericycle. The curious example of the bulbs formed by the leaves of *Oxalis Deppei* is then described, and also the case of *Anemone coronaria*, in which tubercles are formed by the swelling of the stem, root, and leaves. In the genus *Allium* also some of the flowers are frequently transformed into ovoid bulbils.

The second part of the paper deals with physiological researches on tubercles, numerous experiments having been made to show the variation occurring in the proportion of water and of dry weight.

The author concludes this portion by describing two methods employed to measure the temperature of tubercles. In the first method Thomson's galvanometer was used, and the temperature noted, and in the second, specially constructed mercurial thermometers were employed, and the tubercles perforated in order to allow the bulbs of the thermometers to be introduced.

As a summing-up, the following conclusions are drawn. Tubercles may be classified as follows according to their morphological nature :—(1) Tubercles formed by the stem. (*a*) With little or no secondary formation. (α) Dicotyledons (*Stachys tuberifera*, *Oxalis crenata*). (β) Monocotyledons (*Cyperus esculentus*, *Crocus vernus*). (*b*) With development of secondary formations (*Apios tuberosa*, *Epilobium Fleischeri*). (2) Tubercles formed by the root. (*a*) With little or no secondary formation. (α) Dicotyledons (*Ranunculus asiaticus*, *Ficaria ranunculoides*). (β) Monocotyledons (*Asphodelus albus*, *Simethis planifolia*). (*b*) With development of secondary formation (*Spiræa Filipendula*, *Campanula barbata*). (3) Tubercles formed by the stem and root (*Aquilegia vulgaris*, *Beta vulgaris*). (4) Tubercles formed by the leaves (*Oxalis Deppei*, *Tulipa*, *Lilium*). (5) Tubercles formed by the stem, leaves, and root (*Anemone coronaria*). (6) Tubercles formed by the flowers (*Allium carinatum*, *Allium vineale*, *Nothoscordum fragrans*).

As to the chemical composition of tubercles, starch, inulin, saccharose, galactane, and glucose are the substances most frequently found in reserve. As a general rule it may be laid down that the temperature of tubercles is always higher than that of the soil which incloses them. The relation of the dry weight of tubercles to their fresh weight is very variable, not only according to the species, but even according to the period of development when the weight is taken. The proportional dry weight usually reaches a maximum coincident with the period of development when the tubercle is latent.

Tubercles of Stachys tuberifera.*—M. L. Seignette states that the tubercles of *Stachys tuberifera* are formed by the swollen internodes of the underground stems. Their dimensions are variable, the longest observed being eight centimetres. The author then describes the formation of aerial stems on the tubercles, and also traces the development of the tubercles themselves. Their composition has been determined by M. A. Planta, who states that they contain 75 per cent. of galactine, a carbohydrate intermediate between starch and sugar, and discovered by Schultze in lupin seeds. Various experiments having

* Bull. Soc. Bot. France, xxxvi. (1889) pp. 189–94.

been made to ascertain the temperature of the tubercles, it has been determined that the point of maximum temperature is when the aërial stems commence to appear.

The anatomy of the aerial stem and that of the tubercle differ greatly. If the structure of the underground stem bearing the tubercle be examined, it will be found to be quadrangular, and at each of the angles a layer of collenchyme protecting a fibrovascular bundle will be seen; then a cortex fifteen to eighteen cells in thickness, and then the pith. If a transverse section be made of the first slightly swollen internode, the collenchyme will be found to be diminished, the cortex of about thirty cells in thickness, the wood diminished in quantity, and the pith greatly augmented. If a section be made at the base of the aerial stem, the collenchyme will be found greatly developed, and protecting four large fibrovascular bundles, a diminished cortex, a zone of pericyclic lignified fibres, and finally a greatly diminished pith. The tubercle is then formed by a considerable development of the pith accompanied by a relatively less augmentation of the cortex.

M. P. Maury* states that the morphological value of the tubercles of *Stachys affinis* Bge. (*S. tuberifera* Naud.) is the same as that of the potato, both being swollen subterranean stems. If a transverse section be made of an internode towards the middle, the following will be the arrangement from the periphery to the centre:—in the first place an epiderm, on the exterior of which is a thin layer of cutin; the cortex, formed of large roundish cells; then the fibrovascular zone, consisting of four principal fibrovascular bundles; and finally a very bulky pith. The difference between the structure of a tubercle and that of an aerial stem is but slight, and is principally marked by the absence of stomates and chlorophyll and the predominance of pith in the tubercle.

Non-chlorophyllous Humus-plants.†—Herr F. Johow describes the peculiarities of structure of the "holosaprophytes," or saprophytes destitute of chlorophyll, of which he enumerates 165 species belonging to 43 genera and 5 natural orders, viz. Orchidaceæ, Burmanniaceæ, Triuriaceæ, Ericaceæ, and Gentianaceæ, all the species of the two genera of Triuriaceæ belonging to this class of plants. Of these about 44 belong to Temperate, and 121 to Tropical countries. Most grow in the soil, some on rotten branches of trees, *Sciaphila* (Triuriaceæ) on the nests of termites.

The roots are generally but feebly developed, and well-developed root-hairs entirely wanting, except in *Sciaphila*. The central cylinder exhibits varying peculiarities of development. Except in *Wullschlægelia* (Orchidaceæ) the roots are always invested by a mycorhiza, which (except in *Monotropa Hypopitys*) does not penetrate beyond the epidermal cells, and affects the cells so little that they still contain protoplasm and even a nucleus. It is apparently this fungus that causes the usually coral-like or tufted appearance of the root. The author believes that the mycorhiza absorbs not only nitrogen, but also the nutrient substances resulting from the decay of the humus. In epiphytic orchids the mycorhiza is wanting in those parts which hang free. Except in

* T. c., pp. 186–9.

† Jahrb. f. Wiss. Bot. (Pringsheim), xx. (1889) pp. 475–525.

Epipogium stomates are wanting on the stem. The vascular bundles are usually of simple structure. The intercellular system and strengthening tissues are but feebly developed.

All holosaprophytes have small seeds with a rudimentary unsegmented embryo; the ovules frequently do not develope into fertile seeds, showing that the structure is the result of degradation. The ovules of *Voyria* (Gentianaceæ) are destitute of integument, resembling those of *Balanophora*. The seeds of *Sciaphila* contain endosperm, and the author regards the natural order Triuriaceæ as nearly allied to Alismaceæ.

Gramineæ and Cyperaceæ.*— After describing the inflorescence of the Brazilian genus of grasses *Streptochæta*, Dr. L. Celakovsky discusses the phylogenetic connection of the orders Gramineæ and Cyperaceæ, regarding both as descended, in different lines, from the Juncaceæ, the former having departed the more widely from the ancestral form. The reduction of the number of ovules to one, and the origin of this from the base of the ovary, is a phylogenetic advance common to the two orders; the usual coalescence of the ovule with the wall of the ovary, and the formation of the scutellum in the grasses, are further steps in advance not found in the sedges. The position of the embryo in the Cyperaceæ, surrounded by the endosperm, is also more archaic than the lateral position in the Gramineæ. The same is also the case with the 2–3-carpellary pistil of the Cyperaceæ, contrasted with its 1- or 2-carpellary structure in the Gramineæ.

With regard to the inflorescence, that of grasses is usually diplocaulic (biaxial), while that of the Cyperaceæ is frequently haplocaulic (uniaxial). The inflorescence of the tribe Cariceæ of the order Cyperaceæ the author states to be indefinite; and they are therefore more nearly allied to the Scirpoideæ than to the Caricoideæ, under which they are usually placed.

β. Physiology.

(1) Reproduction and Germination.

Physiology of Reproduction.†—Dr. G. Klebs brings forward evidence in favour of the view that the mode of reproduction in the lower organisms, whether sexual or non-sexual, is largely dependent on external conditions. The experiments here described were made entirely on *Hydrodictyon utriculatum*, in which the two modes of reproduction are well known—non-sexual by means of zoospores, and sexual by means of motile gametes which conjugate to form a zygote; the cycle being generally closed by the production of a sexual succeeding a number of non-sexual generations.

Dr. Klebs finds that, by cultivating this alga in a 0·5–1 per cent. nutrient solution, composed of 1 part magnesium sulphate, 1 part potassium phosphate, 1 part potassium nitrate, and 4 parts calcium nitrate, and then bringing it into fresh water, the formation of zoospores is greatly promoted; but that it is in all cases absolutely dependent on light, which must, at least for a time, act upon the culture. It is, however,

* SB. K. Böhm. Gesell. Wiss., 1889, pp. 14–42 (1 pl.), and 9–113 (1 pl.).
† Biol. Centralbl., ix. (1889) pp. 609–17.

only the development and the escape of the zoospores which are promoted by the saline solution, their first formation being the result of the internal nature of the cell. Some organic substances, as maltose and dulcite, also promote the formation of zoospores.

The tendency to produce gametes is not so easily excited, but can be brought about by cultivation in a 7–10 per cent. solution of cane-sugar, the presence of nutrient salts being excluded; and this can take place even in the dark.

Further experiments showed that, in a single net consisting of equivalent sister-cells, some of the cells can be excited, by external conditions, to develope zoospores, others to develope gametes. In a net which is commencing to produce gametes, a change to the formation of zoospores can be brought about by immersion in the above-named saline nutrient solution; a change from the sexual to the non-sexual condition is not so easily effected, but can be brought about by cultivating in maltose or dulcite.

The general conclusion of the author is that there is not in *Hydrodictyon* any true and necessary alternation of sexual and non-sexual generations such as is displayed in the Muscineæ and Vascular Cryptogams, but that every cell of the net has the capacity for producing both kinds of organ, and that it depends on external conditions which of the two forms of reproductive organ is brought into existence; favourable conditions tending, as a rule, to the production of non-sexual, unfavourable conditions to the production of sexual organs.

Nursing of the Embryo.*—Mr. T. Johnson describes the peculiar mode of growth of the embryo in the parasitic *Myzodendron punctulatum*, belonging to the Loranthaceæ. After fertilization the secondary nucleus of the embryo-sac divides repeatedly into a row of nuclei extending the whole length of the embryo-sac, which are soon separated by cell-walls, so that the interior of the embryo-sac is occupied by a uniserial column of endosperm-cells. During this time the narrow antipodal end of the embryo-sac has elongated upwards and backwards in the body of the placenta. It then makes a sharp bend upon itself, and continues its penetrating course, in a more or less winding manner, through the free column of the placenta, and on through the tract of tissue continuous with this, until it reaches the base of the flower, where its tip dilates and becomes imbedded in the vascular cup formed by the three carpellary vascular bundles, between the tip of which and the descending tip of the embryo-sac a few layers of rich parenchymatous cells intervene. Throughout its prolongation the embryo-sac remains a uniserial column of uninucleate richly protoplasmic cells. During the same time the nucellus-portion of the embryo-sac has become filled with endosperm-cells. The embryo, although divided into a small number of cells, remains for a long time undifferentiated, as in many other parasites. The main function of the embryo-sac tube is clearly nutritive. The placenta being destitute of vascular bundles, it acts as a carrier of food from the floral vascular bundle to the developing seed. In the ripe seed it is still an open tube, though its protoplasm is reduced to a thin layer inclosing a large quantity of cell-sap.

* Ann. of Bot., iii. (1889) pp. 179–206 (2 pls.).

A similar elongation of the embryo-sac takes place in many Santalaceæ, as *Santalum*, *Osyris*, and *Thesium*, in *Groutia* among the Olacineæ, and in other Loranthaceæ.

The mode of germination resembles that in *Viscum*.

Fertilization of the Vine.*—In continuation of his previous experiments on this subject, Herr E. Ráthay gives a number of very interesting results, of which the following are some of the more important:—

If the inflorescences of the female plants of the vine are protected from xenogamy, and the impregnation is confined to autogamy or seitonogamy (impregnation by pollen from other flowers of the same inflorescence), the flowers always wither soon after expanding; but, if impregnated xenogamously by the pollen of male or hermaphrodite individuals, normal bunches of grapes are produced. The inflorescences of hermaphrodite individuals, on the other hand, develope into normal bunches by seitonogamy and autogamy, or by the latter alone, if xenogamy alone, or both xenogamy and seitonogamy, are prevented. The author confirms Delpino's observation that the hypogynous nectaries produce abundance of honey. The distance of the hermaphrodite from the female flowers makes no difference in their fertilizing power.

With regard to *Vitis vinifera*, the seedlings of wild grapes are nearly always either male or female, very rarely hermaphrodite; while those of cultivated grapes are partially hermaphrodite. Seedlings of *Vitis riparia* and of American grapes gave somewhat different results. The general conclusion drawn is that there belong properly to the grape-vine only two different kinds of individuals, one of which is purely female, the other male, hermaphrodite, or intermediate, according to the degree of development of the pistil; these two kinds differ from one another in their inflorescence as well as in their individual flowers. Barrenness of the female flowers may be caused by the cap (calyx) remaining permanently attached. Pollination may be effected either by the wind or by insects.

Sexuality of Lychnis vespertina.†—M. A. Magnin gives a detailed account of the structure of the different sexual forms of this plant, and of the deformations caused by the attacks of *Ustilago antherarum*. The male and female plants are essentially different forms, differing not only in the presence or absence of the sexual organs, but also in size (the male plants being smaller), in the venation of the calyx, &c. Hermaphrodite individuals are simply female plants in which stamens are produced by the presence of *Ustilago antherarum*. In the male plants this parasite causes only a slight deformation of the anthers, and usually mesostemony or brachystemony, while in the female plants it brings about:—(1) The production of stamens as the only organ in which its spores can develope; (2) atrophy of the style and upper part of the ovary; (3) a greater or less elongation of the internode between calyx and corolla, this being also characteristic of the male plant. It also

* 'Die Geschlechtsverhältnisse der Reben,' Theil ii., 8vo, Wien, 1889, viii. and 92 pp., 3 pls., and 8 figs. See Bot. Centralbl., xxxix. (1889) p. 380. Cf. this Journal, 1889, p. 249.

† 'Rech. sur le polymorphisme . . . de *Lychnis vespertina*,' Lyon, 1889, 30 pp., 2 pls., and 8 figs. See Bot. Centralbl., xl. (1889) p. 186. Cf. this Journal, 1889, p. 412.

causes frequently tetramery or pentamery of the flowers, lobing of the margin of the petals, and a change in the venation of the sepals. The author traces a close similarity between these phenomena and those of the castration of animals caused by parasites.

Cause of the Direction of Growth of Pollen-tubes.*—According to experiments made by Dr. H. Molisch, the direction of the growth of pollen-tubes is chiefly regulated by two causes—by oxygen, they being negatively aerotropic, and by the stigmatic secretion.

Physiological Researches on the Germination of Seeds.†—M. E. Heckel describes various experiments made to ascertain the action of certain chemicals on the germination of seeds. The results may be summarized as follows:—(1) Contrary to the statements of Detmer, flower-of-sulphur does not accelerate the germination of even those seeds which contain sulphur as one of their constituent elements; (2) Sulphurous acid suspends or arrests germination according to the species of plant with which it is brought in contact; (3) Sulphuric acid in weak solution does not arrest germination; when, however, the percentage reaches 0·2 the germinative process is arrested. Solutions of various salts were tried; salicylate of soda was found, even in small doses, not only to suspend the germination of seeds (*Fagopyrum esculentum*, *Solanum nigrum*, *Brassica Napus*) but also of tubers (*Helianthus tuberosus*); (4) Desiccation of seeds between 40° and 60° C. does not accelerate germination, but permits young plants to develope more rapidly; (5) High humid temperatures of from 40° to 60° considerably accelerate germination.

(2) Nutrition and Growth (including Movements of Fluids).

Fixation of Nitrogen by Leguminosæ.‡—M. E. Bréal has already shown that it is possible to cause nodosities to arise on the roots of Leguminosæ by inoculating them with bacteria. He now gives a *résumé* of certain cultures of Leguminosæ which he has carried on for the last two years, and he agrees with MM. Hellriegel and Willfarth and M. Berthelot, when they state that these plants can grow in a soil which is very poor in nitrogen. By means of their roots they furnish and fix this element in the soil which bears them, and well merit the name of "ameliorating plants," which has for some time been given to them.

Absorption of Nitrogen by Plants from the Soil.§—M. A. Muntz has determined, as the result of a series of experiments, that, contrary to the view generally entertained, the higher plants, such as cereals and beans, can absorb nitrogen directly from the soil when presented to them in the form of a salt of ammonia; and that consequently the nitrification of ammoniacal manures is not an essential condition to their utilization.

Relation between the Physical Characters of Plants and the Richness of the Soil.‖—M. S. Ville describes various experiments made

* SB. K. K. Zool. Bot. Gesell. Wien, xxxix. (1889) p. 52.
† Journ. de Bot. (Morot), iii. (1889) pp. 288-94, 297-305, 315-9, 332-5.
‡ Comptes Rendus, cix. (1889) pp. 670-3. Cf. this Journal, 1889, p. 781.
§ Comptes Rendus, cix. (1889) pp. 646-8. ‖ T. c., pp. 628-31.

with the common hemp, in order to ascertain the relation between the nature of the soil and the colour, habit, weight, and general facies of the plant. The colour was found to be most intense, the height greatest, and the dry weight most, when a manure containing a large proportion of nitrogen was used. When no nitrogen was present the colour was very light. When no phosphate was present in the manure the hemp seemed to be considerably taller and of a deeper colour than when no nitrogen was present; but when no potash was present the height was very much reduced. The absence of lime did not seriously affect the height of the plant.

Wave-growth of Corydalis sempervirens.*—Mr. T. Meehan describes what he terms a recoil in the wave-growth in *Corydalis sempervirens*. The author has pointed out that growth in plants is not by slow and regular modifications, but in rhythms or waves, and that it is the varying intensity of these waves that largely influences those variations that give character to genera and species. In *Corydalis* there is a sleeping of the buds till the apical bud is reached, which keeps on without resting till fully formed. Instead, however, of the next in order downward being started into a renewed growth, as in Compositæ, it is the lowest on the five-flowered raceme that starts the second growth-wave, and the other three upwards then follow successively.

Heredity of Torsion.†—Herr H. de Vries has established that the torsion (Zwangsdrehung) exhibited by *Dipsacus sylvestris* is a hereditary character, fixed by natural selection.

(4) Chemical Changes (including Respiration and Fermentation).

Process of Oxidation in Living Cells.‡—Prof. W. Pfeffer presents the results of a systematic investigation regarding the action on vegetable cells of peroxide of hydrogen. He believes that neither this nor any similar substance furnishing active oxygen arises in living cells or exists in the cell-sap. Hence the processes of oxidation in the living cell must be effected in some other way than by simple imbibition into the protoplasm.

Formation of Glycogen in Beer-yeast.§—M. Laurent shows that the alcoholic fermentation has well-defined limits, for it is only produced when the yeast is supplied with saccharine substances. If the latter be replaced by certain other substances (acetates, glycerin, erythrolene), an excellent development of *Saccharomyces* takes place; but to serve as aliment these carbohydrates must be consumed in contact with air. Of these substances, the author enumerates thirty-four capable of replacing sugar. Not only do these organic substances subserve direct nutrition, but some fourteen assist also in forming reserves of glycogen. And an old experiment of Pasteur is easily explained from the foregoing facts.

Beer-yeast diluted with water and left to itself gives off carbonic acid and produces alcohol. In this autophagic experiment the yeast

* Bull. Torrey Bot. Club, xvi. (1889) p. 293.
† Ber. Deutsch. Bot. Gesell., vii. (1889) pp. 291–8 (1 pl.).
‡ Abhandl. K. Sächs. Gesell. Wiss., xv. (1889) 141 pp. See Bot. Ztg., xxxviii. (1889) p. 621.
§ Ann. Inst. Pasteur, 1889, p. 112. Cf. this Journal, 1888, p. 785.

destroys a substance capable of becoming sugar, and produces an aceto-fermentation. This substance is glycogen. Errera had already clearly perceived the existence of this glycogen. He obtained a red-brown colour with iodine, but no success followed his attempts at isolating it.

M. Laurent has been able to make a step further. By the aid of three imperfect methods, but which gave concordant results, he has calculated the glycogen formed. These three methods were:—(1) To change by means of an acid the glycogen into a reducing sugar, without altering the cell-walls. (2) To weigh a quantity of healthy yeast, to exhaust an equal weight by autophagy, and calculate the loss by subtraction. (3) To estimate the quantity of alcohol produced by a given weight of yeast exhausted by autophagy, and then determine the quantity of saccharine matter consumed.

The result of these researches showed that the quantity of accumulated glycogen might amount to 32 per cent. by weight dry.

The accumulation of glycogen in yeast completes the history of the phenomena of autophagy, and explains the results formerly observed by Pasteur and Duclaux, that yeast loses weight when it is fermented with a relatively small quantity of sugar.

Formation of Albuminoids in Plants containing Chlorophyll.*—By experiments made on several different plants, Herr W. Chrapowicki has determined that the formation of albuminoids takes place in the chromatophores, and that they are not merely transferred there from other parts of the plant where they are first formed. In several instances he was able to establish that the formation of albuminoids can take place in the dark.

Formation of Cane-sugar in Etiolated Seedlings.†—In seedlings of *Lupinus luteus* which had grown for six days in the dark, Herr E. Schulze finds small quantities of a substance agreeing with cane-sugar in its behaviour under the polarizing apparatus, and in its crystalline form. Starch was also found, neither substance being present in the seeds before germination.

Fermentation.‡—M. E. Bourquelot has grouped the various phenomena caused by the action of soluble and organized ferments, interesting alike to chemist, pharmacist, and mycologist. In the introduction the author gives an historical account of fermentation; and the first part of the book is devoted to an account of fermentation produced by soluble ferments. These are classed in the following manner:—(1) The saccharification of starch (diastase); (2) the inversion of cane-sugar (invertin); (3) the doubling of glucosides (emulsin, myrosin); (4) the peptonization of albuminoids (pepsin, trypsin, and papaïne); (5) the coagulation of casein (*présure*); (6) the decomposition of urea (urease). The second part of the book treats of fermentation produced by organized ferments, the principal of which are the alcoholic and lactic fermentations, the ammoniacal fermentation of urea, butyric, sulphydric, acetic, and nitric fermentations.

* Arb. St. Petersburg. Naturf. Gesell., xviii., pp. 1–27 (Russian). See Bot. Centralbl., xxxix. (1889) p. 352. † Ber. Deutsch. Bot. Gesell., vii. (1889) pp. 280–1.
‡ 'Les Fermentations,' Paris, 1889, 8vo, 170 pp. See Rev. Mycol., xi. (1889) p. 209.

γ. General.

Myrmecophilous Plants.*—In the concluding portion of his work on this subject, Prof. F. Delpino enumerates as many as 3030 species, distributed through 292 genera, with extra-floral nectaries or other contrivances for inviting the visits of ants. The natural orders in which the greatest number of myrmecophilous species occur are Mimoseæ (663), Euphobiaceæ (482), and Bignoniaceæ (342). The prevalence of the phenomena in any district is nearly proportional to the average temperature; the central-American region produces the largest number (653). The author believes that both ants and myrmecophilous plants came into existence in the Cretaceous period.

Injury to Vegetation from Gases.†—Herren L. Just and H. Heine describe the injury done to vegetation by various gases, the most injurious being sulphurous acid, which, when taken into the tissues, is oxidized into sulphuric acid, which gradually destroys the protoplasm, causing yellowing of the leaves and final death of the plant. Apple and pear trees, the grape-vine, and conifers, are especially sensitive to its attacks.

Botanical Work of Lacustrine Stations.‡—Prof. F. Ludwig calls the attention of botanists to the scheme proposed by Zacharias for the investigation of lakes. The distribution of aquatic plants, the actual conditions of life, the relations between fauna and flora, e.g. in connection with fertilization, all demand investigation, for which the establishment of lake-side stations is indispensable. "When the 'systematic' survey of a country is roughly completed, then the 'biological' investigation begins," and it is time that this was undertaken in earnest for the lakes.

B. CRYPTOGAMIA.

Cryptogamia Vascularia.

Antherozoids of Marsileaceæ and Equisetaceæ.§—Continuing his researches on the structure and development of the antherozoids of Cryptogams, M. L. Guignard now describes those of *Pilularia* and *Equisetum*.

The antherozoids of *Pilularia* he finds to be formed on the same general plan as those of the Characeæ, Muscineæ, and Filices; the nucleus, which has taken up a lateral position in the mother-cell, and gives birth to the spiral body, partially absorbs the granular and starchy protoplasm; the rest of the protoplasm forms a vesicle, containing particles of starch, which remains attached to the internal face of the posterior portion of the body, and becomes detached only during the rotation of the antherozoid. The general aspect of the antherozoid closely resembles that of *Sphagnum*, differing chiefly in the number of cilia. The cilia are not attached, as has been stated, to the two first

* Funzione mirmecofila del regno vegetale,' pte. 3, Bologna, 1889, 35 pp. See Bot. Centralbl, xl. (1889) p. 387. Cf. this Journal. 1888, p. 998.

† Landwirthsch. Versuchsstat., xxxvi. (1889). See Bot. Centralbl., xl. (1889) p. 296.

‡ Biol. Centralbl., ix. (1889) pp. 414–6.

§ Bull. Soc. Bot. France, xxxvi. (1889) pp. 378–83. Cf. this Journal, 1889, p. 552.

turns of the spiral, but only to the first half of the anterior turn, where they spring from a small swelling which appears to have hitherto escaped notice.

In his view of the mode of development of the antherozoids of *Equisetum*, M. Guignard differs somewhat from that of Belajeff*; he finds it closely analogous to that in Filices. The nucleus of the mother-cell does not, according to his observation, retain its original globular form, but undergoes the same changes as those which take place in other Vascular Cryptogams, accompanied by special changes in the protoplasm of the mother-cell.

Embryogeny of Lycopodiaceæ.†—Dr. M. Treub has continued his researches on the embryogeny and development of various species of *Lycopodium*, especially *L. cernuum*. The young embryo of this species is fixed to the soil, not by a root, but by a parenchymatous tuber covered with root-hairs, resembling the tuber of *Phylloglossum*. The embryo consists of three parts:—a suspensor composed of a single large cell, the foot, which never projects beyond the prothallium, and a third part, which developes into the embryonal tuber and the cotyledons. It is only after the tuber has attained its full size that the growing point is developed on it; near it springs the first root, which is of exogenous origin. The vascular bundle of the leaves ends before reaching the tuber, which contains none. As a general rule only one embryo is formed on each prothallium. The tuber is infested, as in *L. inundatum*, by the hyphæ of a fungus.

In the embryonal condition *L. cernuum* can reproduce itself in a vegetative way by root-tubers. All the roots of the young plant can produce such tubers, which ultimately become detached from the parent-plant, and develope into new plants. *L. salakense* is propagated in the same way.

The embryonal tuber of *Lycopodium*, which has no analogue among Vascular Cryptogams, cannot be regarded as an outcome of degeneration; it must be a rudimentary organ, and Dr. Treub regards it as an intermediate stage between the unsegmented sporophyte of the Muscineæ and the leafy sporophyte of other Vascular Cryptogams. He proposes, therefore, to call it the *protocorm;* it is analogous to the protoneme of mosses. In *Phylloglossum*, the oldest type, the protocorm plays an important part during the entire life of the individual; in species of *Lycopodium* of the *cernuum* type it occurs only in the embryonal condition; in the epiphytal *Phlegmarium* type only traces of it survive.

Lycopodium Spores.‡—According to Herr A. Langer the spores of *Lycopodium clavatum* contain 1·155 per cent. of neutral mineral constituents (chiefly phosphates of potassium, sodium, calcium, magnesium, iron, and aluminium, with smaller quantities of calcium sulphate, potassium chloride, and aluminium silicate, and traces of manganese), and 49·34 per cent. of an acid greenish-yellow oil, composed of 80–

* Cf. this Journal, 1889, p. 785.

† Ann. Jard. Bot. Buitenzorg, viii. (1889) pp. 1–37 (12 pls.).

‡ 'Ueb. Bestandtheile d. Lycopodium-sporen,' Berlin, 1889, 8vo, 46 pp. See Bot. Centralbl., xl. (1889) p. 355.

86·67 per cent. of a volatile oleic acid, with a variable proportion of glycerin, and a mixture of fatty acids, including myristinic acid. The spores contain also a minimum of 2·12 per cent. of cane-sugar.

Apospory in Ferns.*—Prof. F. Cohn describes experiments in the cultivation of the well-known aposporous fern, *Athyrium Filix-femina* var. *clarissima.* He was unable to establish that the peculiarity could be transmitted by heredity.

Roots of Ferns.†—Herr J. P. Lachmann states that, with the exception of some species of *Trichomanes*, all ferns produce lateral roots, which always spring from definite points in the primary meristem of the summits of the stem. In some cases, however (Cyatheaceæ), they cease growing as soon as their apex has traversed the cortex, while in others they remain completely imprisoned, and may lie dormant for an indefinite period, a fact which has given rise to the erroneous statement that these ferns produce adventitious roots. The roots of ferns have a remarkably long duration of life, a phenomenon largely due to the conserving effect of the filicitannic acid produced in their integument.

The lateral roots spring from the petiole only in *Ceratopteris thalictroides;* in all other ferns from the stem. They may be arranged without any definite order, or their number may have a direct relation to the number of leaves. In the species of *Athyrium*, and in *Ceterach officinarum* and *Lomaria spicant* there is always one root to each leaf; in *Osmunda* and *Todea* two lateral roots to each leaf; in *Cystopteris* one lateral and one median; in some species of *Aspidium* three; in the arborescent Cyatheaceæ it may reach a very large number.

Other Filicineæ resemble Filices more or less in the mode of insertion of the roots. In *Marattia* there is one median root beneath each leaf; in *Angiopteris* two lateral ones; in Ophioglossaceæ and Marsiliaceæ the insertion of the roots has a relationship to the leaves; it is less evident in Equisetaceæ, and disappears altogether in the Lycopodineæ. Among Phanerogams such a relationship is very rare; but occurs in *Nuphar lutea* and in some Aroideæ.

It is possible for the roots to bear buds; but this occurs only very rarely. The stolons of *Nephrolepis* are cauline.

Hybrid Ferns and Mosses.‡—Herr H. v. Klinggraeff gives a *résumé* of the authentic cases at present known of hybridization among Ferns, in all of which a mingling of the characters of the parents is exhibited by the offspring. He doubts whether there are at present any unquestionable instances of hybridization in Mosses.

Muscineæ.

Braithwaite's British Moss-flora.§—The most recently published part of this beautiful work completes the genera of Grimmiaceæ with *Pleurozygodon* (1 sp.), *Zygodon* (5 sp.), *Orthotrichum* (17 sp.), and

* JB. Schles. Gesell. Vaterl. Cultur, 1888 (1889) pp. 157–60. Cf. this Journal, 1889, p. 256.

† Ann. Soc. Bot. Lyon. (5 pls. and figs.). See Morot's Journ. de Bot., iii. (1889), Rev. Bibl., p. cix.

‡ Schrift. Nat. Gesell. Danzig, 1889, pp. 172–8. See Bot. Centralbl., xl. (1889) p. 288.

§ Pt. xii. (1889) 18 pp. and 7 pls.

Weissia (7 sp.). The fruit of *Zygodon gracilis* is figured for the first time. The 11th family or Schistostegaceæ comprises a single species, the remarkable *Schistostega osmundacea*, which is beautifully figured.

Rabenhorst's Cryptogamic Flora of Germany (Musci).*—The first volume of the section of this work devoted to the Musci, by Herr K. G. Limpricht, is now completed. It comprises the Sphagnaceæ, Andreæaceæ, Archidiaceæ, and a portion of the Bryineæ, viz. the Cleistocarpæ and Stegocarpæ (Acrocarpæ), the last 3 parts (11–13) being devoted to the Grimmiaceæ and the completion of the Pottiaceæ. The Ephemeraceæ and the Phascaceæ are included in the Cleistocarpæ. The exhaustive character of the descriptions, both of the genera and species, and the beauty and accuracy of the numerous illustrations, render this one of the most important contributions made in recent years to bryological literature. The systematic portion is preceded by a general description of the structure and modes of reproduction of Mosses, and some practical hints as to their collection and preservation.

Species of Sphagnum.†—Herr E. Russow returns to the controversy with Röll, and restates the arguments in favour of the inconstancy of the characters of the species of bog-moss.

Characeæ.

Characeæ.‡—M. l'Abbé Hy describes the modes of cortication and ramification in the Characeæ, and also the characters which are useful for purposes of classification. *Nitella* may be easily distinguished by the caducous corona of the fruit being formed of ten cells, by the stem having no cortex and two branches in each axil, and by there being no stipules. In *Chara* the corona of the fruit is persistent, and consists of five cells, the stem ordinarily has a cortex, and solitary branches at each node, and stipules are present. The principal difficulty consists, however, in the position of *Chara stelligera*, which has the fruit of a true *Chara* with the vegetative organs of *Nitella*. In order to meet this difficulty the author has proposed for it a new genus *Nitellopsis*.

Pericarp of Characeæ.§—Prof. O. Nordstedt has examined the structure of the pericarp of the fruit in the greater number of known species of *Chara*, *Nitella*, *Tolypella*, *Lichnothamnus*, and *Lamprothamnus*; and classifies it under a number of types, according to the structure of its external layer. This may be quite smooth, or granulated or warted in a variety of ways, or with reticulate elevations and pits between them. In *Chara* the two layers of which the pericarp is composed are usually either both smooth or both similarly ornamented, though this is not always the case.

A new species, *Tolypella hispanica*, is described from Spain.

* Limpricht, 'Die Laubmoose Deutschlands, Oesterreichs u. d. Schweiz,' 1te Abtheil., Leipzig, 1890, 836 pp. and 211 figs.

† Bot. Centralbl., xl. (1889) pp. 417–24. Cf. this Journal, 1888, p. 775.

‡ Bull. Soc. Bot. France, xxxvi. (1889) pp. 393–8.

§ Lunds Univ. Arsskr., xxv. (1889) 40 pp. and 1 pl.

Algæ.

Reinke's Atlas of German Seaweeds.*—In the first part of this magnificent work thirty species or varieties are described and figured, including many new species and several new genera. The larger portion is devoted to the Phæophyceæ, which the author divides into four main families:—the Cutleriaceæ, Tilopterideæ, Laminariaceæ, and Ectocarpaceæ, the last being divided into a number of smaller groups.

Halothrix is a new genus, separated from *Ectocarpus*, coming near to *Giraudia*, but monosiphonous, and with plurilocular sporanges arranged in sori on the upper portion of the filaments. *Symphoricoccus* is distinguished from *Myriotrichia* by its monosiphonous filaments, and from *Elachistea* by the unilocular sporanges occurring on the upper as well as the lower part of the filaments. *Kjellmannia* is a new genus of Punctarieæ, with a polysiphonous thallus bearing monosiphonous branches, and with two kinds of sporange, both plurilocular, one intercalary, the other collected into sori. *Microspongium* is a new genus of Myrionemeæ, resembling *Myrionema* in appearance, but with straight branched filaments, growing by apical growth, and with both unilocular and plurilocular sporanges. *Leptonema* is a new genus of Elachisteæ, with both kinds of sporange; the assimilating filaments, which branch only at the base, spring from a creeping protoneme.

One new genus is described of marine Confervaceæ, *Epicladia*, nearly allied to *Entocladia*, resembling it in habit, and propagated by zoospores. *Blastophysa* is a genus of Siphoneæ, allied to *Valonia*, but resembling *Botrydium* in appearance; it is composed of green vesicles, which were not seen to produce zoospores. *Pringsheimia* is a new genus, possibly belonging to the Ulvaceæ, resembling *Coleochæte* in appearance, but without bristles, epiphytic on various Algæ; it produces both megazoospores and conjugating microzoospores or zoogametes; it may possibly be identical with *Chætopeltis* Moeb.

New Algæ from Brazil.†—From a large collection of Algæ sent from Brazil by Dr. H. Schenck, Dr. M. Moebius describes the following new genera:—

Spirocoleus. Genus Oscillariacearum trichomatibus articulatis spiralibus simplicibus, vagina conspicua præditis. One species, *S. Lagerheimii*, growing among a *Chara*.

Entophysa. Genus Chlorosphæracearum. Thallus in algis majoribus sub cuticula vigens, e cellula subrotunda una vel e pluribus cellulis divisione unius cellulæ exortis constitutus, membrana crassa, loco quodam in verrucam vel stipellum producta, chromatophoro unico parietino discoideo; sporæ divisione contentus cellulæ succedanea evolutæ per foramen membranæ externæ ac simul cuticulæ hospitis exeunt. One species, *E. Charæ*, living within the cell-wall of a *Chara*.

In addition to the above, the following new species are also described:—*Acetabularia Schenckii*, *Dictyopteris Hauckiana*, *Gracilaria Salzmanni*.

* 'Atlas Deutscher Meeresalgen,' 1tes Heft, fol., Berlin, 1889, 34 pp. and 25 pls.
† Hedwigia, xxviii. (1889) pp. 309–47 (2 pls. and 1 fig.).

Marine Algæ of West Indies.*—Mr. G. Murray completes his catalogue of 788 species of Marine Algæ from the West Indies, viz. 444 Florideæ, 112 Phæophyceæ, 187 Chlorophyceæ, and 45 Protophyceæ. With regard to their distribution, he states that the Indian Ocean region has, both relatively to Australia and relatively to its total flora, surprisingly little in common with the West Indies as regards species. As respects the forms which are either confined to or almost exclusively represented in the Tropics, the forms of marine Algæ are, speaking broadly, the same in the East Indies as in the West, while the species are in a very high proportion different.

Division of Micrasterias denticulata.†—Mr. S. Helm describes the mode of binary subdivision of this desmid, the description differing from that of previous observers in the order of appearance of the segments.

Sphærocodium.‡—Under this name Dr. A. Rothpletz describes, as a genus of fossil siphonaceous algæ, calcareous remains from the Raibler strata in the Eastern Alps, hitherto known as ooliths. The genus is nearly allied to *Codium* and *Udotea*, but differs from them in its mode of growth, and in its property of calcareous excretion.

Polyblepharideæ §—This new family of the lower Algæ is defined by M. P. A. Dangeard as being nearly allied to the Chlamydomonadineæ, from which they differ merely in their mode of development, multiplying by simple longitudinal division and encysting instead of by a sexual process. The fission commences in the chromatophore, and results in the production of two zoospores, each with four or more cilia. They approach the Flagellatæ through *Tetramitina*, but differ from them in being true Algæ; they do not absorb solid food into the body; and they possess chlorophyll, an amyliferous corpuscle, and a cellulose membrane. The following diagnoses are given of the three genera which make up the order:—

Polyblepharides. Body elongated, obtuse in front; protoplasm intensely green; membrane excessively thin, structureless, permitting of amœboid movements at the moment of the germination of the cyst; the nucleus anterior and nucleolated; amyliferous corpuscle posterior; starch dispersed in granules through the protoplasm; one or two vacuoles at the base of the cilia; division longitudinal and free; cysts surrounded by a gelatinous mucus, giving birth, on germinating, to a single zoospore; cilia from six to eight in a tuft. One species, *P. singularis* Dang.

Pyramimonas. Body with four wings or projecting sides; protoplasm differentiated into ectosarc and endosarc; chlorophyll localized in the ectosarc (chromatophore); enveloping membrane striated; nucleus anterior and nucleolated; amyliferous corpuscle posterior; one contractile vacuole; one pigment-spot; division longitudinal and free; cysts spherical, not enveloped in mucus; cilia four. One species, *P. tetrarhynchus* Schmarda.

* Journ. of Bot., xxvii. (1889) pp. 237–42, 257–62, 298–305.
† Journ. New York Micr. Soc., v. (1889) pp. 93–4 (1 pl.).
‡ SB. Bot. Ver. München, Dec. 9, 1889. See Bot. Centralbl., xli. (1890) p. 9.
§ Comptes Rendus, cix. (1889) pp. 85–6. Cf. this Journal, 1889, p. 95.

Chloraster. Body variable in form, with four more or less projecting sides; protoplasm green; one pigment-spot; cilia five, one central one, surrounded by the four others arranged as a crown. Two species, *C. gyrans* Ehrb., *C. agilis* Kent.

Wittrock and Nordstedt's Algæ aquæ dulcis.*—The last three fasciculi (Nos. 851–1000) of this publication include specimens of the following new species:—*Trentepohlia recurvata* W. and N., *Cladophora Nordstedtii* Hauck, *C. Arechavaletana* Hauck, from Uruguay, *Mougeotia gelatinosa* Wittr., *S. Lagerheimii* Wittr., from Sweden, *Cosmarium substriatum* from Lapland, *Hydrocoleum platense* Nordst., from Uruguay.

Fungi.

Thermogenic Action of Fungi.†—Prof. F. Cohn discusses the cause of the elevation of temperature which always accompanies the germination of seeds, as, e. g. the malting of barley. The difference may amount to as much as 17°, and may raise the temperature to as much as 60° C., causing the death of the seeds. Prof. Cohn rejects the theory that this elevation is due to intramolecular respiration,‡ which may continue even after the death of the seed. He believes it to be due entirely to a process of fermentation. The fungi which are the causes of the earlier stages of this phenomenon, species of *Penicillium* and *Rhizopus*, are themselves killed by the high temperature, and it is then carried on entirely by *Aspergillus fumigatus*, which has the power of resisting a very high degree of heat. The highest temperature is reached only when the fungus begins to fructify.

Mycorhiza.§—Herr A. Schlicht describes the occurrence of mycorhiza in a number of plants in which it had not previously been observed, such as, e. g. *Paris quadrifolia;* while young roots are often completely free of the fungus, older roots are always at least partially infested by it. The hyphæ penetrate through the intercellular substance of the epidermal and hypodermal cells into the large thin-walled cortical cells, and there develope into masses which are in connection with the environment of the root, and with one another by filaments which perforate the septa. The spots which are thus infested have quite the same structure as the uninfested spots; the fungus is not a parasite, and has no injurious influence on the root. Similar phenomena were observed in *Ranunculus acer* and other species of the genus, *Caltha palustris*, *Holcus lanatus*, and other grasses. *Leontodon autumnalis* is infested by an endotrophic mycorhiza, such as is found in other Compositæ, Umbelliferæ, Rosaceæ, Gentianaceæ, &c.

Roots infested with endotrophic mycorhiza more closely resemble normal roots than those with the ectotrophic, which often develope into coral-like tubers.

In a large number of natural orders some of the species are ordinarily attacked by mycorhiza, while others are entirely free from it. It was

* Bot. Notis., 1889, pp. 157–68 (6 figs.).

† JB. Schles. Gesell. Vaterl. Cultur, 1888 (1889) pp. 150–6.

‡ Cf. this Journal, 1887, p. 619.

§ 'Beitr. z. Kenntniss . . . . der Mykorhizen,' 8vo, Berlin, 1889, 35 pp. and 1 pl., See Bot. Centralbl., xl. (1889) p. 383. Cf. this Journal, 1889, p. 422.

not observed in any species of Rhinanthaceæ, Droseraceæ, Cruciferæ, Papaveraceæ, or Cyperaceæ; aquatic and arenaceous plants are destitute of it; it is found only in those which grow in humus. In *Drosera* the author observed a peculiar condition of the roots; the long brown root-hairs are invested by a dense mantle of dead vegetable remains, *Sphagnum*-leaves, &c., only the tips of the roots remaining exposed.

New American Phytophthora.*—Mr. R. Thaxter describes a new *Phytophthora*, *P. Phaseoli*, parasitic on the pods, stems, and leaves of the Lima bean, *Phaseolus lunatus*. The mycelial hyphæ are branched, rarely penetrating the cells of the host by irregular haustoria; conidiophores slightly swollen at their point of exit through the stomates, arising singly or one to several in a cluster, simple or once dichotomously branched, and with one or more inflations below their apices; conids oval or elliptical, with truncate base and papillate apex, 35–50 μ by 20–24 μ. Germination by zoospores, usually fifteen in number, or rarely by a simple germinating hypha. Oosperms unknown.

Beer-yeasts.†—M. E. C. Hansen shows that all the species of *Saccharomyces* pass, in their evolution, successively through the different forms which Reess regarded as specific. The latter based his species on characters drawn from the form of the cells. The author's results were obtained by means of cultivations started from a single cell.

This method, conceived in 1882, has enabled the author to establish that the high and low ferments are not convertible the one into the other, and the opposite results obtained by Pasteur and Reess must have been due to a mixture of the two species.

According to the author, the species of Saccharomycetes are defined by the temperature curves of the development of their spores, by critical temperatures (death, &c.), by the budding, and by the fermentative power.

If various kinds of *Saccharomyces* be cultivated under identical conditions, the form of the individual cell furnishes specific characteristics for the whole group and accordingly for the species, although the course of spore development remains the most important characteristic. Yet the form of the single cell should only be employed for recognition purposes with the greatest caution, because almost all kinds of the genus *Saccharomyces* may appear under the same form, although of course not under the same conditions. It would, therefore, seem easy to transform one species into another if the favourable conditions were ascertainable; but Prof. E. C. Hansen, after more than four years' experimentation, has failed with the aid of variations of temperature to transform the low yeast into the high yeast, and *vice versâ*.

In practice it was of course important that the cultivation should be quite pure, and this was effected by starting from a single cell; yet in the case of the low yeast Carlsberg 1, very different appearances were obtained: some of the cells might have been taken for *S. pastorianus*, others for those of *S. cerevisiæ*. In cultivations in beer-wort *S. cerevisiæ* did not alter in form, while *S. pastorianus*, which at first retained its sausage-like shape, completely lost it after several generations. So that the difference between the two series of experiments became constantly less and less, and finally in both oval cells only appeared. That the

* Bot. Gazette, xiv. (1889) pp. 273–4. † Ann. de Microgr., i. (1888) pp. 11–18.

resemblance was not merely superficial was shown by the production of an identical beer.

Hence the important practical conclusion, that not only microscopical examination of the cells, but also the results of first cultivations are unsafe guides.

Morphology and Biology of Oidium albicans.*—MM. G. Linossier and G. Roux state that if *Oidium albicans* be cultivated in an artificial medium, within certain limits of temperature, a third undescribed sporiferous form will be found to exist. The authors cultivated the fungus in a liquid having the following composition per litre:—saccharose 20 gr., tartrate of ammonium 10 gr., phosphate of potassium 1 gr., sulphate of magnesium 0·2 gr., chloride of calcium 0·1 gr., the temperature being maintained at from 30–35° C., and were able definitely to determine the presence of chlamydospores, and several times to verify the absence of true ascopores. They state further that in the cultures of this fungus the nature of the form depends on the molecular structure of the nourishment. Thus if a small quantity of saccharose be present in the liquid short mycelial filaments will be found to exist, these filaments becoming longer as the quantity of sugar increases. The character of the fungus varies similarly if glycerin or mannite be present, or if the nourishment consist only of a simple ammoniacal salt. Finally the authors state that if the fungus has been cultivated for several generations in a medium where it affects the globular-filamentous form, it more easily takes this form when transported to new media.

New Parasite of Agrostis segetum.†—Prof. N. Sorokine describes and figures a new parasite which has been met with in the Government of Kazan on *Agrostis segetum*, to which he has assigned the name *Sorosporella Agrostidis*, the spores somewhat recalling those of *Sorosporium*, although it has nothing in common with the Ustilagineæ. M. Giard considers *Tarichium uvella* Krass., parasitic on *Agrostis*, as identical with this new fungus.

Fungus-parasites.‡ — Prof. R. Hartig finds that the species of *Melampsora* which attack various species of poplar, *M. Tremulæ*, *populina*, and *balsamifera*, have their æcidio-form in the *Cæoma* of the larch, *C. Laricis* being identical with the *M. populina* of the black poplar as well as with the *M. Tremulæ* of the aspen.

He describes also a hitherto unobserved disease of seedling pines and firs, which causes great destruction, and which is referable to an undescribed parasite belonging to the Pyrenomycetes. The mycele enters the stomates as well as attacks the wall of the epidermal cells; the gonids resemble those of a *Nectria*.

Report of the Chief of the Section of Vegetable Pathology for the year 1888, Washington.§—Mr. B. T. Galloway in this report describes and figures the following:—potato-rot (*Phytophthora infestans*); black-rot of the tomato (*Macrosporium Solani*), also *Fusarium Solani* and *Cladosporium fulvum*; brown-rot of cherry (*Monilia fructigena*); powdery

* Comptes Rendus, cix. (1889) pp. 752–5.
† Bull. Scient. France et Belg., iv., 1889. See Rev. Mycol., xi. (1889) p. 215.
‡ SB. Bot. Ver. München, Nov. 11, 1889. See Bot. Centralbl., xl. (1889) p. 310.
§ Rev. Mycol., xi. (1889) pp. 217–8.

mildew of cherry (*Podosphæria oxyacantha*); cracking of the pear (*Entomosporium maculatum*); leaf-spot of rose (*Cercospora rosæcola*); plum-pockets (*Taphrina Pruni*); apple-rust (*Rœstelia pirata*); *Septosporium* on grape-leaves (*Septosporium heterosporium*); leaf-spot of maple (*Phyllosticta acericola*); sycamore-disease (*Gleosporium nervisequum*); poplar-leaf-rust (*Melampsora populina*).

Agaricini.*—M. V. Fayod gives a detailed account of the morphology of this group of Fungi, and of the relationship to one another of its various families. The various organs are described under the following heads:—(1) the mycele, including the primary mycele, the secondary mycele, and the pseudorhizes. Under the first head the mycele may be either ordinary or persistent; the persistent primary mycele may be either nematoid (filamentous), spartoid (corticated), or tuberous (sclerotes), and is always a reservoir for food-materials; the last form may be again either exosclerotes or mycelial tubercles. By pseudorhizes the author understands root-like mycelial structures which develope at the base of the carpophore from its cells: (2) The carpophore (receptacle), including the stipe, the pileus, and the lamellæ. Under this head are treated three kinds of tissue, the fundamental, the connecting, and the strengthening; excretions, whether of a gaseous, liquid, or solid nature; and the phenomenon of luminosity, a list of all known luminous agarics being given. Under the head of the lamellæ are described the trama, the subhymenium, the hymenopode (which is found sometimes between the subhymenium and the trama), and the hymenium, including the cystids, basids, sterigmates, and spores. Among spores reference is made to the rarely occurring chlamydospores, microconids, and gemmæ. The development of the various forms of the receptacle and of its accessory organs are then described in detail.

In the systematic portion of the paper the genera of Agaricini are classified under six series (a diagnosis of which is not always given) and twenty-seven tribes, and the following new genera are described:—In Pleuroteæ, *Omphalotus*, *Urospora*, *Pleurotellus*; in Lepioteæ, *Cystoderma*, *Fusispora*; in Naucorieæ, *Pholiotina*; in Pholioteæ, *Ryssospora*, *Myxocybe*; in Pluteideæ, *Schinzinia*; in Cortinarieæ, *Sphærotrachys*; in Pratelleæ, *Astylospora*, *Pluteopsis*, *Psilocybe*, *Glyptospora*; in Coprinoideæ, *Lentispora*, *Ephemerocybe*; in Paxilleæ, *Gymnogomphus*; in Fusisporeæ, *Hexajuga*.

Cultures of Nyctalis asterophora.†—M. J. Costantin states that in 1859 De Bary returned to the opinion of Krombholz, and regarded *Asterophora* as composed of the chlamydospores of *Nyctalis*, and Brefeld has definitely closed the debate by establishing that the pure cultures of the basidiospores of *Nyctalis* give *Asterophora*. The author describes cultures made by himself on sterilized potato dipped in orange juice.

Cuprophilous Fungus.‡—Prof. F. Cohn describes the mycele of a fungus (species undetermined) from the copper-mines of Rio Tinto in Spain, which grew vigorously and produced conids in soil containing a considerable amount of both sulphate of iron and sulphate of copper.

* Ann. Sci. Nat. (Bot.), ix. (1889) pp. 181–411 (2 pls.).
† Journ. de Bot. (Morot), iii. (1889) pp. 313–5.
‡ JB. Schles. Gesell. Vaterl. Cultur, 1888 (1889) p 166.

Protophyta.

α. Schizophyceæ.

Genetic Connection of Scytonema, Nostoc, and Glœocapsa.*—Herr H. Zukal describes the result of experiments made chiefly on *Scytonema myochrous*, in order to ascertain its power of assuming other forms. For this purpose the *Scytonema*-filaments were placed in the axils of moss-leaves grown in pots. In about three weeks a change commenced, the sheath swelled up and became more transparent, and the filament gradually assumed a blue-green colour, and was divided repeatedly by very fine septa. The cells now assumed a more rounded form, and, the filament growing much faster than its inclosing sheath, became necessarily twisted and coiled in a variety of ways. Heterocysts and hormogones were also gradually formed, and the separate portions of the filament became inclosed in a very thin internal secondary sheath. The *Scytonema* had now assumed all the characters of *Nostoc rupestre* or *microscopicum*, except that it consisted of only a single filament, and that the outer sheath took no part in its curvature. When cultivated in a nutrient solution, this *Nostoc*-form continued to reproduce itself; while, if grown in distilled water, it had a tendency to reassume a *Scytonema*-condition. Continued cultivation on moss leaves induced still further degeneration, and the *Nostoc*-filament gradually broke up into separate cells, each invested with its own mucilaginous sheath, in which condition it is a *Glœocapsa*, closely resembling *G. æruginosa;* and this again, by further culture, became a *Chroococcus*, with very thick sheath.

Parasitism of Nostoc on Gunnera.†—According to Herr P. Merker, the filaments of *Nostoc* enter the leaves of *Gunnera macrophylla* through the mucilage-canals in the glands, where they first take possession of the empty space caused by the conversion into mucilage of individual gland-cells. From here filaments find their way into the intercellular spaces of the starchy parenchyme which surrounds the glands. When a *Nostoc*-filament enters a cell of this tissue, it applies itself closely to the cell-wall, dissolves it or converts it into mucilage, advances to the interior of the cell, consumes the whole of the starch, and completely fills up the cell. Individual filaments then attack neighbouring intercellular spaces, and the contents of other cells are consumed in the same way.

β. Schizomycetes.

Transformations of Microbes.‡—M. A. Chauveau has continued his researches on the limits, conditions, and consequences of the variability of *Bacillus anthracis;* and now describes those in which he has tested the ascending or reconstituting variability of this form. He finds that the *Bacillus anthracis* may exhibit three types, the respective properties of which appear to have been definitely acquired.

(1) The bacillus brought to the bottom of the scale of descending variation, non-virulent, but still with vaccinal properties.

(2) The bacillus partially revivified by ascending variation and

* Oester. Bot. Zeitschr., xxxix. (1889) pp. 349–54, 390–5, 432–5 (1 pl.).
† Flora, lxxii. (1889) pp. 211–32 (1 pl.).
‡ Comptes Rendus, cix. (1889) pp. 597–603. Cf. this Journal, 1889, p. 796.

again capable of killing an adult guinea-pig and even a rabbit, but ineffective against ruminants or horses, though highly vaccinal towards them.

(3) The bacillus whose revivification has been rendered complete, that is, is mortal to the sheep; this type is probably still only vaccinal to the cow or the horse.

It will be remembered that the non-virulent bacilli were obtained by cultivations brought into contact with compressed oxygen. To restore the virulence it is necessary to add blood to the cultivation in contact with greatly rarefied air. If the blood be that of a guinea-pig the bacilli produced will kill mice and just-born guinea-pigs, and, later on, adult guinea-pigs and rabbits. To make these bacilli capable of killing sheep, the blood of a sheep must be added, and the spores of cultivations thus prepared are mortal to small ruminants.

Metabolism of Micro-organisms.*—Dr. G. Strazza has made some experiments with the object of ascertaining to what extent micro-organisms cause metabolism of the nutrient medium in which they are cultivated. The result of his experiments is that a distinct loss of weight can be demonstrated, but this loss is extremely small, and is represented in the second or third place of decimals. Secondly, that this loss of weight is accompanied by the production of carbonic acid.

The micro-organism which was mostly used for these experiments was *Micrococcus prodigiosus*. In the first set all that was requisite was to weigh the tubes carefully before and after growth, and compare this loss with the loss of weight due to evaporation from an equal surface of gelatin. The next thing was to show that the loss was due to development of gas, and this was effected by inverting the inoculated test-tube over caustic potash, when it was found that the liquid ascended 5–10 mm. That the gas developed by the metabolism of the micro-organisms was carbonic acid was shown by its causing a precipitate with lime water.

Action of the Gastric Juice on Pathogenic Microbes.†—MM. J. Strauss and R. Wurtz have examined the action of the gastric juice of the dog, man, and sheep on the bacilli of tubercle, anthrax, enteric fever, and cholera. The gastric secretion was placed in test-tubes, inoculated with the microbes, and kept at a temperature of 38° C. After various periods of time inoculation experiments in guinea-pigs and rabbits showed that tubercle bacilli survived the action of the gastric juice up to six hours sufficiently well to produce a general tuberculosis. From 8–12 hours a tubercular abscess was formed at the inoculation site, and this quickly healed. After 18 hours the bacilli were either dead or had lost their virulence. Anthrax bacilli without spores were killed in 15–20 minutes, and the spores died after 30 minutes. Under similar conditions typhoid bacilli died in 2–3 hours, and cholera bacilli after 2 hours.

Further experiments with hydrochloric acid in the proportion of 0·9, 1·7, and 3 per thousand on anthrax, cholera, and typhoid bacilli gave similar results to those obtained with gastric juice. Hence the authors

* MT. Embryol. Instit. Univ. Wien, 1888, pp. 8–13.

† Arch. Méd. Expér. et d'Anat. Pathol., 1889, No. 3. Cf. Centralbl. f. Bakteriol. u. Parasitenk., vii. (1890) p. 39.

conclude that the antiseptic effect of the gastric juice is to be ascribed to its containing hydrochloric acid.

New Schizomycetes.*—In a review of the additions to the flora of Bohemia as far as fresh-water algæ and saprophytic bacteria are concerned, made in the course of the year 1888, Prof. A. Hansgirg enumerates the following new species of Schizomycetes:—*Leptothrix cellaris*, *Bacillus vialis*, *Mycothece cellaris*, *Hyalococcus cellaris*, *Micrococcus thermophilus*, *M. subterraneus*.

Bacterium phosphorescens.†—In discussing the origin and causation of the light emitted by *Bacterium phosphorescens*, Dr. K. Lehmann observes that there are two obvious possibilities to be considered. First the illumination may be a vital phenomenon accompanied by the production of CO_2, heat, &c. Secondly it may arise from the oxidation of a photogenous substance excreted by the cells, and resembling the pigment formation of many chromogenous species. This photogen must therefore be very sensitive to chemical reagents.

In favour of the former view are the following facts. Cultivations when emitting light always contain illuminant bacteria, and in this condition can always be successfully cultivated. All germicidal media destroy the illumination. Lastly, in correspondence with the great resistance *B. phosphorescens* shows to low temperatures, the illuminative power is preserved at similarly low temperatures. In association with this is to be counted in the fact that while development diminishes with increased temperature, so also does the emission of light.

These facts seem to show that the light emitted by the fungi is always associated with their vitality, and is therefore not reconcilable with a photogenic property unless the latter has ascribed to it all the characteristic of a living plasma.

Specific Microbe of the contagious Bovine Pneumonia.‡—M. S. Arloing, by making direct plate-cultivations from the pulmonary secretion of an ox affected with cattle-plague, was able to isolate four micro-organisms, a bacillus which rapidly liquefies gelatin, and three micrococci. These he calls *Pneumobacillus liquefaciens*, *Pneumococcus gutta-cerci*, *Pneumococcus lichenoides*, *Pneumococcus flavescens*. The author assumed that one of these four microbes was the specific cause of the pneumonia. By means of subcutanous injection of pure cultivations, it was found that the bacillus produced the greatest effect, and also that when injected in larger doses, pulmonary effects were produced resembling those of the original disease. From those results the author concludes that he has discovered the specific cause of contagious bovine pneumonia.

Two pseudo Hay-Fungi.§—Dr. L. Klein describes two bacilli which, from their resemblance in certain particulars to *B. subtilis*, he calls false hay-fungi.

The first of these, *B. leptosporus*, was found as an impurity in a flask containing grape-sugar-meat-extract solution, wherein it formed a thick

* SB. K. Böhm. Gesell. Wiss., 1889, pp. 121–64.

† Biologisches Centralblatt, ix. (1889) pp. 479–80.

‡ Comptes Rendus, cix. (1889) pp. 428–30, 459–62.

§ Centralbl. f. Bakteriol. u. Parasitenk., vi. (1889) pp. 313–9, 345–9, 377–83 (2 pls.).

white scum. The second was found in the blood of a cow which was supposed to have died of anthrax. The coarse appearances of the cultivation were similar to those of *B. leptosporus.* These two bacteria are designated hay-fungi, not only from the resemblance of the scum which they form on the surface of the nutrient media, but also from the habitual likeness which the individual elements and the chains of rodlets show to those of *B. subtilis.*

B. leptosporus receives its name specially from the length of the rectangular endospores, and *B. sessilis* from the fact that one end of the germinating primary element remains covered for a considerable time by the spore-membrane, and thus there is imparted to the development of the micro-organism a special characteristic hitherto not observed in any other species.

These bacteria were found to thrive well in most solutions, but best in meat-extract to which grape-sugar was added. The observations were made in the usual way from cultivations in hanging drops, and examined under high powers. The author gives minute details of his observations, and numerous illustrations of the micro-organism at various periods of development.

Bacteria-destroying Power of the Blood.*—In experimenting on the property of blood-serum devoid of cells as to its power of destroying micro-organisms, Dr. F. Nissen used the blood of dogs and rabbits. The blood was withdrawn from the carotids and received into sterilized vessels heated up to 35° C., and then defibrinated with sand. In the result it was found that while the various kinds of bacteria did not behave in the same way, yet a great number were found to be quickly destroyed by the blood influence. Of the pathogenic species which were found to be susceptible to this blood power were the bacteria of cholera asiatica, anthrax, typhoid, and pneumonia, and of the Saprophytes, *Coccus aquatilis, Bac. acidi lactici, subtilis, Megatherium.* On the other hand, *Staphylococcus aureus, albus, Streptococcus erysipelatis,* bacilli of fowl cholera, swine plague, *Proteus vulgaris, hominis, B. fluorescens, prodigiosus, aquatilis,* and others multiplied with great facility. The power of killing bacteria possessed by the blood is also influenced by certain conditions and reagents; thus, if heated for half an hour to 54°–56° C. it loses it, as is also the case if allowed to stand for some hours, or if its coagulability be affected as by the intravenous injection of pepton, or by admixture with sulphate of magnesia.

Moreover, the quantity of micro-organisms has great influence on the result, the annihilating influence of the blood being only able to prevail up to a certain extent; when this point is reached, the blood becomes quite a perfectly suitable medium for their development.

The author concludes from the foregoing experiments, and also from others made with horse's blood, that the power of the blood to overcome bacteria is to be regarded as a destructive property residing in the plasma, but he does not explain if there be any reason to suppose that there exists a definite separable constituent of the plasma which is capable of producing this effect.

* Zeitschr. f. Hygiene, vi., Heft 3. Cf. Centralbl. f. Bakteriol. u. Parasitenk., vii. (1890) pp. 36–8.

Phagocytes.*—Dr. W. Osler, in discussing the doctrine of phagocytes, and the theory according to which they play an important part in protecting the organism against the invasion of germs, declines to express a positive opinion of the relations between the phagocytes and bacteria, on the ground that our present knowledge is insufficient. An experience of 150 cases of malaria, in which the behaviour of leucocytes to the various forms of hæmatozoa and the manner in which the leucocytes pick up the pigment granules were observed, shows that here and there leucocytes containing amœboid forms of the parasites are met with. But the absence of any considerable number of white cells containing parasites prevents the acceptance of the hypothesis of aggression. It is more probable that the pigment granules are taken up after the disintegration of the parasites, or that the phagocytic action takes place where more favourable conditions exist, as in the spleen or in the marrow of bone (Metschnikoff). On the ground of examinations of spleen, liver, and marrow, the author concedes an increased activity of the leucocytes, but one not sufficient to form a basis for a theory, and he concludes that while phagocytosis is, in the animal kingdom, a widespread and important physiological process, and while it undoubtedly plays an important part in many pathological conditions, the question whether the white cells possess an actual militant function against the micro-organisms of disease must at present be considered as unanswered.

Bacterial Disease of Corn.†—Mr. T. J. Burrill has from 1881–1889 observed a disease which attacks young corn, and frequently causes great devastation. The first indication is a dwarfish wasted appearance of the plant. The condition of the soil seems to play no unimportant part in the spread of the disease, for the author was able to determine that in a large rye-field, of which one part had been a reclaimed marsh, the plants herein were diseased, while in the drier portions there was scarcely any disease. The plants attacked stop growing, become yellow, dark slimy spots appear on stalk, leaf, and root, and then they soon die. Microscopical examination of the dark slimy masses, which occur within and without the plant, shows that they contain a large quantity of rod-shaped bacteria and others of a spheroidal shape, both varieties being of one and the same species.

These bacteria were found to develope easily at ordinary temperatures, but above 36° C. their growth ceased. At first independent motion was seen, but later observations failed to verify this. They do not liquefy gelatin.

In fluid media the individual elements are larger than in solid media. Their breadth is about $0 \cdot 65\ \mu$, and they vary in length from $0 \cdot 8 – 1 \cdot 6\ \mu$. Spore-formation was never observed.

Bacillus of Grouse Disease.‡—Prof. E. Klein communicates some further facts relative to the bacillus of grouse disease. He had

* New York Med. Record, xxxv. (1889) p. 393. Cf. Centralbl. f. Bakteriol. u. Parasitenk., vii. (1890) pp. 183–4.

† University of Illinois Agricultural Experiment Station, Champaign, 1889, Bull. No. 6, pp. 165–73. Cf. Centralbl. f. Bakteriol. u. Parasitenk., vii. (1890) pp. 70–1.

‡ Centralbl. f. Bakteriol. u. Parasitenk., vii. (1890) pp. 81–3.

previously found that guinea-pigs and mice were susceptible on subcutaneous inoculation, while fowls and pigeons were refractory thereto. He now states that wild birds are susceptible, but that they are so in different degrees, for while yellowhammers and greenfinches are so sensitive that they soon die, starlings are somewhat refractory. The small birds die in 20–72 hours, and on examination present the same appearances that are seen in grouse, i. e. hyperæmia and inflammation of both lungs, hyperæmia of the liver, petechiæ in the intestine. The bacilli are less frequent in the blood than in the lungs, where they are found in large numbers (cover-glass preparations were stained in a 2 per cent. aqueous solution of rubin, then washed in water, and contrast stained with methylen-blue for 1/2–1 minute; this stained the blood-discs red, while their nuclei and the bacilli were of a blue or purple colour.)

Feeding the birds with cultivations gave no positive results, but it was found that the contagion could be conveyed through the air, a sick yellowhammer in one cage passing the disease on to six others in a new adjacent cage.

It was also found from inoculation experiments that cultivations from the heart-blood or lung-juice of mice were less virulent than those from birds, consequently the author thinks this may aid in obtaining a protective virus.

Spirillum endoparagogicum.*—Prof. N. Sorokin, who some time ago described this interesting endosporous *Spirillum*,† has from recent observations discovered that the spore membrane remains within the mother-cell. This was effected by using the iris diaphragm, and then, when the aperture was considerably contracted, tilting the light a little sideways. In this way the outline of the membrane could just be descried; with much light it was quite invisible. It was also found that by killing motile cells with weak iodine solution, a cilium could, with high power (water-immersion apochromatic), be detected at one or both ends.

Cultivation experiments quite failed, owing apparently to the extreme sensitiveness of the parasite to any added fluid.

Nasal Bacteria in Health.‡—Dr. J. Wright examined the nasal secretion of ten healthy persons of different ages for bacteria. The secretion had a neutral or slightly alkaline reaction. The germs were isolated by the plate method. There were found in six cases *Staphylococcus pyogenes albus*, *aureus* and *citreus*; in three, *Micrococcus flavus desidens*; in one, *Bacterium lactis aerogenes*; in one, *Penicillium glaucum*; in one, *Micrococcus cereus flavus*; in one, *M. tetragonus*; and in three, some undetermined species. The numerical preponderance of suppurative cocci agrees with the results of other authors.

The author further attempted to determine what was the proportion of bacteria before and after inspiration, or in other words, how far the nose acts as a bacteria filter. He used Sedgwick and Tucker's apparatus

* Centralbl. f. Bakteriol. u. Parasitenk., vii. (1890) pp. 123–4 (3 figs.).

† See this Journal, 1887, p 631.

‡ New York Med. Journ., July 1889. Cf. Centralbl. f. Bakteriol. u. Parasitenk., vii. (1890) p. 135.

with Petri's modification, and found that with a rapidity of 1 litre a minute, 3/4 to 4/5 of the bacterial contents of the inspired air were deposited in the nasal cavity or its neighbourhood.

Increased Virulence of Vibrios.*—M. N. Gamaleia has discovered a method whereby increased virulence can be imparted to certain microbes, for example, *Vibrio Metschnikovi*, and Koch's cholera vibrio. Rabbits, which are but little sensitive to *V. Metschnikovi*, cannot be infected by intravenous injection, but if the vibrio be injected into the lungs the microbes from the pleural exudation are found to have acquired toxic properties. The toxicity is first shown by the diminution of the duration of illness, i. e. for equal volumes of infective fluid (2 ccm.). The animals die in two hours or even one, with the customary post-mortem appearances: intestines distended with fluid, exfoliated epithelium, presence of numerous vibrios, pale spleen, hæmorrhagic pleural exudation, and vibrios in the heart's blood.

Rendered thus virulent, the vibrios kill otherwise immune fowls, sheep, and dogs, while in rabbits they set up a disease resembling a septicæmia.

The increased virulence disappears if the vibrio be bred outside the body, and indeed inside, for the virulence seems to be limited to the pleural exudation, not being found in the vibrios from the blood. It was also found that high degrees of virulence could be obtained by the combination of ordinary vibrios and the sterilized poison of the virulent vibrios.

Exactly parallel results were obtained with the white rat and the cholera vibrio. Hence the author concludes that it is possible to obtain an increase of virulence in the bodies of refractory animals, and that this possibility or predisposition to infection, as it is called, consists of two factors—the "prédisposition humorale" and the "prédisposition cellulaire." In the former the juices of the body are susceptible in a greater or less degree to the influence (and multiplication) of the virus and the formation of toxines; in the latter the cell-elements betray a greater or less tendency to a local reaction.

Antiseptic and Germicide Action of Creolin.†—Van Ermengem, as the result of his experiments with creolin, states that he considers it to be an antiseptic of the first rank. The germicidal effect of creolin was tested with typhoid stools and micro-organisms of suppuration; and though its action was somewhat interfered with by the presence of serous and albuminous fluids, 5 per cent. solutions gave most satisfactory results. These, therefore, and also on account of their non-irritating properties, are to be preferred to carbolic acid or to sublimate solutions acidulated with tartaric acid.

In 5 per cent. solution creolin is found to be a certain and prompt disinfectant. In addition, its deodorizing and antiseptic properties, as well as its safety and the ease with which it is manipulated, give it a high place among disinfectant deodorizers.

* Annales de l'Institut Pasteur, 1889, p. 609. Cf. Centralbl. f. Bakteriol. u. Parasitenk., vii. (1890) pp. 75–6.

† Bull. de l'Acad. Royale de Méd. de Belgique (ser. iv.). iii., No. 1. Cf. Centralbl. f. Bakteriol. u. Parasitenk., vii. (1890) pp. 75–6.

Microbic Products which favour the development of Infection.*— M. G. H. Roger finds that bacterial secreta have partly poisonous, partly vaccinative properties. There are therefore among these some which favour the development of certain viruses. This latter phase has been observed by the author in the bacillus of symptomatic anthrax. This bacillus, which by itself is harmless to rabbits, speedily kills them if another microbe be injected along with it. This can be done with *Staphylococcus pyogenes aureus*, *Proteus vulgaris*, and especially with *Bacillus prodigiosus*.

A similar result can be obtained from the anthrax bacillus itself. For if the serum from an anthrax tumour be deprived of its cell-elements by means of a porcelain filter, 4–5 ccm. per kilo. of live weight can be injected without harm, while 1–1·5 ccm. coupled with the anthrax bacillus quickly kills. The morbid predisposition induced by such a procedure is, however, of short duration, lasting not more than 24 hours, after which the animal again becomes refractory. Hence it would seem that a vaccinative effect is preceded by a period of diminished resistance to the virus.

Another observation showed that the anthrax bacillus did secrete products favouring its development; for while the virus, if injected into the thigh, was powerless, the same virus was found to be fatal if injected into the anterior chamber of the eye at one and the same time. Hence the products of the latter injection must have arrested the immunity in the muscles, and accordingly it may be concluded that the resistance of animals to infectious diseases can be affected by harmless as well as by pathogenic bacteria.

Bacillus of Leprosy.†—Dr. O. Katz mentions two series of experiments made by him to obtain cultivations of the leprosy bacillus. Both were failures. In the first instance leprous blood was inoculated on coagulated human hydrothorax fluid. The tubes were incubated in a thermostat for about two months at a temperature varying from 30–34° C. No evidence of the multiplication of the bacilli was found. In the second series, pepton-glycerin-agar was used, and the tubes were incubated for a month at a temperature of 37° C. At the end of this period the tubes were still sterile.

Bacillus isolated from a fatal case of Cholera Nostras.‡—Dr. B. Schiavuzzi describes a bacillus which he isolated from the intestinal contents of a case of cholera nostras. The organism was separated in the usual way on gelatin plates, the colonies in 24 hours forming small milky-looking clumps, about 1 mm. in size. Under a 1/15 homogeneous-immersion lens the colonies were found to consist of straight rods 1·7–2 μ long, 0·85 μ broad. Every individual contained at both ends well-marked spores, which were also seen free. Both rods and spores stained easily with fuchsin. In hanging drops swarming movements were visible. Cultivated on potato the colonies were of a whitish-yellow colour, the rods grew larger, and the spores were very distinct.

* Comptes Rendus, cix. (1889) p. 192. Cf. Centralbl. f. Bakteriol. u. Parasitenk., vii. (1890) pp. 60–1.
† Proc. Linn. Soc. N.S.W., iv. (1889) pp. 325–8.
‡ Bollettino Soc. Ital. Micr., i. (1889) pp. 45–50.

This bacillus is said by the author to possess considerable affinities with *Bacillus choleræ gallinarum*, *B. typhi abdominalis*, *B. neapolitanus*, and *Bacterium coli commune*, but is distinguishable therefrom by the size of the individual or the size, shape, or colour of the colonies, and is to be regarded as a pathogenic microphyte capable of exciting inflammation of the intestine.

No name is proposed for the micro-organism, and no experiments on living animals with pure cultivations were made.

In addition to the foregoing, the author also isolated a bacillus which is identical with *Bacillus malariæ*.

Fraenkel and Pfeiffer's Microphotographic Atlas of Bacteriology.*—Drs. Fraenkel and Pfeiffer have just issued the fourth instalment of the Atlas of Bacteriology. This part deals with the bacillus of anthrax, and six plates, accompanied by explanatory text, are given.

Bacteria and Disease.†—The following provisional table is intended to show the present status of bacteriological investigation with reference to the causation of some of the more important diseases.

(1) *Diseases whose bacterial cause is determined with comparative certainty*:—Anthrax, caused by *Bacillus anthracis*. Aphtha, caused by *Oidium albicans*. Cholera, caused by comma bacillus. Erysipelas, caused by *Streptococcus erysipelatosus*. Gonorrhœa, caused by the gonococcus. Leprosy, caused by the lepra bacillus. Malarial fever, caused by *Bacillus malariæ*. Meningitis (epidemic, cerebro-spinal), caused by *Diplococcus lanceolatus*. Pertussis, caused by a bacillus. Pneumonia, caused by *Diplococcus pneumoniæ*. Purpura, caused by *Monas hæmorrhagica*. Pyæmia, caused by *Streptococcus pyogenes*. Relapsing fever, caused by a spirillum. Tetanus, caused by a "pin-head" bacillus. Tuberculosis, caused by the tubercle bacillus. Typhoid fever, caused by *Bacillus typhosus*. Typhus fever, caused by a bacillus.

(2) *Diseases probably bacterial, but whose exciting cause has not been certainly determined*:—Carcinoma, dengue, diphtheria, dysentery, gangrene, glanders, measles, parotitis, rabies, rheumatism, rötheln, scarlatina, syphilis, yellow fever.

It is probable that all catarrhal diseases, such as bronchitis, conjunctivitis, diarrhœa, &c., are of bacterial origin, and that various bacteria are engaged as causative factors in different varieties of these several diseases. These have been isolated with varying degrees of certainty.

With regard to diphtheria, it is probable that two or more diseases are included under this name, and that more than one bacterium is capable of inducing the formation of pseudo-membrane.

PRUDDEN, S. MITCHELL, M.D.—**The Story of the Bacteria, and their relations to health and disease.** (New York, 1889, 16mo, 143 pp.)
Micr. Bull. and Sci. News, VI. (1889) p. 48.

* Berlin, 1889. Cf. Centralbl. f. Bakteriol. u. Parasitenk., vii. (1890) p. 58.
† Amer. Mon. Micr. Journ., x. (1889) pp. 255–6.

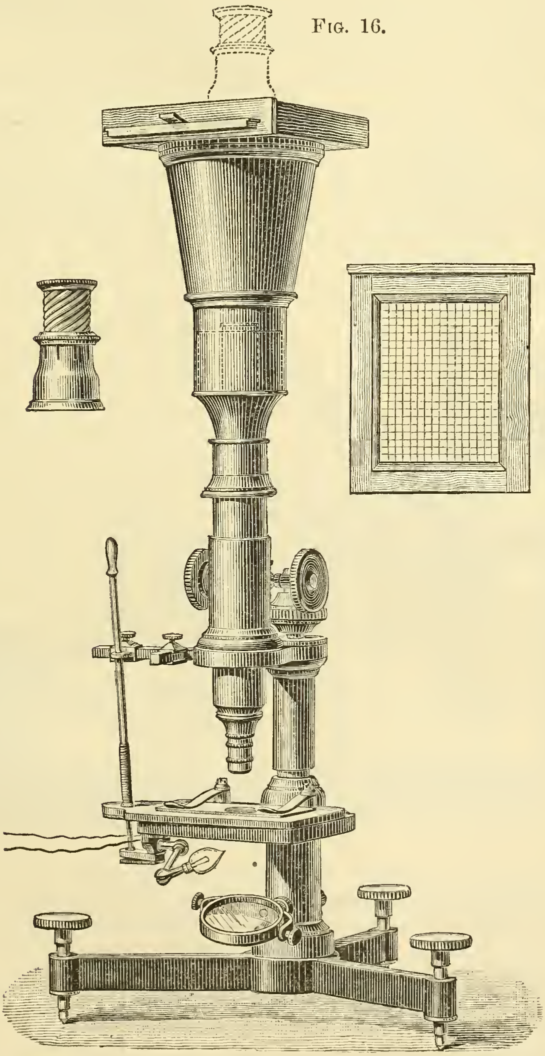
MICROSCOPY.

a. Instruments, Accessories, &c.*

(1) Stands.

Duboscq's Photographic Microscope.—The Microscope shown in fig. 16 was devised by M. Jules Duboscq of Paris for obtaining photographs 8 cm. in diameter.

Fig. 16.



* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

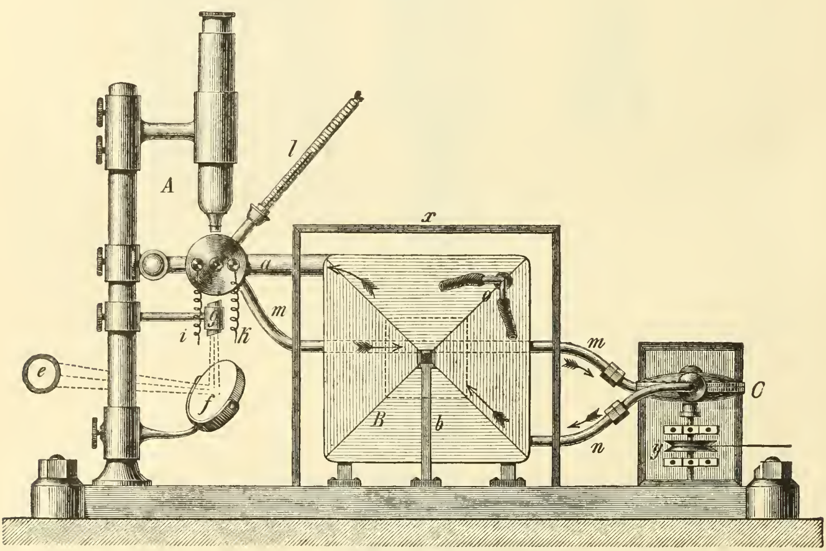
A camera, as will be seen from the fig., slides over the top of the body-tube. The tripod feet of the Microscope are provided with levelling screws, while the movements of the stage are effected by a White lever, which is made of extra length so that it may be close to the milled heads of the coarse-adjustment. A special support for the lever is attached to the cross-arm. A small electric incandescent lamp is attached beneath the stage.

The small fig. on the left is the focusing glass (shown in position by dotted lines on the top of the camera). The fig. on the right is the ground-glass plate, which is divided into spaces.

The instrument is also made with the photographic part independent, and mounted on a slide fitting, supported by a strong cast-iron base.*

Lehmann's Microscope for heating objects at definite temperatures.†—Dr. O. Lehmann has found the Microscope shown in figs. 17 and 18 very serviceable where it is desired to heat an object at definite temperatures, a regular stream of hot liquid being kept up through the vessel containing the preparation by means of a pump. Dr. Lehmann

Fig. 17.



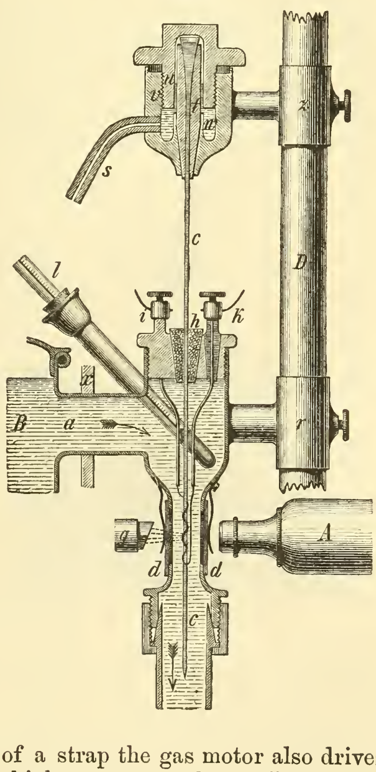
first made use of an ordinary air-pump, in combination with a spacious reservoir, which was put in motion by a gas motor, but in the later form a centrifugal pump is used, as represented (somewhat diagrammatically) in fig. 17. A is the Microscope, whose stand is fastened to the wall in order to avoid oscillations due to the action of the pump; B is the reservoir for the liquid, and C the centrifugal pump. Out of the reservoir B, in which equal distribution of temperature is effected by

* Cf. La Lumière Électrique, xix. (1886) pp. 217–9 (2 figs.).
† 'Molekularphysik,' Band i. (1888) pp. 151–2 (2 figs.).

a stirrer worked by the arm *b*, the liquid passes through a short wide tube *a* into the observation tube, which is shown in section in fig. 18. This tube is contracted and flattened out opposite the objective, and the side walls are cut away and replaced by plate glass *d d*, through which the light from the lamp *e*, after reflection at the mirror *f* and passage through the nicol *g*, can enter into the body-tube A.

The substance under observation is contained in a thin capillary tube *c c*, which passes through a cork *h* in the cover of the observation tube. It is closed below, but terminates above in a funnel-shaped opening. *i* and *k* are two wires, attached to two binding-screws, which transmit the electric current through the fine wire spirally wound round the capillary tube at the position of observation. By the passage of the current the temperature is locally and for an instant considerably raised. One wire *k* is insulated from, while the other is directly connected with, the cover. A thermometer with small bulb close to the capillary tube serves to register the temperature. The hot water or paraffin passes from the tube *a* (fig. 17) into the exhaust tube *m m* of the pump, and from this through the tube *n* back into the reservoir B. To protect the observer from the hot gas-flame, the reservoir is surrounded by a screen of asbestos *x*. The reservoir is provided with a Reichert's temperature-regulator O, which automatically keeps the gas-flame at the right height.

Fig. 18.



The wheel *y* which drives the pump is put in motion by a small gas motor stationed on the ground away from the wall on which the Microscope is mounted. By means of a strap the gas motor also drives the stirrer. For examining under high pressures the capillary tube *c c* can be put in connection with a Cailletet pump by means of the capillary tube *s* (fig. 18), which passes into the small metal reservoir *v*, closed above by the cover *u* screwed on air-tight, and below by the stopper *t*, in which the capillary tube *c c* is fixed with shellac. *t* is so high that it can be fastened after removal of the cover *u*. The open space *w* contains glycerin from the Cailletet pump. The whole is supported by the clamp *z*, sliding on the rod D, which is provided with a second clamp *r* for holding the observation tube, while it is itself supported by a clamp of the Microscope-stand or is fixed to the wall which supports the whole apparatus.

Lehmann's large Crystallization Microscope.*—Dr. O. Lehmann describes the large Crystallization Microscope which he designed for use where great stability is required. (A more portable form was described in this Journal, 1885, p. 117.) The instrument is shown in figs. 19–21.

For stability the base of the whole is formed of a large heavy cast-iron plate *b b* (fig. 20), which for convenience in height is let into an opening in the table, and rests by means of four levelling-screws upon two strong ledges strengthened by cross-pieces. It is pierced by several holes provided with screw-threads in which fit the different stands and apparatus. On the same ground of greater stability the movement of the body-tube is effected in quite a different manner to that of the ordinary Microscope. The socket which carries it is rigidly connected with the base-plate by a ⌐-formed holder (fig. 21). This allows the cross-arm to be very long, which renders more convenient the handling of the object on the stage. Since experiments at high

FIG. 19.

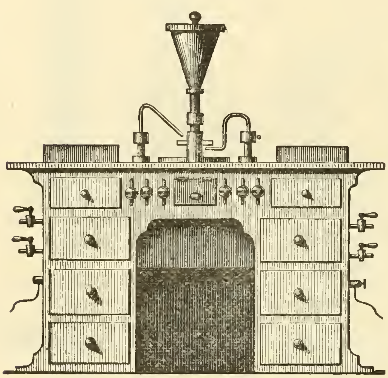
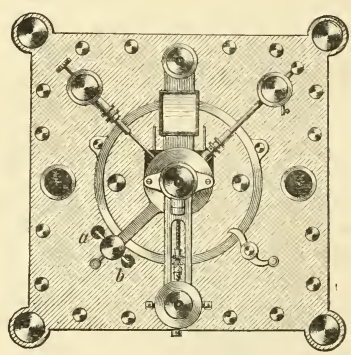


FIG. 20.



temperatures, in which a large flame is used, require a considerable raising of the stage, and consequently a greater height of the body-tube than could be attained by a simple movement in the socket, the ⌐-formed holder consists of two parts, viz. the tube, firmly screwed into the base-plate, and the holder proper, which slides tightly in this, and can be fixed in definite positions by means of a steel pin, which is inserted into holes bored through the holder at regular intervals equal to the distance through which the body-tube slides in its socket. The nut is then screwed on to the lower end, and the whole is as firmly fastened as if it consisted of a single piece. For the coarse-adjustment the body-tube simply slides in the socket, but the fine-adjustment is effected by means of a second socket, consisting of two parts, in which

* 'Molekularphysik,' Band i. (1888) pp. 126–33 (3 figs.).

the first moves, though not quite freely. The first socket is provided with a screw-thread, upon which works a collar fastened to the second socket by pins. By turning the collar the first socket is slowly raised or lowered as the adjustment requires. Two spiral springs on the second socket, fixed below, and having their upper ends in contact with a long plate attached to the first socket, prevent backlash between the screws. (Later this was effected by means of a single screw attached to the cross-piece of the holder.)

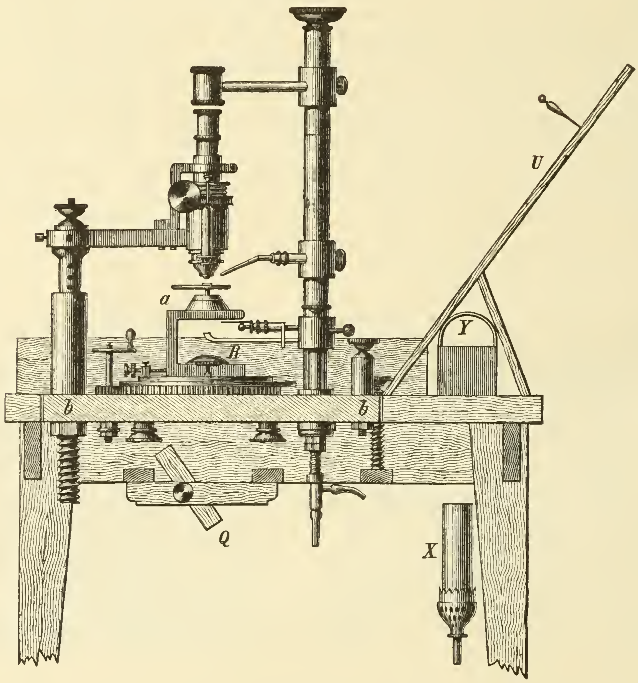
Another peculiarity of the instrument is the stage, which is not connected with the body-tube, but is carried by a special foot. In the middle of the base-plate is let in a conically-turned toothed ring, which can be rotated by a small toothed wheel. On this ring is screwed a divided circle, which is itself surmounted by a cast-iron plate of smaller diameter, provided with two parallel slits, in which slide the two sides (tapered below) of the horse-shoe which forms the foot of the stage. This motion is effected and measured by means of a micrometer-screw provided with a divided head. The ring as well as the foot are provided on their under side with screws and caoutchouc rings for avoiding backlash. The foot carries a pillar, which supports a plate *a*, bored through, and having on its upper side a conical projection. On this cone rotates a second plate, provided with a slit in which slides a metal piece, bored through and tapered below, to which are attached two short pins, which support the thin circular disc forming the stage proper. The form and size of the stage varies according to the experiment. When a high temperature is required the lenses of the Microscope are protected by a thick copper diaphragm, provided with a small hole. In certain cases this is made hollow and kept cool by a stream of cold water flowing through it. In fig. 20, *a*, *b* are the holes through which pass the tubes conveying the water.

The burner R for heating the object, and the rod carrying the screen of glass or mica for moderating the temperature, are attached at right angles to a hollow metal column, which communicates by a branch tube below with the gas supply, and contains a smaller tube, reaching as far as the attachment of the burner, which conveys from a gas-holder the air necessary for the non-luminosity of the flame. The gas supply is cut off from the burner by a screw stopper at the top of the column. The latter is not screwed into the base-plate, but fits conically into it, and is fastened by a nut and caoutchouc ring only so firmly that it may be easily turned by the hand about its axis. The contact of two arresting pins during the rotation automatically effects the correct adjustment of the burner exactly beneath the opening of the stage.

Polarization can be effected in several ways, either by a bundle of glass plates Q (fig. 21) reflecting to a condensing lens the light from the gas-lamp X, the smoke from which passes off by the chimney Y; or by means of a concave mirror; or finally by a bundle of plates, which receives its light from an adjustable plane mirror. The analysing nicol is carried by an arm which slides on a vertical pillar, and can be clamped in any position above the eye-piece. The pillar in the lower part of its length is hollow, and forms a tube which at about the middle projects outwards at right angles, and is then bent downwards towards the stage with gradually diminishing section. This tube serves to convey a stream of air for cooling the preparation. The tube is closed, and consequently the air cut off, by means of a conically pointed screw on the opposite side of the pillar.

For measuring extinction angles and angles of crystals, &c., the Microscope is provided with cross wires. In order that the axis of rotation of the stage should pass exactly through the centre of the cross-wires, the cross-piece of the ⌐-formed arm is not rigidly connected with the vertical column, but only by means of a nut screwed

Fig. 21.



firmly on. The opening through which the spindle of the screw passes is somewhat larger than it, and the latter is square below. Against the faces press four screws set in the cross-piece at angles of 90° to each other. As is seen from fig. 20, the required adjustment can be effected by suitable movement of these. In order to be able to fix the form of the object a drawing-board U (fig. 21) is set up obliquely behind the Microscope, a small three-sided prism being fixed to the eye-piece. Two raised portions on the table serve to support the arm during drawing and observation.

Konkoly's Microscopes for the Cameras of Telescopes.*—Dr. N. v. Konkoly uses a compound Microscope for focusing the image produced

* Central-Ztg. f. Optik u. Mech., x. (1889) pp. 229–32 (6 figs.).

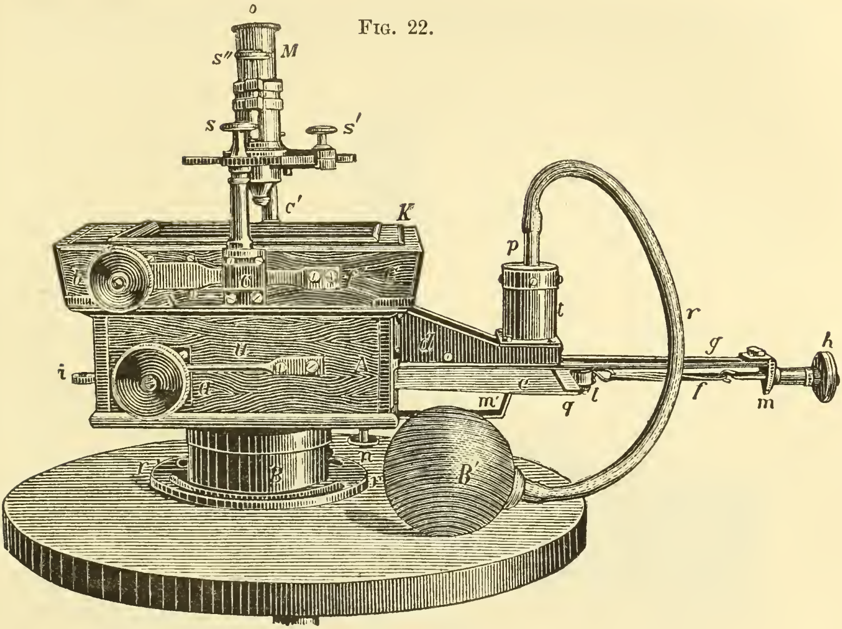
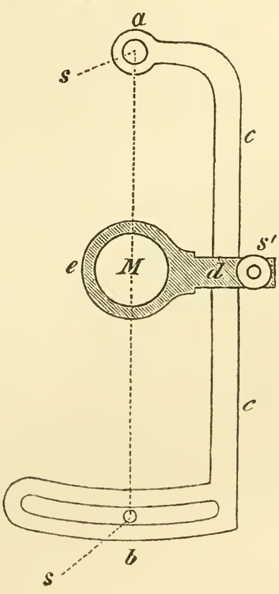


FIG. 22.

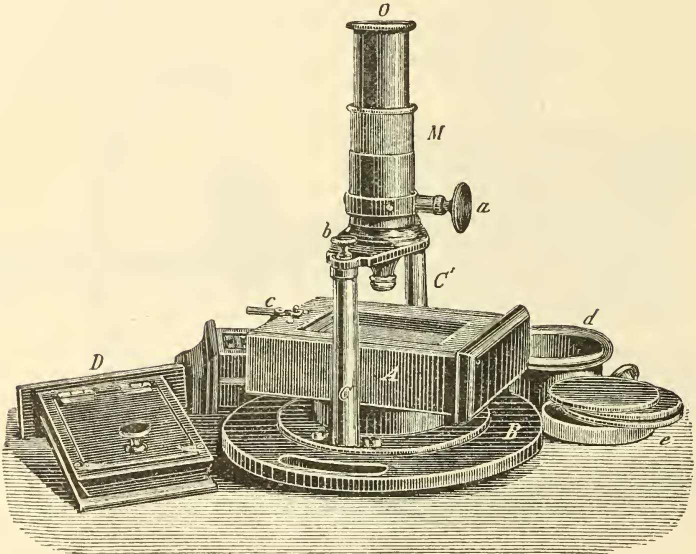
by a telescope on the plate of a camera, "as" (he says) "I venture to designate as illusory any other mode of focusing." Such an arrangement is new to us. In the "Universal Camera" the Microscope M is connected with the apparatus, as shown in fig. 22, and the following arrangement is adopted for viewing the different parts of the picture on the plate. To the plate-holder are attached two pillars C C′, which carry an arm *a b c c* (fig. 23) secured in position by two milled heads *s s*. This arm supports the holder *d e* for the Microscope, *d e* slides on *c c* and can be clamped in any required position. At *b* the arm has an arc-shaped slit whose centre is at *a*. The movement of the Microscope along the arm *c c*, combined with the rotation about the centre *a*, enables the observer to cover the whole field of view. In order to bring the focal planes of Microscope and telescope into coincidence, a limited fine motion is communicated to the eyepiece O of the Microscope by means of the screw *s″* (fig. 23).

FIG. 23.



In the small camera for small telescopes (fig. 24) the focusing is also effected by a Microscope. The two pillars C C′ carry the fixed bridge *b* in which the Microscope M is

Fig. 24.



screwed. The objective is a dividing doublet, so that greater play has to be given to the movement of the eye-piece, as one or both are used, and for this purpose a rack and pinion *a* is applied.

Boys' Microscope Cathetometer.*—Mr. C. V. Boys, in his experiments on the elasticity of quartz fibres both to stretching and to torsion, devised the apparatus shown in fig. 25.

The apparatus (made by Hilger) consists of a Microscope cathetometer shown in the figure at M, which can be made to traverse a vertical slide by means of a fine screw having a micrometer-head, the divisions of which are capable of being read directly to the 1/1000 mm. To the end of the Microscope farthest from the eye-piece is attached the vertical tube T, which carries at its lower end an adjustable arm A, fitted with a clamp C. To the end of a separate bracket is fixed the block *a*, which supports, by means of a knife-edge, the beam B, which is weighted with a gravity-bob W, and carries on a second knife-edge *b* the micrometer-scale D, the opposite end of the lever being counterpoised by the adjustable weight P. The fibre to be tested has attached to it a pin at each end to facilitate its being fixed in the apparatus, it being stretched vertically between the scale D and the clamp C.

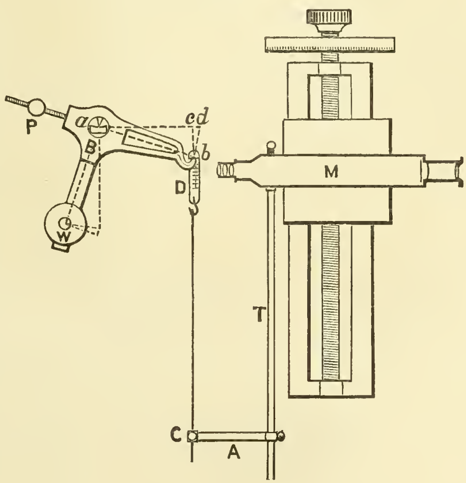
When the micrometer-head is turned, the cathetometer M is lowered, carrying with it the tube T, and thereby putting a tensile strain on the fibre, which draws down the lever B, being itself stretched under the

* Journ. Soc. Arts, xxxvii. (1889) pp. 833–4 (1 fig.).

increasing pull of the lever. The extension of the fibre is measured by the movement of the scale D across the field of the Microscope, and the deflection of the lever B is a measure of the force that is being applied to the fibre, which is obtained by subtracting the amount of extension of the filament from the distance traversed by the Microscope, which latter may be determined with the greatest accuracy by the readings of the micrometer-head.

In adjusting the instrument, the slide is first made vertical by levelling screws, the accuracy of the levelling being determined by means of a spirit-level placed in different azimuths on the top of the micrometer-head. The counterweight P is next adjusted until the knife-edges at *a* and *b* are both in the same horizontal plane, and this adjustment is made when the scale D and the upper attachment pin of the fibre are in their proper position, and the Microscope is focused so as to give a sharp definition of the divisions on the scale. The fibre having been attached to the upper supporting pin and suspended in its place, the length of the arm A is so adjusted that the lower supporting pin of the fibre hangs freely in the axis of the clamp C, which is then tightened, and thus perfect verticality at the commencement of the pull is insured. The micrometer-head is then slowly turned, readings being taken as each division of the scale D traverses and coincides with the cross wire of the Microscope, and the force which thus extends the fibre by each increment of 1/20 mm. is determined in the following way.

Fig. 25.



If the adjustments of the instrument have been made in the manner described above, the moment due to a vertical pull is proportional to the cosine of the angular displacement of the beam, while that due to the gravity-bob and the other portions of the beam varies as the sine of that angle, the actual tensile force applied at D being proportional to the tangent of the inclination of the beam. The vertical distance *c b* is a measure of the sine of the inclination, and when the angular displacement is small this distance is practically the same as the tangent of the angle, and it may be corrected to measure the tangent if very great accuracy be required. The true value of the force corresponding to various values of *c b* may, however, be more easily found by attaching weights to D, and observing by means of the Microscope and scale the weights which produce corresponding deflections.

In this instrument there are two apparent sources of error, which, however, do not in any way affect the accuracy of the measurement. In the first place, it is evident that as the beam is deflected the point *b* becomes more and more distant from the Microscope, and the pull on the fibre ceases to be vertical, but it must be also noticed that in doing so the scale D is carried out of the focus of the Microscope, which has in consequence to be adjusted by being moved forward to the exact amount which the scale had receded by the movement of the beam, and thus the arm A, carried by the end of the Microscope, is moved forward to an equal extent, the scale comes again into focus, and the fibre becomes again vertical.

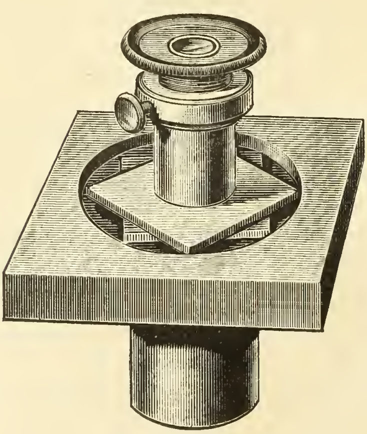
Again, in the case of the tube T being very long, it might happen that the spring of the tube and of the arm A might cause the fibre to appear more stretched than it really is, but the error due to this cause can be perfectly eliminated by finding, in the course of the experiment, the force that is being applied to the fibre, and afterwards placing weights on C until a pull of the same amount is obtained. As a matter of fact, however, with ordinary fibres the further movement of D under these circumstances is not observable.

POLI, A.—**Note di Microscopia. III., Il condensator nei Microscopi.** (The condenser in microscopy.)
Rivista Scient.-Industr., XXI. (1889) Nos. 18, 19, p. 217.

(4) Photomicrography.

Bourdin's Photomicrographic Apparatus.* — After describing Duboscq's large Microscope for photomicrography,† M. J. Bourdin advises microscopists not to neglect the very simple method of producing photomicrographs by means of a small camera, applied in the body-tube when the eye-piece is removed, large enough to permit the use of glass plates of 3 cm. square. The exposure of the sensitive plate is very short, and the magnification being low, it becomes necessary to employ an enlarging apparatus with which one may readily obtain transparent positives as large and as sharp as may be desired, especially by the use of Cowan's chloro-bromide plates which are developed with a solution of 30 grm. citric acid and 20 grm. carbonate of ammonia in 100 grm. distilled water.

FIG. 26.



The small camera in question is shown in fig. 26, and is stated to be recommended by M. Luiz de Andrade Corvo, who is engaged on special investigations of the phylloxera. It is shown together with a focusing lens made by Starsnic, the successor of Vérick.

* La Lumière Électrique, xix. (1886) pp. 217–9 (2 figs.). † *Supra*, p. 231.

The focusing lens is adjusted over a glass square, on the underside of which is fixed a fragment of a fly's wing, and the image produced in the Microscope is focused on the plane of the fly's wing. The focusing lens and the glass square are then removed, and a sensitive plate is substituted, being covered by a small cap of obvious construction; the incandescence lamp is then set in action as required, care being taken that no actinic light strikes the sensitive plate except during the required exposure in the Microscope.

Roux's Lantern for Photomicrography.—Dr. Roux has devised the lantern for photomicrography shown in fig. 27.

A small ball of magnesia, 5-6 mm. in diameter, is placed in the lantern D, which is rendered incandescent by an oxy-hydrogen jet. A

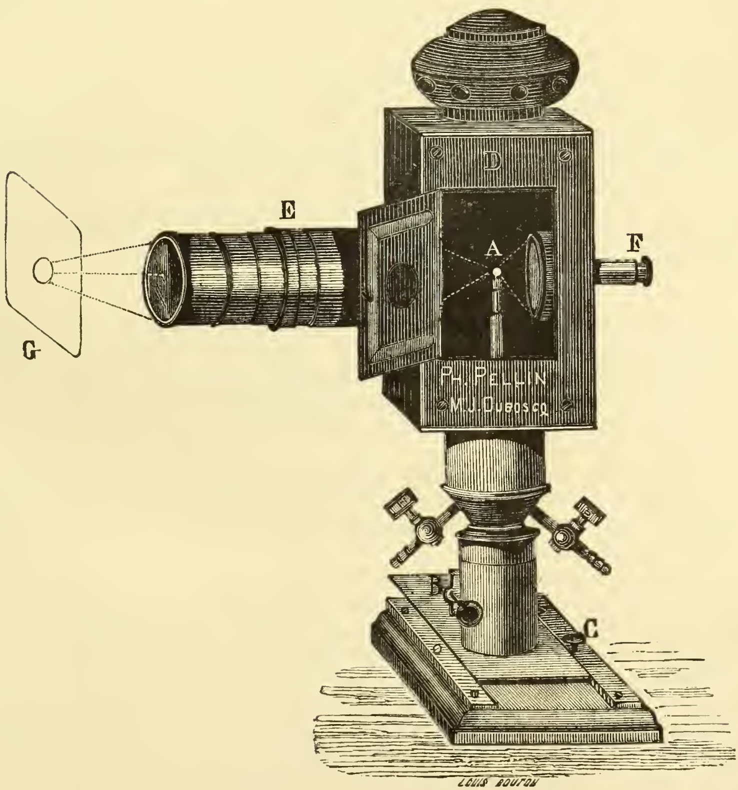


Fig. 27.

condenser E concentrates the light on the stage G of the Microscope. Behind the ball is a mirror adjustable by the rod F. The screws at B and C enable the lantern to be centered vertically and horizontally.

Care is required in heating the ball, which must be brought to incandescence gradually, but when attention has been paid to this point it will last from 60 to 70 hours.

Photomicrography at the Photographic Jubilee Exhibition at Berlin, 1889.*—Dr. R. Neuhauss, who gives his impressions of the photographic exhibition, awards the first place in the microscopical class to the photographs exhibited by the Berlin Hygienic Institute. These are principally the work of Dr. Koch and Dr. Pfeiffer. The latter showed the flagellate micro-organisms, some of which have appeared in the 'Atlas of Bacteriology' of Fraenkel and Pfeiffer. The Institute also showed a very interesting series illustrating the progress of microscopical photography.

Schultz-Henke showed two photographs taken from the same preparation—one with the ordinary dry plate, the other with the eosin-silver plate (spinal cord × 30). The latter photograph showed more details, but it is possible that the dry-plate process was not shown at its best.

Max Hauer exhibited a series of photographs from his 'Atlas of Vegetable Anatomy.' The photographs, which were very large, had been taken with relatively low powers. The size had been attained by means of a large camera or subsequent enlargement of the negative. The defect of this procedure is that the photographs show diffraction lines, a defect possibly inseparable from the method.

The foregoing afford a good illustration of the exhibits, but there are several others mentioned by the author, including an album of his own work.

(5) Microscopical Optics and Manipulation.

Method of Detecting Spurious Diffraction Images.†—Mr. E. M. Nelson writes:—In a previous paper I gave as my opinion that certain alleged diatom gratings, of double fineness and either above or below the original structure, were spurious, because they were caused by the action of an over- or under-corrected Microscope objective on the diffraction-spectra.

I now show how a test may be applied to determine whether these structures are entities or only diffraction-ghosts. The test will suit equally well other objects which yield a similar arrangement of interference conditions.

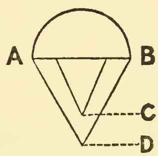
Set up the Microscope and adjust tube-length, &c., so that the best view is obtained of say the upper fine grating in *Pleurosigma formosum*, the reality of which is required to be tested. By means of the fine-adjustment the distance between this fine grating and the original coarse grating is accurately measured. The draw-tube of the Microscope is now lengthened one inch or more, and the distance between the two gratings is again measured. If this last measure agrees with the former measure, the grating is in all probability an entity, but if the measure with the long tube exceeds that with the original adjustment, then the fine grating is an optical ghost. In the case of an under-corrected objective, with a fine grating below a coarse grating, it will be necessary

* Zeitschr. f. Wiss. Mikr., vi. (1889) pp. 273-7.

† Note read 10th April, 1889. Cf. also Journ. Quek. Micr. Club, iv. (1890) pp. 55-6 (1 fig.).

to shorten the draw-tube before the second measure is made. The increase in tube-length need not be so great in the case of a short tube as in a long. In the actual measures I made of the distance between Mr. Smith's upper fine grating and the ordinary well-known grating on *P. formosum* I found the distance between them, at the original adjustment, was 1/8000 in.; an additional inch of tube on the long body increased that distance to 1/5000 in., thus making a difference of nearly 1/13,000 in. A reference to the subjoined figure will make the case abundantly clear. Let A B represent the front lens of an over-corrected objective, C being the objective. Now when a *P. formosum* is placed at C, the spectra of the focus for the central, and D the focus for the marginal portion of the first order only are recombined at the objective conjugate, consequently only the original coarse structure is seen. Let, however, the focus be raised so that the valve is placed at D, then the spectra of the second order only are united at the conjugate, and a grating of double fineness is seen. The movement of the objective gives, of course, an irresistible idea that the fine grating is above the coarse. The effect of lengthening the tube is to increase the over-correction of the objective, i. e. the distance between C and D, and consequently the distance between the fine and coarse gratings.

Fig. 28.



Let me put it in another way: when there is, say, an over-corrected objective on the Microscope, it is just the same as if there were two separate objectives in a rotating nose-piece: the one, a narrow-angled lens of short focus, which is only capable of resolving the coarse grating of, say, 25,000 per inch; the other, a wide-angled longer-focused objective with its centre stopped out, which exhibits the same grating as possessing double fineness, viz. 50,000 per inch. In such a case no one would have been led astray, as an alteration of focus would have been expected, but because all this occurs in one and the same objective, a confusion has arisen.

It is for those who deny the effect of diffraction in the production of the Microscope image, and those who insist on the reality of structures which are not consonant with that theory, to explain why an alteration of one inch in tube-length nearly doubles the distance between the gratings.

Method for measuring the Spherical and Chromatic Aberration of Microscope Objectives.*—M. C. J. A. Leroy remarks that the principle of his method is similar to that which enabled Foucault to put in practice his method of "retouches locales." The surface of the objective, observed through a small hole in a screen is seen illuminated only in the part traversed by the rays isolated by the hole. When the object is a monochromatic luminous point, and the small hole is on one side of the axis, the part illuminated is on the same side or the opposite, according as the corresponding rays cut the axis in front of or behind the plane of the small hole. If the latter be displaced transversely the limit of the bright zone will be displaced, under the same conditions, in

* Comptes Rendus, cix. (1889) pp. 857–9.

the same direction (direct) or in the opposite (inverse). Accordingly, if the observer move along the length of the pencil, so long as he is in front of, or beyond the extreme points of crossing of the rays, the path of the light in the whole extent of the displacement will be either direct or inverse. On the other hand, throughout the extent of the zone limited by these extreme points, there will be simultaneously direct and inverse paths for a certain number of positions of the small hole during a transversal displacement.

The study of chromatic aberration was made in the same manner, the bright regions presenting the colour of the rays isolated by the small hole when white light was used.

The longitudinal aberration proving very troublesome to measure, owing to its enormous extent, the author confines himself to the transverse.

The object was a luminous slit, traced with a sharp razor in a silver layer deposited on a glass plate, and had a width of from 0·005 mm. to 0·0025 mm. The slit was covered by a cover-glass. The small hole, having a diameter of 0·8 mm., was displaced perpendicularly to the slit, and the displacement was read on a scale giving 1/10 mm. The Microscope was adjusted so that the image was clearly defined in the plane of the small hole, whose distance from the slit, placed on the stage, was always the same, 0·20 mm.

The image was generally decomposed into two parts, one with rays coming from the marginal zone of the objective presenting an aberration in a determinate direction, the other, corresponding to the central zone, presenting an aberration in the opposite direction. In subtracting from the total displacement (between the limits of appearance and extinction of the light) the displacement due to the central zone, the same result was always obtained as in taking account of the dimensions of the slit and hole measured directly.

The objectives of the best makers of France and Germany were studied, and gave measurable spherical aberration varying from tenths of a millimetre to several millimetres. In measuring the spherical aberration, a coloured glass was placed over the small hole; for the chromatic aberration white light was used, and its value was judged by the intensity of the variations of the tints. Nearly all the objectives had sensible chromatic aberration, but many were found in which it was scarcely perceptible, and in some, constructed simply of flint and crown glass, it was quite inappreciable.

The author concludes, therefore, that the problem of achromatism may be considered as solved, but that that of aplanatism is far from being so. For the improvement, therefore, of objectives, the correction of the spherical aberration must be chiefly kept in view.

(6) Miscellaneous.

Dr. Hudson's Presidential Address.—The 'Times' of the 18th February contained the following leading article on this Address.

"An address such as the President, Dr. C. T. Hudson, delivered before the Royal Microscopical Society at its Annual Meeting last week is as surprising as it is delightful. All science has a tendency to grow more and more technical and elaborate. So complicated become its processes, that they exceed the powers of all who cannot devote their lives to it. The details increase so constantly in number and variety that it is compelled to partition itself into infinitesimal provinces. Its mere language and vocabulary distract by their immensity and peculiarities. None but professed students are any longer able to master the diction and the classifications, which are perpetually being changed. The literature on any and every department follows the same rule of crabbedness and bulk. Its publications are too costly for the majority of pockets, and particularly for those which have other demands upon them. Intending naturalists have the authority of the President of the Microscopical Society for believing that all these impediments to the pursuit are superfluous and erroneous. The instrument from which the association derives its name might have been supposed to be principally responsible for the modern banishment of a popular character from inquiries into natural history. Dr. Hudson protests against the injurious suspicion, and deprecates earnestly the practices of professors of science in which it has originated. Specialists, he declares, are enemies against whom war should be waged. Natural history does not need, in his judgment, the uncouth terminology which is the bane of monographs. A host of creatures would, he is persuaded, live more comfortably within the common species, in which of old they congregated, than penned, as now, into separate little enclosures. The one essential for a naturalist is joy in the investigation of the wonders of life; and the freest cultivation of the propensity to indulge the pleasure is equally requisite for the progress of the true science of natural history. Other sciences are backed by their utility. On them arts are founded which ward off material dangers, or serve material interests. The structure of civilization, and most of the conveniences of human existence depend on the principles they embody. Dr. Hudson sees little of this practical bearing in the study for which he pleads. Though a few branches, especially researches into the minutest forms of life, may, he acknowledges, be of the profoundest consequence to human health and prosperity, in general the knowledge of natural history must be its own final reward. For the attraction of recruits to its camp it will, as hitherto, have, he thinks, to rely chiefly on the delight it yields. He is seriously afraid that the emotion may be choked, stifled, and killed before it has had a chance of maturing into a habit, by the exasperating resolve of specialists to encompass the whole subject with an atmosphere in which none but themselves can breathe.

This is a very grave indictment to proceed from the learned recesses of the Royal Microscopical Society. Its President based his remarks on the stumbling-block interposed by the caprices of classification, the addiction to technical terms, and the multiplication of species, to the enrolment of volunteers in the army of naturalists. Their real importance rests rather upon the degree to which the disposition he attacks is adverse to the advancement of science itself. Specialists would not be afflicted if they were left alone in their pursuit. They are inclined to resent and not to court the company of amateurs. They feel the eager inner enjoyment of their study which Dr. Hudson regards as the mainstay of the whole. To them the changes in classification are substantially necessary. Every fresh subdivision for which they can invent a plausible excuse is for them an absolute enlargement of the territories they severally occupy. To a certain extent they probably could defend themselves successfully against their present critic. Definitions and frontier lines laid down a generation ago have been superseded and over-ridden by the fruitful discoveries of late years. The kingdom of nature has been found to be an agglomeration of a vast multitude of realms within realms. The new technical vocabulary in which it is described has had to be expressly manufactured to name orders of existence revealed only after the elder terminology had encrusted itself with a confusing significance. Partly it has been rendered indispensable by the demand of fellow workers in different regions of the globe for a common tongue. Melancholy as is the conclusion, and reluctant as everybody must be to come to it, the ancient simplicity and stability of scientific nomenclature are, it is to be apprehended, gone beyond recall. It does not follow, therefore, that the ponderous intricacy and restlessness of the system installed in their stead, of which Dr. Hudson complains, can prove any sufficient justification. A cry has been raised for the establishment of a tribunal to create a fair and uniform standard of judicial pains and penalties. In the world of science a Court is as much wanted for the revision of the vocabulary and classifications introduced by a legion of discretionary scientific jurisdictions. Formerly, when the field of natural science was virtually undivided, the terminology had to submit to a measure of central control. A Linnæus or a Cuvier would sanction or disallow. At present the distribution into an indefinite medley of special groups has given to the workers on them an autonomy they are not invariably qualified to exercise. Though it is too much to hope for a return of the golden age when naturalists spoke in a tongue understanded of the people, and species were not continually splitting off under the disintegrating operation of the Microscope, at least there ought to be some sort of warranty against a repetition in natural science of the experiences of the Tower of Babel.

That would be for the benefit of specialists themselves. The unlicensed fabrication of terminologies and classifications cannot be agreeable to any of them, unless when they are personally engaged in the process. For the sake of the outside commonalty of persons simply endowed with delight in natural history, to whom Dr. Hudson was addressing himself at King's College, it is much to be wished that his professed brethren would give more encouragement than they have given of late to the pursuit in its older form. Without disrespect to the physiological aspects of the study, it is to be regretted that the view which treated it as primarily observation of the ways and usages of the stages of animated nature below the human has fallen comparatively into neglect. The President of the Microscopical Society has exhorted its members to prepare themselves for the profitable employment of microscopical investigation by diligent attention to living animals, their beauty and their actions. Nothing can be more astonishing than that science, with all its toil, has as yet discovered so few of their characteristics as sentient and moving creatures. How they exist, the arts by which they catch their prey or elude capture, the secret of their confidence or spite, the laws of their affections, their amusements, their sense of humour, and their humours, their cleverness and their stupidity, are problems still for the most part remaining for natural history to answer. Its students will find but scanty information on them throughout the entire stately library of science. The system thus inculcated was followed by Gilbert White. Old fashioned as it appears now, it may well be that the path it points out leads more directly than those which modern philosophy prefers to the solution of the deep mysteries of the gradations of animate being and intelligence. With relation even to utility, which Dr. Hudson is ready to give up as off the naturalist's beat, there are questions fully worthy of his consideration. Miss Ormerod has shown that natural science has its uses for agriculture. Beside her particular charges there are other insect pests in plenty of which the world could be rid if naturalists would take the trouble to learn their habits. Where, for instance, is there a martyr of science willing to devote himself to a thorough search into the manners and morals of black-beetles, the things they love, and the things they hate? A naturalist who taught London to understand, and rout and extirpate, them would deserve any metropolitan honours he chose to ask. The County Council might feast him as lavishly as the City Corporation, and not the meanest ratepayer would grudge the cost of the entertainment."

New Italian Microscopical Journal.—We welcome the appearance of the first and second fascicles of the *Bollettino della Società Italiana dei Microscopisti*, the organ of the Italian Society of Microscopists. The Society, which embraces the whole of Italy, was founded on the model of the corresponding Societies in England and America; and its *Bollettino* will contain papers on the investigations of microscopists on animal and vegetable organisms, on petrology, on bacteriology, especially in its pathological relations, and on the structure of the Microscope and microscopical appliances. In addition to a number of minor articles and notes, the first number contains important papers on a new genus of green Algæ, and on two new genera of fossil Foraminifera, on a rock containing leucite from Etna, on the function of calcium oxalate in leaves, and two important contributions to bacteriology.

Prof. Frey.—The death is announced of the famous Zurich professor, Dr. Heinrich Frey, one of our Honorary Fellows since 1879, who after forty years of active work, retired only a few months ago. Frey was born at Frankfort-on-the-Main, June 15th, 1822, and at twenty-five years of age had qualified, by brilliant preliminary studies, for the post of *Docent* in the University of Göttingen. In 1848, the Medical Faculty of Zurich nominated him Extraordinary Professor, and in 1851 Ordinary Professor. In 1855 he undertook the Professorship of Medicine in the Polytechnic of Zurich, and also the post of Director of the Microscopo-Anatomical Institute. From 1854 to 1856 he also filled the position of Rector in the "Hochschule." His researches in physiology were published in works which have been translated into nearly every European language, and are valued as models of lucid exposition. His book 'Das Mikroskop' has passed through eight editions, and was translated into English by Dr. G. R. Cutter. Prof. Frey was also an accomplished entomologist.

Microscopy at the Paris Exhibition.—The 'Annales de Micrographie' has concluded * a series of brief articles on the Microscopes and apparatus at the Paris Exhibition of 1889, which, with those of Dr. Pelletan in the 'Journal de Micrographie,' and of Mr. Mayall in this Journal, constitute, so far as we know, the only record of this section of the Exhibition.

Price of the new Objective of 1·63 N.A.—We understand that the price of this objective is not 10,000 francs or 400*l.*, but 1000 francs or 40*l.* An extra nought seems to have crept into the original report on the subject.

β. Technique.†

(1) Collecting Objects, including Culture Processes.

Friedländer's Microscopical Technique for Clinical and Pathological Purposes.‡—Dr. C. J. Eberth has just published the fourth edition of C. Friedländer's well-known work on microscopical technique. The author has not only revised the whole, but made considerable improvements. For example, Section II., which treats of the microtome, is much enlarged, and Section III., dealing with the methods of preparation, such as hardening, imbedding, &c., has evidently had a good deal of pains bestowed on it. Some of the sections, e. g. Section V., "Observing Living Tissues," are unaltered, and some sections appear to contain views of doubtful value, but on the whole the work is one which can be recommended to the bacteriologist and the pathological anatomist.

Artificial Cultivation of Ringworm Fungus.§—Dr. H. L. Roberts' observations, and his conclusions from a series of cultivation experiments made on *Trichophyton tonsurans*, are very interesting. A portion of scalp affected with ringworm was first cleansed with a 1:200 solution of corrosive sublimate. The broken hairs were then removed with forceps, and their bulbous ends having been snipped off, the pieces were dropped into flasks containing saccharine infusion of malt and alkalinized beef-broth, and incubated at 30° C.

The fungus was observed to have started developing in 24 hours, and in three or four days from the formation of the primary colony secondary deposits were visible. If the colonies rose to the surface, they speedily became covered with a white powder. On microscopical examination the mycelium was found to be regularly septate, and filled with a granular protoplasm. When development takes place in air, the mycelium becomes finer, the segments are small, and the terminal fruit-bearing filament may end in an ampulla. The spores are pear-shaped, are attached by their narrow end, and are sometimes seen to project from the ampullæ.

Inoculation experiments on guinea-pigs, and on the author's own

* Ann. de Micrographie, ii. (1890) pp. 168–71.

† This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Imbedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservative fluids, &c.; (6) Miscellaneous.

‡ 'Friedländer's Microscopical Technique,' 4th edition revised by C. J. Eberth, Berlin, 1889. Cf. Centralbl. f. Bakteriol. u. Parasitenk., vii. (1890) p. 72.

§ 'British Journal of Dermatology,' i. (1889) pp. 359–65 (3 pls.).

arm, gave the usual characteristics of ringworm. The author concludes that *Trichophyton* is "a fungus able to vary its form and activity according to the physical and chemical properties of the soil on which it grows." As a saccharine medium has been found to be the most favourable soil, it follows that the animal skin is unsuitable; hence "the ringworm fungus vegetates, but does not develope" there.

BEHRENS, W., KOSSEL, A., u. SCHIEFFERDECKER, P.—**Das Mikroskop und die Methoden der mikroskopischen Untersuchung. Bd. I. Die Gewebe des menschlichen Körpers und ihre mikroskopische Untersuchung.** (The Microscope and the Methods of Microscopical Investigation. Vol. I. The Tissues of the Human Body and their Examination by the Microscope.)
Braunschweig (Bruhn), 8vo, 1889, 315 pp., 193 figs.

BONEVAL, R.—**Nouveau guide pratique de technique microscopique appliquée à l'Histologie et à l'Embryogénie. Suivi d'un formulaire indiquant la composition des réactifs employés en anatomie microscopique.** (New Practical Guide of Microscopical Technique applied to Histology and Embryology. Followed by formulæ for the reagents employed in Histology.) 8vo, Paris, 1889, 21 figs.

DAVIS, G. E.—**Practical Microscopy.** New ed., Philadelphia (Lippincott), 1889.

RAMON Y CAJAL, S.—**Manual de histología normal y de técnica micrográfica.** (Handbook of normal Histology and Microscopical Technique.)
Valencia (Ostega), 4to, 1889, 692 pp., 203 figs.

(2) Preparing Objects.

Mode of Studying Free-swimming Larvæ.*—Dr. G. C. J. Vosmaer recommends that free-swimming larvæ should be put into a glass, the bottom of which is covered by a loose, thin sheet of collodium; to this they attach themselves readily. The spot to which a larva is attached can be cut out under water whenever required. The collodium is transparent and easily cut with the larva. If it is desired to examine the base, the collodium may easily be dissolved. The preservative fluid recommended is that which Kleinenberg used for *Lopadorhynchus;* this gives by far the best results, cilia, for example, being hardly shorter than in the living animal.

Examination of Renal Organ of Prosobranch Gastropoda.†—M. R. Perrier has used three methods in examining the renal organs of Prosobranch Gastropods. The examination of living tissues, teasings, and serial sections have been the methods employed. The great difficulty to overcome has been the extreme alterability of the tissues, and the delicacy of the renal cells has been noticed by all observers. Under the influence of whatever reagents, the epithelium becomes completely destroyed unless sufficient precautions are taken. Owing to the changes which are continually taking place it is necessary to at once arrest the secretion. Ordinary fixing reagents, and particularly osmic acid, are of no use for this purpose; indeed, they seem to make the secretion more active. The best results have been obtained with acetic or picric acid, or, still better, a mixture of the two; picro-sulphuric acid has also been of use. The organ must be cut out of the body as rapidly as possible, plunged for one or two minutes into a 1 per cent. solution of osmic acid, washed rapidly, and left for some hours in a mixture of picric and acetic acids. It must then be put in 70 per cent. alcohol for as long a period

* Tijdschr. Nederl. Dierk. Ver., ii. (1889) p. 289.
† Ann. Sci. Nat. Zool., vii. (1889) pp. 71–9.

as may be wished, when it is ready for sectionizing. Sections were made with one of Dumaige's automatic microtomes, which gives the most excellent results. When fixed, the specimen was stained with picrocarminate of ammonia, which is the best of all; after one or two days in a solution of this material, the preparation must be gradually hardened in alcohol of 70°, 90°, and 100°—one day in each, fresh absolute alcohol being applied two days in succession. To this last fluid methylene-blue may be added, as it will stain the protoplasm and muscles, while having no influence on the nuclei. The object should next be successively placed in cedarwood-oil, paraffin with this oil, and pure paraffin. As the renal cells of Molluscs are very small, the sections should be extremely fine, and it is well not to have them more than 1/400 mm. in thickness.

When about to be placed on the slides it is well to make a limpid solution of 2 or 3 parts of gelatin in 100 parts of water; this, after careful filtration, should be placed on the slide, and the rows of sections will be found to swim in it; they can then be arranged as desired. The slide must then be placed on a plate warmed to about 40°, but not hot enough to melt the paraffin. At this gentle heat the sections become spontaneously extended in the gelatin, and all the creases in them will be found to disappear. The gelatin may now be left to dry. When the gelatin is dry, the paraffin may be easily dissolved away and the sections mounted in balsam.

Mode of Preparing Ova and Embryos of Blatta Doryphora.*—Mr. W. M. Wheeler used the following method in his studies on Insects' eggs:—The ovarian ova in all stages up to maturity were dissected out in normal salt solution, and hardened for fifteen minutes in Perenyi's fluid. They were then transferred to 70 per cent. alcohol, which was changed several times at intervals of an hour, and were finally preserved in alcohol of the same strength. When stained with borax-carmine and sectioned, the yolk retained none of the red stain, while the chromatin of the nucleus shone out as a glistening deep red spot. Perenyi's fluid rendered the chorion of the mature ovarian egg pervious to borax-carmine. Hardening in a saturated aqueous solution of corrosive sublimate gave good results with young ovarian eggs. Oviposited eggs were killed by placing the capsules in water slowly heated to 80°–90° C. The two lips of the crista of the capsule were then separated by the aid of fine forceps, and pieces of the walls torn away, till the eggs could be easily pushed out of the compartments formed by their choria. The ova thus isolated were either transferred directly through 35 per cent. (10 min.) to 70 per cent. alcohol, or they were left for 15 minutes in Kleinenberg's picrosulphuric acid, and after repeated washing in 70 per cent. alcohol, preserved in alcohol of the same strength. Both methods gave equally good results.

Though he has succeeded in dissolving the chitin of the ootheca with sodium hypochlorite, the method of tearing off the walls after heating to 80° C. gave such satisfactory results that he adhered to it through his work. He has found Grenacher's borax-carmine in every way the most expedient and reliable staining fluid. Eggs and embryos, up to the time

* Journ. Morphology, iii. (1889) pp. 292–3.

when the cuticle developes, were stained before imbedding in paraffin; the sections of other embryos were stained on the slide after attaching them with Mayer's albumen fixative. Beautiful results in preparation were obtained by heating the eggs to 80° C. for 10 minutes in Kleinenberg's picrosulphuric acid (with 3 volumes of water), and preserving in 70 per cent. alcohol. By this process the envelopes, which in the fresh egg adhere closely to the yolk, dilate and stand off from the surface of the egg, and except in the very youngest stages can be rapidly and easily removed with the dissecting needles.

Investigation of Derostoma unipunctatum.*—Herr K. Lippitsch found his specimens of this worm preserved in sublimate, osmic acid, or osmic-acetic acid. The staining reagents used were hæmatoxylin, picrocarmine, and alum-carmine; osmic acid is not a good preservative, as it causes deformations of the epithelium, but sublimate is, as with other Turbellaria, very good. After treatment with hæmatoxylin for two or three hours all the glands become very clear, and the same reagent is good for the nervous system when osmic-acetic acid has been previously used. Twenty-four hours' stay in picrocarmine is useful for the study of the epithelium, nervous system, musculature of the pharynx, and connective tissue. Alum-carmine is also to be recommended.

Preparation of Horny Teeth of Batrachian Larvæ.†—Herr E. Gutzeit preserved his larvæ in 0·2 per cent. chromic acid or in sublimate, and afterwards placed them in alcohol; they were stained *in toto* by hæmatoxylin or picrocarmine. Paraffin was generally, and soap only rarely used as imbedding material. The sections were attached by oil of cloves and collodion, and Canada balsam was added. Wickersheim's fluid or Müller's solution was used for macerating purposes, and preparations so made were preserved in glycerin-gelatin.

Production of Colourless Spirit-preparations.‡—Herr H. de Vries proposes the following process for this purpose:—By adding two parts by volume of strong hydrochloric acid to 100 parts of alcohol, the production is prevented of brown pigments in the parts of plants which are plunged when living into the mixture; and the preparations thus obtained are much more beautiful than by the ordinary method. Even plants in which the brown pigment is very conspicuous, such as *Orobanche*, become white in this mixture; the only case of failure was with *Aucuba*, older portions still retaining their brown colour, while younger portions became quite white.

Observation of Nuclear Division in Plants.§—Prof. D. H. Campbell recommends for this purpose the pollen-mother-cells of *Allium canadense* or of *Podophyllum peltatum*, taken from a bud. They should be crushed or teased out into a mixture of equal parts of acetic acid and water, when the pollen-mother-cells are at once recognizable by their thick colourless walls; if they are already in the required stage of division, they may be stained by acetic methyl-green or gentian-violet, made by adding a sufficient quantity of a saturated alcoholic solution of gentian-

* Zeitschr. f. Wiss. Zool., xlix. (1889) pp. 148–9. † T. c., p. 65.
‡ Ber. Deutsch. Bot. Gesell., vii. (1889) pp. 298–301.
§ Bot. Gazette, xiv. (1889) p. 199.

violet to a mixture of two parts of distilled water and one of acetic acid. If a drop of this mixture is added to the preparation containing the pollen-cells, the nuclei will almost instantly be coloured a deep blue-purple, while the cell-protoplasm remains colourless and entirely uncontracted. The staining fluid may now be removed by blotting-paper, and the preparation mounted in dilute glycerin. Specimens prepared in this way, especially when first made, show all the finest details of the structure of the nucleus.

Fixing the Spores of Hymenomycetes.*—Inasmuch as a solution of Canada balsam in turpentine-oil has a tendency to oxidize and become cloudy after having been prepared for a year, Prof. C. O. Harz now proposes to substitute lavender-oil or petroleum for the turpentine-oil.

Direct Impressions of Plants.†—M. Bertot obtains direct impressions of plants in the following way:—The plant is first saturated with oil by placing between pieces of paper soaked in oil, and an impression of it is then obtained in oil on white paper. The paper is now treated with graphite, and the oily places are thus turned black and a perfect impression of the plant obtained. The paper is now freed from excess of graphite by wood-ash. To fix the image, powdered colophone is mixed with the graphite, which sinks into the paper when slightly warmed. Spots which sometimes appear upon the paper may be removed by soaking the paper in an aqueous solution of tragacanth.

Demonstrating Tubercle Bacilli.‡—Dr. Bliesener recommends the following method as being very expeditious:—The cover-glass, having been dried in the air and passed thrice through a flame, is placed with the sputum layer uppermost on a metal plate about 5–6 cm. square fixed to a stand so as to keep it horizontal. Five or six drops of carbolic fuchsin are then dropped on with a pipette and the metal plate warmed until the fluid begins to evaporate. The flame is then removed, and then the cover-glass, after remaining on the plate for about a minute, is washed with water previous to its being dropped on the acid contrast fluid (methylen-blue 1·5, H_2O 100, H_2SO_4 25). In about fifty seconds it is removed, washed in water, and examined.

The foregoing staining procedure, if combined with Biedert's method of examining sputum, is said by the author to be very satisfactory. Biedert's method consists in boiling the sputa with water to which some drops of caustic soda have been added.

Agar-agar as a Fixative for Microscopical Sections.§—M. A. Gervis, who recommends agar-agar as a medium for fixing sections, imbedded in paraffin, on slides, proceeds as follows:—Half a gramme of agar having been cut up into small pieces, is allowed to soak for some hours in 500 grammes of distilled water. When it has swelled up it is boiled for about a quarter of an hour in order to completely dissolve the agar.

* SB. Bot. Ver. München, Nov. 11, 1889. See Bot. Centralbl., xl. (1889) p. 345. Cf. this Journal, 1889, p. 461.

† Bull. Soc. Linn. Normandie, ii., 1887–8 (1889) pp. 442–5. See Bot. Centralbl., xl. (1889) p. 285.

‡ Deutsche militärarztl. Zeitschr., xviii., pp. 406–9. Cf. Centralbl. f. Bakteriol. u. Parasitenk., vii. (1890) pp. 72–3.

§ Bull. Soc. Belge de Microscopie, xv. (1889) pp. 72–5.

When cold the liquid is filtered through a fine cloth and kept in stoppered bottles. A small piece of camphor to prevent the development of micro-organisms may be placed in each bottle. The slides must be perfectly clean, and should be boiled in water acidulated with hydrochloric acid, and, having been rinsed in distilled water, are dried with a perfectly clean cloth. Upon the slide is brushed over a layer of this fixative, excess of which is immaterial, as it is easily removed later on.

The sections are then arranged on the slide with a fine brush. Directly this is finished the slide is gently heated over a Bunsen's burner. The paraffin is to be softened only, and not melted. Any unevenness or folds in the sections at once disappear. As the slide cools the paraffin sets; and now if there be too much of the fixative, it may be removed by just sloping the slide so as to drain it off. The fixative must now be allowed to dry thoroughly, and it is best to leave the slides just covered from dust, &c., until the next day.

The paraffin is then dissolved in warm turpentine or in chloroform, and these last removed by means of a little strong spirit. If the preparations have been stained before imbedding, nothing remains to be done but to dehydrate the section in absolute alcohol, clear up in oil of cloves, and mount in balsam. If not stained, the slide is placed in the staining solution, and when withdrawn goes straight into spirit.

The advantages of this method are that the fixative is liquid at ordinary temperature, the sections are easily arranged, all folds and creases are completely removed, and no air-bubbles trouble the manipulator. As the fixative is an aqueous solution, the cells of vegetable preparations swell up in it to their original size. When properly dried, the fixative is insoluble in all reagents and alkalies, &c., except water, which causes it to swell up and tends to loosen it from the slide. Unless the agar-layer be thick, the fixative does not become coloured in the staining solutions.

The preparations may be mounted either in balsam or glycerin.

(3) Cutting, including Imbedding and Microtomes.

Florman's Method of Imbedding in Celloidin.*—Dr. S. Apáthy raises several objections to the method of celloidin imbedding advocated and practised by Florman. The principles of the two methods are diametrically opposite. Florman advises imbedding in glass capsules in a thin solution of celloidin, and then solidifies by allowing the slow evaporation of the solvents, ether and alcohol. Dr. S. Apáthy's method consists in transferring the objects to solutions of celloidin of increasing thickness, and in only allowing evaporation of the ether-alcohol when the thickest solution has been reached. The objections to Florman's method seem chiefly to consist in the possibility of delicate objects being distorted, owing to the contraction of the celloidin, and also disarranged; in the long time required for imbedding; and in the fact that the undermost layer is usually left behind when the mass is extracted from the capsule.

But it is possible that the two microtomists are in the habit of dealing with different materials; the one with delicate objects, the

* Zeitschr. f. Wiss. Mikr., vi. (1889) pp. 301–3.

structure of which becomes materially altered by the slow contraction of the imbedding mass, and the other with material which has been previously well hardened and is in itself dense, so that the defects alluded to are unperceived.

(4) Staining and Injecting.

Kühne's Methylene-blue Method of Staining Bacteria.*—This method is especially recommended for staining bacteria in sections of animal tissues, although it is equally applicable to cover-glass preparations made from fresh tissues. The usual differences in the method of staining cover-glass preparations and sections are to be observed.

The advantages to be derived from this method are found in its being applicable to all known forms of bacteria. It eliminates the use of special stains for certain micro-organisms where only their presence is to be demonstrated. It possesses superior powers of differentiation between bacteria and the tissue elements. The method as given by Dr. Kühne † is essentially as follows.

The sections which have been cut by the ordinary method (although Dr. Kühne recommends the freezing microtome for this purpose), are transferred directly from alcohol to a watch-glass containing carbol-methylene-blue. (1) The sections should remain in this staining fluid for about half an hour; some bacteria, such as the bacillus of leprosy, requiring a longer time, one to two hours. If the sections remain in the staining fluid for a much longer period, the differentiation between the germs and tissue-elements becomes more difficult.

After staining for the desired length of time, the exact period of which will have to be determined by test experiments for the different germs and tissues, the sections are rinsed in clear water and then placed in acidulated water (2) until they become a pale blue. They are then washed in a weak watery solution of carbonate of lithium (3), and again placed in clear water. This part of the procedure is very important, and to insure good results should be performed with much care. The time that the sections should remain in the decolorizing agents varies with their thickness, histological structure, and the intensity of the stain, making it impossible to give any definite rule to be followed. The degree of decolorization can be very nearly determined at any moment by moving the sections about in the fluid by means of a glass rod. If the section is very thin, or if there are other reasons why it should take up very little of the stain, a momentary immersion in the acidulated water is sufficient. In all cases where the staining process is completed the sections should have a pale blue colour, for if darker, the over-stained corpuscles and cell-nuclei of the tissue would obscure the bacteria. In cases where it is feared that too much colour has been removed in the acid a drop of a saturated watery solution of methylene-blue should be added to the lithium-water.

After the sections have remained in the water for some minutes they are dehydrated in absolute alcohol in which, in difficult cases, a little methylene-blue may be dissolved, and then transferred to a watch-glass

* Amer. Mon. Micr. Journ., x. (1889) pp. 259–60.

† Kühne, 'Praktische Anleitung zum mikroskopischen Nachweis der Bakterien im tierischen Gewebe,' p. 15.

containing methylene-blue anilin oil (4). The sections can be dehydrated in the alcohol without injury to the stained bacteria. The sections are now transferred to pure anilin oil, in which they are rinsed and then placed in some essential oil, as turpentine, where they should remain for two minutes. In order that the sections should be perfectly cleared they are transferred from the turpentine to xylol, from which they are mounted in balsam. It is recommended that the sections should pass successively through two xylol baths in order to secure absolute elimination of the anilin oil. The xylol may be used for a considerable number of sections.

Dr. Kühne employs a glass rod for transferring the sections from one solution to another instead of the ordinary spatula or section-lifter. The end of a small glass rod is immersed in the fluid containing the section, which is allowed to fold itself over the rod, and in this position it is lifted from the fluid. The end of the rod is then gently immersed in the second liquid, where the section unfolds itself from the rod and floats upon the surface. In this way the danger of tearing the section is diminished and the time required for their transfer from solution to solution is much shortened. This is an important consideration where a large number of sections are to be stained.

(1) *Carbol-methylene-blue.*—This is prepared by grinding in a mortar 1·5 grams of methylene-blue with 10 ccm. of absolute alcohol until dissolved; 100 ccm. of 5 per cent. carbolic acid are gradually added and thoroughly mixed with the alcoholic solution. The resulting liquid is preserved in a well-stoppered bottle, until used. When only a small quantity is to be employed it is better to prepare only a half, or a quarter even, of the above quantity, as its staining power is diminished by long standing. It should always be *filtered* before using.

(2) *Weak acidulated water.*—To 500 ccm. of distilled water add 10 drops of nitric acid.

(3) *Lithium-water.*—To 10 ccm. of distilled water add from 6 to 8 drops of a saturated watery solution of carbonate of lithium. The saturated solution may be used as a decolorizing agent in sections with over-stained nuclei.

(4) *Methylene-blue anilin oil.*—About one-half gram of methylene-blue is ground in a mortar with 10 ccm. of pure anilin oil. When the oil is saturated with the colouring matter the entire mass is poured unfiltered into a vial, where the undissolved colouring matter will settle, leaving the saturated supernatant oil clear. To a watch-glass of pure anilin oil add a few drops of the saturated methylene-blue-oil until the desired degree of colorization is obtained.

(5) Mounting, including Slides, Preservative Fluids, &c.

New Form of Clip for Balsam Mounting.*—Mr G. H. Bryan says that there are few practical microscopists who do not admit that the spring-clips which have for so many years been used in mounting objects in balsam are a failure. The usual query which has been repeatedly asked is, "Why does air run in as soon as the clip is removed?" The answer is pretty obvious, viz. that the object yields to the pressure of the clip as long as it is subject to it, but as soon as

* Journ. of Microscopy, iii. (1890) pp. 45–7 (1 fig.).

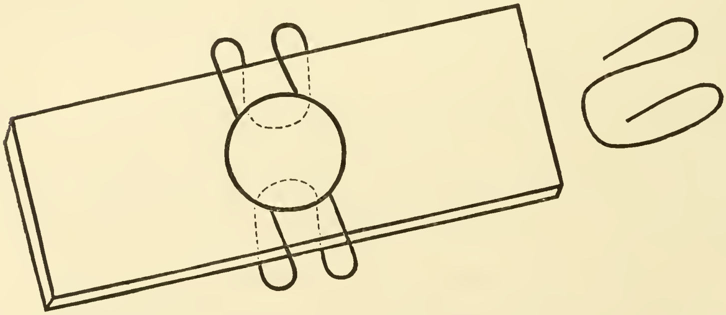
that is taken off, the elasticity of the specimen causes the latter to lift the cover up again, and what naturally happens? Why, of course the air runs in, because "nature abhors a vacuum."

Nor is this the only fault of spring-clips, for even a moderate amount of pressure is sufficient to damage many delicate specimens. Take the case of sections of stems of plants; the effect of squashing very frequently makes the cells and vessels in parts turn on one side, and where each cell should by rights be in its natural place, nothing is seen but a jumbled mass of tissue. Yet spring-clips are still frequently used in balsam mounting, the reason being that they fulfil a twofold purpose. One use of them is to produce pressure. This, as we have seen, is a bad purpose. Not but what a certain small class of specimens require flattening out, but this must be done before mounting them; it is too late to make the attempt when they are in the balsam. Their other use is to keep the cover in place while the balsam is hardening, and it is for this alone that they are usually used. They do not accomplish this end practically, for as a general rule, in applying the clip, the cover gets slightly shifted to begin with; moreover, they are almost certain to tilt the cover on one side or the other unless supports have been placed round its edges.

Nearly two years ago the idea occurred to the author that what was wanted was an arrangement that would hold the cover in its proper position by firmly gripping the edges instead of pressing down on the top of the glass. Since then he has mounted a number of slides, using these "pressureless edge clips" until the balsam has hardened, and with such success that now he "uses no other."

Fig. 29 shows one of the pressureless clips of the natural size, and how they are used for keeping the cover of a slide in its proper position.

Fig. 29.



It will be noticed that two clips are necessary, and when in use they firmly clip the slide only, their four points resting against the edges, not on the top of the cover-glass. In this way the cover is perfectly firmly held in position; it is impossible for it to slip out of place, while no pressure is applied to the object. In applying them to the slide, they are first clipped on anywhere, and then pushed up until their points touch the edges of the thin glass circle; this can generally be accomplished without shifting the latter perceptibly. The slide can then be handled with perfect impunity, no matter how soft the balsam may be, and a good deal of the superfluous balsam may be removed if care be taken not to displace the clips. The balsam may then, if advisable, be hardened under more or less heat; the top of a hot-water cistern is a first-rate drying-ground for the purpose. After about a fortnight in such a position, even slides mounted in ordinary balsam will generally be found sufficiently hard to be cleaned with perfect safety, but theoretically it is evident that the time taken to harden under the cover is the same as the time taken to harden in an open vessel by a layer of balsam whose thickness is one-quarter the diameter of the cover-glass. When the balsam is fully set the points of the clips will be firmly stuck down on the slides, but there is no difficulty in pulling them off; if necessary the wires might be heated, but this is not required.

Mr. Bryan now makes the clips of brass wire, the length required for each being about 2½ in. It is advisable to make the clips of different sizes, to accommodate the different sizes of cover-glasses, and, properly, the distance between the points of the clip should be about seven-tenths of the diameter of the covers for which it is made. For use with some mounts, it is convenient to bend the points of the clip inwards, while if the object be a very thick one the points turned down will be found very useful. Where neither of these things is done, the ends may be filed off at a suitable angle, so that they hold the edges of the cover more firmly.

Quick Method of Mounting Microscopical Preparations.*—K. Schilbersky, jun., finds that numerous micro-organisms can be permanently preserved by mounting them in an aqueous fluid (water or dilute glycerin) or glycerin-jelly, by means of the following simple device.

The object is (suppose) in water, and lying about the centre of the cover-glass. Any excess of water is then to be removed with bibulous paper, so that the edges of the cover-glass are quite dry; or this may be effected by evaporation. Before the edges are dried it is advisable to pass under the cover-glass a droplet of dilute carbolic acid, to prevent the development and settlement of schizomycetes, &c. When the edges are dry, the corners of the cover-glass are to be fixed with asphalt so thick that it runs with difficulty. Along the margins and corners of the cover-glass the asphalt is to be applied by means of a brush or glass rod, in such a way that the cover-glass is not moved. When complete, the ridge may be covered with Canada balsam.

If the object is in glycerin or other fluid not a solvent of asphalt, the procedure is quite similar, but extra care must be taken with glycerin to remove all traces of it outside the edge of the cover-glass, otherwise the asphalt will not stick. This is best done with a brush or strip of blotting-paper moistened with spirit. Instead of asphalt, balsam may be used, but it is not quite so serviceable.

If the object is to be mounted in glycerin-jelly, the following modification is adopted. The object (usually obtained by maceration) is placed under a cover-glass in water or glycerin, and the latter is then absorbed by means of a pipette or blotting-paper to one-third. The

* Zeitschr. f. Wiss. Mikr., vi. (1889) pp. 273–83.

cover-glass is next carefully raised, and a small piece of glycerin-jelly put in the water or glycerin which remains on the slide. The slide is then heated to melt the jelly. Air-bubbles having been pricked out, the cover-glass is replaced in its original position. It is advisable to take too little rather than too much glycerin-jelly, as the deficiency is easily made good afterwards.

Venetian Turpentine as a Mounting Medium.*—Dr. J. Vosseler recommends Venetian turpentine for mounting specimens permanently, on the ground that it possesses all the advantages of the ordinary resinous media employed for the purpose; that in some respects it is superior to them; and that it is cheaper.

Venetian turpentine is obtained from the larch, and is found to consist of a resin and an ethereal oil; consequently it is to be classed among the balsams. In colour and consistence the raw material resembles honey, but is sometimes brownish from admixture with minute fragments of bark.

To obtain a suitable solution the author merely mixes equal volumes of the crude balsam and 90 per cent. alcohol in a tall glass vessel, the top of which is protected from dust, and allows this to stand in a warm place for three or four weeks. The processes may be hastened by increasing the heat in an incubator. A clear yellowish or sometimes greenish mixture is obtained, and this is at once ready for use, as the impurities have already sunk to the bottom. These impurities may be extracted with greater rapidity by filtration. If the filtrate should be of a brownish hue, it must be thickened anew until the yellow colour returns. If the balsam be applied in a too fluid form it may become milky: should this turbidity be not too great, it will be found to disappear in a day or two; if considerable, the balsam must be dissolved out in 96 per cent. alcohol, and the specimen be remounted. The ordinary consistence of Canada balsam is that most suitable for the solution of Venice turpentine.

Prepared in the foregoing manner, Venice turpentine mixes with the reagents constantly in use in histological technique—for example, ether, alcohol 100–96 per cent., chloroform, pure carbolic acid, creosote, xylol, benzol, toluol, and the ethereal oils. Preliminary clarification of sections or pieces of tissue is quite superfluous, although when an entire animal, e. g. a small arthropod, is to be mounted, it is preferable to pass it through turpentine or creosote first. Hence, with a few exceptions, specimens are to be transferred directly from 96 per cent. spirit to this medium.

The finer details of structure are better shown in the medium than in dammar or balsam, but it is remarked that these details may disappear shortly after mounting, to reappear again on the second or third day. The medium behaves towards staining agents in the same way as other resinous substances, and is perfectly suited for specimens and sections imbedded in celloidin or paraffin.

The only inconvenience connected with the medium indicated by the author is that it is as slow to dry as dammar; but when dry it is harder and less brittle than balsam or dammar.

* Zeitschr. f. Wiss. Mikr., vi. (1889) pp. 292–8.

In order to examine specimens just mounted with an immersion lens, the author mentions the following device for preventing the cover-glass from slipping. A couple of needles, made hot, are laid along two sides of the cover-glass. This causes the resin to thicken from evaporation of the solvent. Of course, all the four sides might be banked up in this way, and the device is quite suitable for similar conditions of balsam or dammar.

Fixatives for Diatom Preparations.*—Herr E. Debes, after alluding to the isobutyl-alcoholic solution of shellac introduced by Dr. Witt, and which, though eminently suitable for a mounting medium, is equally difficult to make, proceeds to discuss two kinds of media convenient for mounting diatoms. These are resinous and gelatinous preparations. The resins are certain copals, and these are divisible into three classes according to their solvency in turpentine. To the first class, which is quite insoluble, belongs Zanzibar copal; to the second, Manila or soft copal—this is only imperfectly soluble; the third class includes those resins which, being quite soluble, are omitted.

The Zanzibar, or insoluble copal is made into solution with isobutyl-alcohol, after having been previously treated with turpentine to dissolve out any resinous matter that may be present. The filtrate is then dissolved in isobutyl-alcohol and again filtered. The solution is quite colourless and clear, and is at once ready for use.

The diatoms are fixed by placing on a 3-mm. cover-glass a small drop of the liquid, which spreads itself out all over the cover. The cover-glass is then put on a metal plate, heated by a spirit-lamp, and when the proper degree is arrived at, the diatoms are arranged. This degree is estimated by placing close to the cover-glass a small fragment of resin on a bit of cover-glass, and when the fragment is quite dissolved the correct degree of heat is indicated and the source of heat removed.

Another way of estimating the proper amount of heat is to place a small strip of white writing-paper on the hot plate, and when this turns colour (white to yellow or brown), the source of heat is removed. After having been heated, both these resins (Manila and Zanzibar) become less soluble, an inconvenience which, as may be understood, may cause disasters if not properly anticipated.

The gelatinous media are made from gelatin or isinglass. Two grm. of pure white gelatin are dissolved in 70 ccm. of glacial acetic acid (or 3 grm. of isinglass in 75 ccm.), the mixture being placed in a well-stoppered bottle. By frequent shaking, the solution is effected in three or four days. The process may be hastened by heating in a water-bath. If isinglass be used the solution must be filtered to get rid of fat and fibres. Five grm. of the solution are then diluted with a mixture of 3 grm. of ethyl-alcohol and 1·5 grm. isobutyl-alcohol. The mixture is made by squirting in small quantities of the latter through a pipette, and constantly shaking. If a cloudy or opalescent precipitate be formed, a little more acetic acid must be added.

The solution must be put in a well-stoppered bottle and kept in a cool dark place. The fluid, which keeps well, is put on the cover-glass &c., with a pipette; a small drop runs out peripherally to form a thin

* Zeitschr. f. Wiss. Mikr., vi. (1889) pp. 283–92.

even layer. The diatoms are laid on dry, and fixed in position by merely breathing ever so lightly upon the cover-glass.

Sterilization of Water by the Chamberland Filter.*—M. L. Dor finds from several experiments that Chamberland's filter may be confidently relied on for removing bacteria, for by means of it the author has succeeded in rendering the water perfectly free of germs.

Microchemical Test for Alkaloids and Proteids.†—M. L. Errera finds, as the result of numerous and prolonged experiments between alkaloids and proteids, that alcohol acidulated with tartaric acid fulfils all the conditions required for a good test between these two classes of highly organized bodies; for the alkaloids are removed by means of the tartaric acid, and the proteids remain behind. Hence little difficulty will be experienced in distinguishing the one class of compound from the other. The experiments were made upon colchicine, pepton, mucor, ciguë, and lupin.

"Air-gas" for Bacteriological Work.‡—Dr. O. Katz, who had to work on Rodd Island, N. S. Wales, where the ordinary appliances of civilization were not available, made use of the "Alpha patent gas-making machine." This apparatus produces gas in the shape of a mixture of atmospheric air and the vapour of petroleum spirit (gasoline), the mixture being called air-gas. By means of weights atmospheric air is pumped through a drum into a chamber, where it is impregnated with the vapour of the volatile fluid. The mixture then passes into a gasometer, from which the burners are supplied automatically. The author used a 40-light machine capable of yielding 200 feet of gas an hour.

The author considers that air-gas makes an efficient substitute for coal-gas for ordinary lighting purposes, and he also used it with success for heating thermostats, and also for other bacteriological purposes.

(6) Miscellaneous.

Changes in the Firm of Zeiss.§—The firm of C. Zeiss, in Jena, has advertised by circulars a change in their management. Dr. Ernst Abbe, who has hitherto acted as general manager of the firm, was, on November 29th, 1889, admitted into the firm as partner with Dr. R. Zeiss, and has now undertaken the sole management of the company so formed. At the same time power of procuration of the firm has been given to Dr. Otto Schott, of Jena; and Dr. Siegfried Czapski, of Jena, has also been authorized to represent the firm in all business matters.

Correction, by Dr. H. van Heurck.—Dr. H. van Heurck, Director of the Jardin Botanique, Antwerp, requests us "to correct an error, or rather an omission," which occurred in his note on *Pleurosigma angulatum.*‖

He wrote:—"The last photograph, No. 6, shows that the valve of *Pleurosigma* is formed of two layers." In writing this phrase he states: "I had in view the upper membrane and the intermediate layer, which are

* Lyon Médical, 1889, No. 23. Cf. Centralbl. f. Bakteriol., vii. (1890) p. 75.
† Annales Soc. Belge de Microscopie (Mémoires), xiii. (1889) pp. 72–121.
‡ Proc. Soc. Linn. N.S.W., iv. (1889) pp. 328–30.
§ Zeitschr. f. Instrumentenk., x. (1890) p. 37.
‖ *Ante*, p. 104.

seen in this photograph, the lower membrane which is beneath not being visible. My clerk omitted the two words "at least," thus completely altering the sense and placing me in contradiction both with the statements in my Synopsis, published in 1885, and with the note on the 'Structure of Diatom Valves' which I recently sent to the Royal Microscopical Society, in which I everywhere admit the existence of three layers."

New Photograph of P. angulatum, by Dr. H. van Heurck.—At the March meeting of the Society a photograph, by Dr. H. van Heurck, was exhibited of *P. angulatum*, produced with Zeiss's apochromatic objective of 1·6 N.A., in further elucidation of Dr. van Heurck's views on the structure of diatom valves.

The note accompanying the photograph was as follows:—

"I have the honour to submit to the Royal Microscopical Society a photograph of *P. angulatum*, made with the objective of 1·6 N.A., using strictly axial illumination. The fracture of the upper edge shows clearly that the "beads" are holes in the intermediate layer, and that the form of these holes (beads) is hexagonal, as maintained by Mr. Smith and myself. The form of the small bar on the extreme top, which is the part of the negative focused, shows that the "beads" cannot be round."

The Formation of Images in the Pleurosigma formosum.—Mr. E. M. Nelson communicated the following note to the Society at the meeting of the 19th March:—"It was stated at the January meeting of the Royal Microscopical Society that it was impossible to produce images in the markings on a *P. formosum*. Some years ago it was said that images formed by the primary structure of coarse diatoms, such as *Triceratium* and *Coscinodiscus*, proved that the markings were lenticular. With this opinion I did not agree, and was led to investigate the subject. I not only confirmed the experiment with regard to the coarse diatoms, but eventually succeeded in producing images in the *P. formosum*. I also produced images in minute holes punctured in a piece of tinfoil. This latter experiment shows that the production of images in diatom markings does not prove that they are lenticular. I have now made a photomicrograph of a *P. formosum* with images formed in the markings × 2000. The images might have been made more distinct had more time been expended on the photomicrograph."

PROCEEDINGS OF THE SOCIETY.

Annual Meeting held 12th February, 1890, at King's College, Strand, W.C., the President (Dr. C. T. Hudson, F.R.S.) in the Chair.

The Minutes of the meeting of 8th January last were read and confirmed, and were signed by the President.

The List of Donations (exclusive of exchanges and reprints) received since the last meeting was submitted, and the thanks of the Society given to the donors.

	From
Kühne, H., Practical Guide to the Demonstration of Bacteria in Animal Tissues. Translated by F. D. Harris, M.D. viii. and 53 pp. and 7 figs. (8vo, London, 1890)	*Dr. Harris.*
Tryon, H., Report on Insects and Fungus Pests. Pt. I., ix. and 238 pp. and 4 pls. (8vo, Brisbane, 1889)	*Mr. H. Tryon.*

Mr. Crisp having read the notice given at the January meeting, as to the alterations it was proposed to make in the Bye-Laws, it was moved by Mr. Glaisher, seconded by Canon Carr, and resolved :—

(1) That Article 36 of the Bye-Laws of the Society be suspended for the purpose of allowing Dr. C. T. Hudson to be eligible for election to the office of President for the ensuing year, notwithstanding that he has already been elected to such office for two years in succession.

(2) That Articles 37, 61, 74, and 77 of the Bye-Laws be altered so as to read as follows :—

37. The Council at their meeting in November shall prepare a list of Fellows to be recommended to the Society for election at the ensuing annual meeting, which list shall be read at the general meeting in December.

61. Two Ordinary Fellows, one a member and the other not a member of the Council, shall be appointed at the general meeting in December, to audit the Treasurer's account for the past year. They shall have the power of calling for all necessary books, papers, vouchers, and information.

74. The ordinary meetings of the Society shall be held at 8 o'clock p.m., on the third Wednesday in each month, from October to December, and February to June, inclusive.

77. The annual meeting shall be held at 8 o'clock p.m. on the third Wednesday in January.

Mr. Crisp read the following list of Fellows nominated by the Council as Officers and Council of the Society for the ensuing year :—

President—Charles T. Hudson, Esq., M.A., LL.D. (Cantab.), F.R.S.

Vice-Presidents—*Lionel S. Beale, Esq., M.B., F.R.C.P., F.R.S.;

* Have not held during the preceding year the office for which they are nominated.

James Glaisher, Esq., F.R.S., F.R.A.S.; Prof. Urban Pritchard, M.D.; *Charles Tyler, Esq., F.L.S.

Treasurer—*Frank Crisp, Esq., LL.B., B.A., V.P. & Treas. L.S.

Secretaries—Prof. F. Jeffrey Bell, M.A.; *John Mayall, Esq., Jun., F.Z.S.

Twelve other Members of Council—Alfred W. Bennett, Esq., M.A., B.Sc., F.L.S.; Robert Braithwaite, Esq., M.D., M.R.C.S., F.L.S.; *Rev. W. H. Dallinger, LL.D., F.R.S.; Prof. J. William Groves, F.L.S.; *Richard G. Hebb, Esq., M.D.; George C. Karop, Esq., M.R.C.S.; Albert D. Michael, Esq., F.L.S.; Thomas H. Powell, Esq.; *Walter W. Reeves, Esq.; *Prof. Charles Stewart, F.L.S.; William Thomas Suffolk, Esq.; Frederic H. Ward, Esq., M.R.C.S.

Canon Carr and Mr. Vezey were appointed Scrutineers by the President, and the ballot was proceeded with.

The Treasurer, Dr. Lionel S. Beale, F.R.S., then read the annual statement of accounts from the duly audited balance sheet (see p. 264).

Dr. Beale then formally resigned the office of Treasurer of the Society, at the same time congratulating the Fellows upon the fact that he was about to be succeeded by one who would no doubt make a more useful Treasurer than he himself had been able to be. Although the Treasurer was not dead, he might heartily say, "Long live the Treasurer."

The President felt sure that all present would join heartily in according a vote of thanks to Dr. Beale for his services, not only during the past year, but throughout the long time during which he had undertaken the duties of Treasurer of the Society. It was a great pleasure, not only to have had him as their Treasurer, but also to know that they were still to retain him amongst them as one of their Vice-Presidents.

Mr. Crisp, in seconding the motion, said that it was a matter of surprise to him at the time, that Dr. Beale accepted the office of Treasurer when asked to do so, seeing the nature and number of his professional engagements; but he not only cheerfully undertook the office, but carried out the duties with punctuality and efficiency. It might also be mentioned that he had resigned his office in a very genial manner, under circumstances, which perhaps, he might be permitted to mention. When he himself was obliged to give up the office of Secretary and Editor of the Journal, it was desired by the Council that he should remain in some official connection with the Society, but in what way they could not very clearly settle. Dr. Beale, happening to come in at the moment, grasped the situation and resigned the Treasurership at once, to meet the difficulty, so that he felt they owed him a double debt of gratitude on the occasion.

The motion, having been put by the President, was carried unanimously.

Dr. Beale expressed his thanks to the meeting for the very cordial way in which this vote of thanks had been passed, though he felt that

* Have not held during the preceding year the office for which they are nominated.

Dr. THE TREASURER'S ACCOUNT FOR 1889. Cr.

1889.	£	s.	d.
To Balance brought from 31st December, 1888	116	0	1
„ Interest on Investments	84	2	4
„ Admission Fees	77	14	0
„ Annual Subscriptions	810	14	6
„ Compositions	63	0	0
„ Reprints sold	1	10	0
„ Catalogues sold	2	5	0
„ Screw tools sold	1	5	0
	£1156	10	11

1889.	£	s.	d.
By Rent, Gas, and Attendance	95	11	9
„ Salaries, Reporting, and Commission	190	15	6
„ Books and Binding	95	5	6
„ Expenses of Journal (less receipts)	450	1	7
„ Postage of Journal	78	6	10
„ Reprints from Journal	8	7	6
„ Stationery and Miscellaneous Printing (including Library Catalogue and Charter)	63	19	9
„ Coffee at Evening Meetings	18	11	0
„ Fire Insurance	3	0	0
„ Petty Cash	37	2	0
„ Balance remaining 31st December, 1889	114	19	6
	£1156	10	11

LIONEL S. BEALE, *Treasurer.*

Investments, 31*st December*, 1889.

1200*l*. Freehold Mortgages. 875*l*. 19*s*. 8*d*. India Three per Cents. (including 100*l*. Quekett Memorial Fund).

The foregoing Annual Account examined and found correct, 16th January, 1890.

W. T. SUFFOLK, J. D. HARDY, } *Auditors.*

whilst he had always endeavoured to attend to the duties properly, he had not done more than any other Fellow of the Society would have done under the circumstances.

Prof. Bell then read the Report of the Council for the past year as follows:—

REPORT OF THE COUNCIL.

The Council are glad to be able to report the continued prosperity of the Society during the year 1889.

Fellows.—39 new Fellows were elected, being approximately the average of the last ten years, whilst 21 died or resigned. One Honorary Fellow, Rev. M. J. Berkeley, died, whose place was supplied by the election of Mr. John Ralfs, the author of 'British Desmidieæ.'

The list of Fellows now contains 659 Ordinary Fellows, 50 Honorary, and 88 Ex-officio, or a total of 797.

Finances.—As many of the Fellows who died or resigned were either compounders or subscribers under the old scale of 1 guinea, the annual revenue has been substantially increased, the increase amounting to 39*l.* 18*s.* 6*d.*

The capital funds of the Society remain at the amount reported last year, namely, 1200*l.* on mortgage, and 875*l.* 19*s.* 8*d.* invested in India 3 per Cents.

Rooms.—As previously reported, the Council have succeeded in obtaining rooms at 20, Hanover Square, under a lease from the Royal Medical and Chirurgical Society.

The accommodation consists of two rooms on the second floor, which will be reserved exclusively for the use of the Society, with the right of meeting in a large commodious meeting room on the ground floor. The Society has a lease for 21 years, at a rent of 130*l.* a year, which includes rates and taxes and also electric lighting.

The extra expense caused by this lease will be met by the increase in revenue above referred to.

Journal.—It was with much regret that the Council received the announcement of the retirement of Mr. Crisp from the Editorship of the Journal and Secretaryship of the Society, but as they found that it was quite impossible for him to reconsider his determination, they had no alternative but to acquiesce in it. The Council cannot refrain, however, from placing on record their sense of the deep obligation which the Society is under to Mr. Crisp for his labours of the last twelve years, both as Secretary of the Society and as Editor of the Journal. The Council are glad that Mr. Crisp has seen his way to accept the Treasurership, so that his official connection with the Society will remain unbroken.

Dr. Beale felt sure the Fellows of the Society would consider this a very satisfactory report; he had therefore much pleasure in moving that it be received and adopted, and that it be printed and circulated in the usual way.

Mr. Vezey having seconded the motion, it was put to the meeting and carried unanimously.

The President announced that the Scrutineers had handed in their report of the result of the ballot, showing that the whole of those whose names were printed in the list had been elected.

The President said he had in the first place to thank them for the honour they had done him by electing him to a third year of office, a very graceful act on their part when it was remembered how imperfectly, owing to his absence from many of the meetings, he had been able to discharge his duties. It had been a great pleasure to him to be in his place whenever his health had permitted, and it had been a still greater pleasure to observe how greatly the Society had flourished, not on account of, but during his Presidency, and he could only add to this the hope that its prosperity would both increase and be long continued.

"And now, gentlemen, I propose to deviate from the usual custom of the chair, and, acting as I believe you, under the circumstances, would wish me to do, not only to propose, as your spokesman, the usual vote of thanks to your Secretaries for the admirable way in which the affairs of your Society have been conducted during the last year, but to express to your senior Secretary, Mr. Crisp, our gratitude for his long and unwearied labours, and our deep regret that he has found it imperatively necessary to resign his office.

Mr. Crisp has now discharged the arduous duties of Secretary and Editor of our Journal for twelve years; and during that time the Society has doubled its numbers and has greatly improved its position and influence; results which I feel sure you will consider to be due, in no slight degree, to the energy, sound advice, admirable tact, and unfailing good temper of our senior Secretary. Our Journal, too, as the 'Athenæum' has justly said, has, during his editing, 'been converted into one of the most useful aids to research which can be put into the hands of working biologists. It has averaged a thousand pages in each volume, and its circulation is understood to be more than a thousand copies.' Mr. Crisp's editing has been the reverse of nominal. Of course he has had the assistance of very able and willing colleagues, but when I mention that, till quite lately, he has selected nearly all the papers to be noted; that he has read all the proofs, and often made excellent suggestions on them; and that he has himself largely written the part of 'Microscopy,' I have said enough to show how much we lose in parting, not only with our Secretary, but also with our Editor.

But this is by no means all. It is to him that we are indebted for the introduction of Prof. Abbe's theories to the notice of English microscopists and opticians, and for a lucid explanation and vigorous defence of them. Strictly speaking, Dr. Henry Fripp, of Clifton, then President of our Bristol Microscopical Society, was the first to translate Prof. Abbe's original paper; but his translation, which was published in the 'Proceedings' of the Bristol Naturalists' Society, attracted little notice, till Mr. Crisp republished it, with others following it, in your 'Proceedings.'

You, of course, well remember the storm that raged round immersion lenses and angles of aperture, &c., and how your Secretary never wearied in exploding fallacy after fallacy, as one antagonist after another rose up to maintain the old ideas. His victory, indeed, has been so complete, that it runs the risk even of being forgotten from want of opposition. But the results of his victory remain; and it is not too much to say that to it is, in a very large measure, due the great improvement in our lenses which has taken place within the last few years, culminating in those beautiful apochromatic objectives which give promise of making many things familiar to us about which, hitherto, we have only feebly guessed.

Nor can our thanks stop here: for I think that on an occasion like this, I may be permitted to allude to the material assistance which Mr. Crisp has generously given to the Society, in the heavy expenses of the Journal, and to tender him our hearty thanks for that assistance. It is enough, indeed, merely to mention the fact, which speaks volumes for the interest that Mr. Crisp takes both in microscopical science and in the Royal Microscopical Society itself.

We are, too, all greatly indebted to our senior Secretary for the opportunities that he has given us of studying his splendid collection of Microscopes, from the earliest to the most modern times, and of rare books which treat of their use and structure: and I am sure that when he next surveys the cabinets which hold his treasures he may say, as his eye rests on the twelve goodly volumes of our Journal, 'Monumentum exegi ære perennius.'

It is, morever, a source of no little satisfaction to us all that Mr. Crisp has accepted the office of Treasurer, so that we shall still benefit by his able advice and kindly presence; and in conclusion I can only assure him (speaking as I do for the whole Society), that in retiring from the Secretaryship he takes with him our warmest thanks, and our heartiest good wishes for his continued health, happiness, and prosperity."

He felt that it was unnecessary for him to call upon any one to move and second the adoption of that which he had read, and would therefore put it at once to them. The resolution was carried by acclamation.

Mr. Crisp said if he were now upon the point of altogether retiring from his official connection with the Society, he should perhaps take a more formal farewell than it was his intention to do under the circumstances, inasmuch as he was only shifting his position from one office to another, and intended to continue to attend all the meetings, just the same as he had done, with one exception, during the last twelve years. The President had drawn rather too rosy a picture of his association with them during that period; that, however, could be corrected before it appeared in print. But whilst he thanked them sincerely for this expression of goodwill, he could hardly regard what he had done as altogether arising from disinterested motives, because he had taken great pleasure in the work connected with the Society, which had been to him a matter both of relaxation and amusement, and any expenditure incurred had been more than repaid by the advantages he had derived from it.

The Rev. T. S. King said he should like—as one of the country Fellows of the Society—to say how greatly those who, like himself, lived at a distance from London, felt their indebtedness to Mr. Crisp for the way in which he had supplied them with the remarkable amount of information to be found in the Journal. He ventured to hope that the

President would exercise the despotic power which belonged to him in preventing the paper which he had just read from being in any way mutilated in passing through the press.

The President then read his Annual Address (see p. 129), concluding with the exhibition of a number of transparencies, which he explained seriatim.

Prof. Bell was sure they would agree with him that a vote of thanks should be moved for the very instructive and entertaining address to which they had just listened, leaving them, as it did, so much to think about, and presenting to them in an original manner a view which was gaining considerable credit with the naturalists of to-day. The matter to which the President had directed their attention had passed through several stages, and the ultimate result was that the natural objects of their studies had become too much obscured, and the difference between the field naturalist and the cabinet naturalist far too great. The study of the science of natural history began with Linnæus, who gave them a system of nomenclature and method of classification, and there was no doubt that the method which he adopted was so complete and perfect that it had been found practically impossible to improve upon it. Then came the age of Cuvier and Richard Owen, in which people got so interested in the bones and teeth that they seemed quite to forget the true study of the forms from which those bones or those teeth were derived. After this came the age of Von Baer and his followers, people who knew so much about eggs, but so little about what the creature was from which the egg came—people who got an egg, but what it was to produce or whether it came from a reptile or a guinea-pig were matters on which they seemed unable to be certain. After these came Darwin and that so-called Darwinism which had been used as a means for weaving phylogenies by Germans and others; and now they seemed to be reaching a period when there was arising a truer Darwinism, and there was still a class of naturalists who were able to follow its leadings. What Darwin did for this portion of his followers, what the President was himself doing in the lines which he had taken, what was being done at Naples and at our own marine zoological station, would, he believed, give a great impetus in a true direction to these studies, and would put them in touch again with those who were so fond of nature that they wanted to know the truth about her. He believed, therefore, that a time had come when zoology could no longer be defined as interesting to those who were interested in the study of words. Books were not without their uses, and in connection with the subject brought before them it was undoubtedly as necessary to have a book as to have the natural forms. The President and Mr. Gosse had given them one sort of book; might they not hope that the address to which they had been listening indicated that the President would also provide them with the other?

Mr. Glaisher said he had much pleasure indeed in seconding the vote of thanks which had been proposed by Prof. Bell to be given to the President for his very admirable address of that evening. When the latter gave his first address to their Society he thought he passed the highest compliment upon their transactions by such a contribution to them, and now, at the end of his second year of office, he had not only given them an address, but had shown them some of the results of his researches by means of the very beautiful illustrations which he had placed before them. An address such as that could not fail to give a great impetus to others to go and do as he had done. He felt that their warmest thanks were due to the President for this address, which he presumed would be printed and circulated amongst the Fellows in the usual way.

The motion having been put to the meeting, was unanimously carried.

The President said at that late hour of the evening he would not do more than thank them very heartily for the vote of thanks, and for the very kind way in which they had taken not only his Address, but his services for the year, notwithstanding the imperfections from occasional absences from the meetings of the Society from causes beyond his control.

Mr. Crisp said they must not separate on that occasion without passing a vote of thanks to their Auditors—Mr. Suffolk and Mr. Hardy—for their services. He had much pleasure in proposing it.

Mr. Glaisher seconded the motion.

The motion having been put to the meeting by the President, was carried unanimously.

Mr. Crisp reminded the Fellows that they had now held their last meeting in that room, and that in future they would meet in their new premises, No. 20, Hanover Square, on the third Wednesday in the month, so that their next meeting would be held on March 19th.

New Fellows:—The following were elected *Ordinary* Fellows:—Messrs. Thomas D. Aldous, George M. Elwood, H. A. Francis, and William Odricks.

Meeting of 19th March, 1890, at 20, Hanover Square, W., Professor U. Pritchard (Vice-President), in the Chair.

The Minutes of the meeting of 12th February last were read and confirmed, and were signed by the Chairman.

The List of Donations (exclusive of exchanges and reprints) received since the last meeting was submitted, and the thanks of the Society given to the donors.

	From
Zeiss's New Apochromatic Objective of 1·6 N.A., condenser, slide of diatom preparations, 12 flint glass slips, and 20 cover-glasses	*Prof. E. Abbe.*
Photograph of *P. angulatum* produced with Zeiss's Apochromatic Objective of 1·6 N.A., and axial illumination.. ..	*Dr. H. Van Heurck.*

A letter from the President was read by Prof. Bell, regretting his inability to be present at the meeting, in consequence of a fall, from the effects of which he was suffering severely at the time of writing.

The Chairman was sure that the Fellows of the Society would agree with him that it was a very great loss to them not to have the President with them on the occasion of their first meeting in their new rooms. He hoped, however, that his recovery from the effects of the accident would soon take place, and that they would before long see him amongst them again.

Mr. J. Mayall, junr., said that before entering upon the business of the evening he must thank the Fellows of the Society for the honour which they had done him in electing him to the office of Secretary. He desired to say that during his tenure of the Secretaryship it would be his endeavour and chief aim to promote the welfare of the Society as far as he was able, and to give every one who was interested in the study of microscopy the fairest possible play at the meetings. Because he held certain views upon optical questions, it must not be thought that he was unwilling to hear those who differed from him on those subjects; on the contrary, he desired that, so far as the interests of the Society permitted, every one should be at liberty to state his opinions in the freest and fairest way.

Mr. Mayall said that the Society had since their last meeting received a donation of a specially interesting character, from Prof. E. Abbe, of Jena, namely, one of Zeiss's new apochromatic 1/10th objectives, of 1·6 N.A. It would be remembered that the new objectives had recently formed the subject of several communications to the Society. When first he heard from Dr. Czapski, of the firm of Zeiss, of an intention to send one of the objectives to the Society, he was not quite certain whether it was to be sent as a donation or for inspection only. Upon further inquiry, however, he found that it was sent to them as a donation, as would be seen from the letter, dated Jena, 17th inst., just received from Prof. Abbe, as follows:—

> "A few months ago our co-operator, Dr. Czapski, of this town, communicated with the Royal Microscopical Society on the subject of a new objective of increased aperture, which had been constructed by us last year. The Editors of the Journal of the Society published this communication in the February number of the Journal, in the Transactions of the Society, and they also gave a full account of observations made with the lens.
>
> The aim which was held in view in the construction of the objective—viz. to increase the aperture of the microscope to the maximum degree obtainable with the means at present available in practical optics—unavoidably involves such restrictions in the use of the objective as to render its application very limited. It is, therefore, not to be expected that this objective will be at all extensively employed by microscopists, and, in fact, only a small number of these lenses have as yet been constructed.
>
> It was, however, our opinion that it would be of some interest to the Fellows of the Royal Microscopical Society to test the result of this, our experiment, by ocular inspection. We accordingly constructed one of these lenses specially for the Royal Microscopical Society, and now forward it by our agent, Mr. C. Baker, of London, requesting the Society's acceptance of it as a token of our estimation of the valuable services rendered by the Society towards the advancement of microscopical optics."

Mr. Mayall said the new objective would naturally be regarded by the Society with extreme interest. In order that its merits might be tested, the Council had recommended that Dr. Dallinger, Mr. Nelson, and himself, should form a committee for the purpose of examining it, and reporting the result at their next meeting. Prof. Abbe had forwarded with the objective a condenser, of 1·6 N.A., and a flint-glass slide, containing mixed diatoms mounted by Dr. Van Heurck, of Antwerp. It was, of course, understood that in order to exhibit the full power of the increased aperture, it was necessary to employ a condenser of corresponding aperture, and the objects to be viewed must be mounted on slips, with covers, and mounting and immersion fluids of corresponding high refractive power.

Mr. C. L. Curties said that Prof. Abbe had also sent for the Society's acceptance a supply of flint-glass slips and cover-glasses for use in mounting objects for examination with the new objective.

The Chairman was sure that the thanks of the Society would be given to Prof. Abbe for his valuable and interesting donation, and that the Society would be very much interested in hearing the report of the gentlemen who had undertaken to examine it.

Mr. Mayall called attention to two Microscopes exhibited by Mr. Crisp. One of these was an example of the highest grade of construction made by M. Nachet; a special novelty about it was that the stage was fitted with two small mirrors, one concave and one plane, which were placed right and left of the stage, so that an observer looking down the body-tube with one eye could see in the plane mirror with the other eye the image of the profile of the objective, and could thus see when the objective was approaching dangerously close to the cover-glass, an advantage which he was himself hardly able to appreciate. He thought appliances of that kind interfered with the freedom of manipulation. The general construction should be compared with that of other opticians in France, and then it would probably be found to rank high, for centering movements were applied to the substage, which had also a fine-adjustment. There seemed to have been an oversight in the fitting of the rackwork of the coarse-adjustment, because when run down low with the pinion, the body-tube was apt to slip away from the pinion and crush down upon the stage.

Mr. Crisp said this defect had been noticed by himself, and he had also found, in handling the stand with average care, the body-tube rack ran so unusually free that the lower part of the instrument had narrowly escaped dropping on the floor in the removal from one table to another.

Mr. Mayall said that the other Microscope exhibited by Mr. Crisp was constructed by M. Pellin, of Paris, successor to the late Jules Duboscq, for the purpose of examining and photographing adulterations in food, which was one of the official duties at the Paris Municipal Laboratory. It stood upon a wide tripod provided with levelling screws, which were probably of use in examining fluids. The photographic accessories were of substantial construction, consisting of a brass shaped tube, the smaller end fitting as a socket over a cylindrical chamber encircling the eye-piece, and the upper end receiving the sensitive-plate holder at about twenty inches from the objective.

Mr. Crisp pointed out that the cylindrical chamber round the eye-piece was a very awkward arrangement for the observer, not at all calculated to facilitate observations.

Prof. Bell announced that the Council had nominated for election as an Honorary Fellow of the Society, Prof. F. Leydig, of Bonn, whose name would be submitted for election at the ensuing meeting.

Prof. Bell also stated that, in connection with a movement which had been set on foot for the purpose of presenting a memorial to Prof. Pasteur, one of the Honorary Fellows of the Society, a letter had been received from Mrs. Priestley, inclosed with which was a page of the memorial upon which the signatures of Fellows of the Society were to be placed. The Council had signed it as requested, and there was about half the page left for the signatures of any other Fellows who might like to record their names also, whilst it was intimated that another page might be procured if found necessary.

Mr. Rousselet said that he exhibited a number of Rotifers, chiefly for the purpose of showing their abundance at the present season of the year.

Prof. Bell read a letter received from Colonel O'Hara with reference to a specimen exhibited in the room, which was supposed to be some kind of Entozoon passed in urine.

Prof. Stewart said he had looked at this object; it was not very transparent, and therefore not easy to determine, but it looked like a Trematode worm of some sort. These things were well known as occurring in the bladders of frogs and Amphibia, but so far as known to him they had not been found before in human urine.

Prof. Bell said the letter did not state that the object was found in human urine.

Prof. Bennett thought that to be heard well in that room it would be necessary for speakers to raise their voices to a higher tone than was usually adopted. There seemed to be a good deal of resonance somewhere, and much of what had been said had been very imperfectly audible from where he was sitting.

Prof. Stewart thought that the tone of the speaker was not of so much consequence as the clearness and slowness with which he spoke, as the difficulty was due rather to the nature of the room. Probably if some kind of curtain or banner were hung up so as to prevent the reflection of sound from so many surfaces it would greatly modify the defect which had been noticed.

Prof. Bell said it would be remembered that at their meeting in January last a paper was to have been read by Mr. Michael "On the Variations of the Female Reproductive Organs, especially the Vestibule, in different species of Uropoda," but that, owing to a want of time on that occasion, the subject was postponed until March. Since then he regretted to say that Mr. Michael had been seriously ill, and was consequently unable to read his paper as they had hoped. The paper had been sent to the printer, but it had been returned to him without the proof of the plate by which it was to be illustrated, and not having therefore the opportunity of comparing the figures with the descriptions given in the text, he was unable to give a sufficiently clear explanation of the very minute details entered into by the author. He gave, however, such a *résumé* as was possible under the circumstances.

Prof. Stewart, who had seen some of Mr. Michael's specimens, pointed out the chief features illustrated by the diagrams.

The Chairman expressed the thanks of the Society to Mr. Michael for his communication, and the regret which he was sure they felt at his absence.

Mr. C. H. Wright gave a description of a new British hymenolichen, and exhibited specimens lent for the occasion from the herbarium at Kew. His observations led him to the conclusion that the species was *Cyconema interruptum*, which he believed to be a synonym of *Rhizonema interruptum*, and that in future descriptions the last-mentioned term must be omitted.

Prof. Bennett regretted that he had not been able clearly to hear the observations of Mr. Wright, but if he rightly understood the purport of his remarks, it was that this form must in future be referred to the genus *Cyconema*, which was an exceedingly polymorphic family. He thought it was a fact of great interest to have found this form in this country.

Mr. E. M. Nelson read a short note with reference to a statement alleged to have been made at one of the meetings of the Society, to the effect that it was impossible to produce images of external objects from the markings of *P. formosum*, and he said it had been contended that the production of such images did not prove that the openings were lenticular. Images could be seen so long as they were within the resolving power of the lenses employed.

Mr. Crisp said he was present at the meeting referred to by Mr. Nelson, but did not hear any one say that images could not be produced in *P. formosum*, because it was well known that in *P. formosum* they could, Dr. Matthews having shown them. The whole point was that they could not do it after they reached a certain limit, and *P. angulatum* being beyond that point, they could not see them there.

Mr. Mayall said that *P. formosum* might be within the limit, but *P. angulatum* was never within it so far as he knew. He remembered that the question was submitted some years ago to Prof. Abbe, and he replied that *P. formosum* was, generally speaking, within the limit.

Mr. T. F. Smith would have thought that if they had a cross shown by *P. formosum*, and they also had one produced by *P. angulatum*, it would point to their being of the same structure.

Mr. Mayall would be glad to have the matter of fact first demonstrated by the production of photographs of the image of a cross produced by the structure of *P. angulatum*; the rationale of the phenomenon might then be a subject for useful discussion at the Society.

Mr. Crisp suggested a prize to be offered in connection with this matter. He did not say that a cross was produced, but "*what looked like a cross*"—not being an image, but an effect caused by the intersection of points.

Mr. Nelson thought Mr. Crisp was mistaken in his description of what was done by Dr. Matthews, for although he showed crosses in the case of some of the coarse diatoms, he did not produce them with *P. formosum*, but he did produce a bar which was the image of a pin. It should be remembered that at that time it was more difficult to show these things than with their present apparatus. It was always exceedingly difficult to show the image in the markings, because by the time they reached the image the markings were out of focus, but they could sometimes show a very much out-of-focus hole with some sort of image got out of it. He remembered that at a microscopical *soirée* some one showed the seconds hand of a watch in the eye of a beetle, but it was found impossible at the same time to show the hexagonal holes. He thought they would also be unable to show it in photography, because the holes would have all run together by the time the crosses were focused. Possibly the new lens of 1·6 N.A. might help them.

A note was read from Dr. van Heurck correcting an error in his recent communication to the Society relating to the structure of diatoms. An enlarged photograph of a photomicrograph of *P. angulatum* by Dr. van Heurck was also handed round for inspection.

Mr. Crisp thought that for *P. angulatum* it was a remarkable photograph.

Mr. Mayall read a translation of an article * by Prof. E. Abbe in the 'Zeitschrift für Instrumentenkunde,' of January, relating to the use of fluorite for optical purposes, in which it appeared that the special qualities of the new apochromatic objectives were due to the employment of fluorite lenses in their construction. This mineral had lower refractive and dispersive indices than any optical glass hitherto produced, and its introduction as a new element in the construction of Microscope objectives enabled the optician to reduce the spherical and chromatic aberrations much below the point previously reached in achromatic combinations of the usual construction. Following upon the publication of Prof. Abbe's note, Mr. Mayall said, the essential secret of the apochromatic formula appeared to be disclosed, and he hoped the English opticians would soon recover the ground lost through their neglect to discover the fact of the employment of fluorite in Zeiss's new lenses. The Society were of course most desirous of promoting optical improvements, and as it appeared that fluorite in crystals of the requisite size and clearness seemed hardly obtainable in Europe, it was important that other sources should be found. He trusted that those Fellows who had correspondents abroad, where there was any probability of obtaining such fluorite, would not fail to engage them to inquire as to the possibility of discovering a supply of the mineral, and would bring the matter before the Society, should their efforts prove successful. Applications were already on the way to the Brazils, Chili, and Peru, thanks to the

* To be published in the next number of the Journal.

co-operation of Mr. F. Justen, a candidate nominated for the Fellowship of the Society that evening.

Prof. Bell said he had asked the opinion of Mr. Davis (of the British Museum) upon this subject, and he told him that it was almost impossible to get it clear anywhere.

Mr. Crisp thought that if it was a fact that this crystal was used as suggested, it seemed as if something else would do as well, because, when Mr. Powell produced his lens, it was said to be nearly, if not quite, equal to those produced by Zeiss.

Mr. Powell said that their lenses were not made of it, but he felt equally sure that the first apochromatic lenses sent to England by Zeiss were not altogether made of Schott's glass as was supposed.

Mr. Mayall said the matter referred to by Mr. Crisp needed explanation. There was no doubt that when Mr. Powell brought out what he termed his "apochromatic" objective, and it was compared with the Zeiss apochromatic, the opinions of experts were balanced as to their comparative merits. The estimations were then made by the eye only —by the images seen in the Microscope. Since then, however, it had been found that the production of photomicrographs by the rival objectives was a still more searching test—a test that could not be neglected when once fairly tried. Judged, then, by the photomicrographic test, the Zeiss apochromatic objectives proved superior, although when compared by the eye only the rival lenses showed but minute differences—differences in the earliest trials that were slightly in favour of Mr. Powell's work. With reference to Mr. Powell's remarks as to the various kinds of glass employed in the apochromatic constructions by Zeiss, he (Mr. Mayall) thought Mr. Powell's criticism was probably accurate. At the same time he did not think there was any obligation on the part of Zeiss to explain what materials he employed. If Prof. Abbe chose to communicate the fact that fluorite was one of the elements so employed, that was a matter of great scientific interest, and if other opticians availed themselves of the use of the mineral the construction of Microscope objectives would doubtless make great progress.

Mr. Nelson said he saw several glasses of foreign construction very shortly after Zeiss's were introduced; they were made as copies of Zeiss's and were apochromatic, and although they were of great excellence, they did not appear to be so well corrected as Zeiss's. He had no doubt that certain German opticians had found out the secret of Zeiss's apochromatic constructions, though their workmanship was not equal to Zeiss's.

Mr. T. F. Smith said it had been known to him for some time that some mineral had been used in the construction of these lenses, which gave results not previously obtained with glass.

Mr. Mayall said it might be advisable to correct an error by Dr. Pelletan in his description of the new lens; he mentioned the price as 10,000 francs or 400*l*. It appeared that the fact was, as suggested by Mr. Crisp at the time, an extra zero had been added; the actual price was 1000 francs or 40*l*.

Mr. C. H. Gill read a paper "On some methods of preparing Diatoms so as to clearly exhibit the nature of their markings." He illustrated the subject with numerous photomicrographs.

Mr. Crisp thought the appearances shown by these photographs were so striking that it would be very useful if they could publish a selection of them in the Journal. They would there be of great value and interest to the Fellows of the Society.

Prof. Bell agreed with this suggestion, and said they would publish a plate in the June number of the Journal.

Mr. P. Braham exhibited and described a new form of oxyhydrogen lamp adapted for microscopical purposes, the lamp being so mounted as to be used in any position above or below the object. Its application to photomicrography was demonstrated in the room.

Mr. Mayall mentioned that Mr. Clarkson, who had made a special study of appliances for the use of compressed gases, had brought another of the same lamps for inspection, separate from the photographic arrangement.

The Chairman in closing the meeting thought the Society was to be congratulated upon their new rooms, in spite of their being rather cold and a little too resonant—defects which would no doubt prove to be capable of remedy.

The next Conversazione of the Society was announced for the 30th April.

The following Instruments, Objects, &c., were exhibited:—

Mr. F. Crisp:—(1) Nachet's Microscope; (2) Pellin's Microscope.

Mr. P. Braham:—(1) New Oxyhydrogen Lamp; (2) Microscope for photomicrographic work.

Mr. C. Clarkson:—Braham's New Oxyhydrogen Lamp, on stand, with universal adjustments.

Colonel O'Hara:—Entozoon.

Mr. C. Rousselet:—Rotifers.

Mr. C. H. Wright:—British Hymenolichen.

New Fellows:—The following were elected *Ordinary* Fellows:—Messrs. A. F. Bilderbeck-Gomess, F. W. Crick, M.D., J. M. Kirk, J. M. McMahan, J. More, Jun., E. M. Nelson, L. Stevens, W. H. Youdale, and Rev. Harward Turner, B.Sc.

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JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY;

CONTAINING ITS TRANSACTIONS AND PROCEEDINGS,

AND A SUMMARY OF CURRENT RESEARCHES RELATING TO

ZOOLOGY AND BOTANY

(principally Invertebrata and Cryptogamia),

MICROSCOPY, &c.

Edited by

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and Professor of Comparative Anatomy and Zoology in King's College;

WITH THE ASSISTANCE OF THE PUBLICATION COMMITTEE AND

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FELLOWS OF THE SOCIETY.

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CONTENTS.

SUMMARY OF CURRENT RESEARCHES.

ZOOLOGY.

A. VERTEBRATA:—Embryology, Histology, and General.

α. Embryology.

β. Histology.

γ. General.

B. INVERTEBRATA.

Mollusca.

β. Pteropoda.

γ. Gastropoda.

Molluscoida.

β. Bryozoa.

Arthropoda.

α. Insecta.

ε. Crustacea.

Vermes.

α. Annelida.

β. Nemathelminthes.

γ. Platyhelminthes.

B. CRYPTOGAMIA.

Cryptogamia Vascularia.

Muscineæ.

Algæ.

Fungi.

Mycetozoa.

Protophyta.

α. Schizophyceæ.

β. Schizomycetes.

MICROSCOPY.

α. Instruments, Accessories, &c.

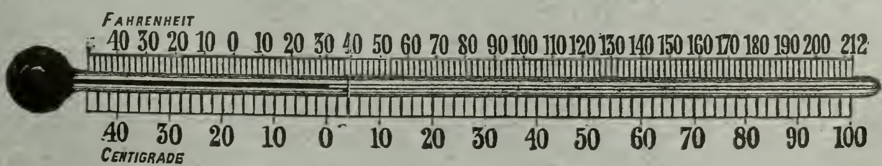
(1) Stands.

APERTURE TABLE.

Numerical Aperture. ($n \sin u = a.$)	Corresponding Angle ($2u$) for			Limit of Resolving Power, in Lines to an Inch.			Illuminating Power. (a^2.)	Penetrating Power. $\left(\frac{1}{a}\right)$
	Air ($n = 1·00$).	*Water* ($n = 1·33$).	*Homogeneous Immersion* ($n = 1·52$).	White Light. ($\lambda = 0·5269\ \mu$, Line E.)	Monochromatic (Blue) Light. ($\lambda = 0·4861\ \mu$, Line F.)	Photography. ($\lambda = 0·4000\ \mu$, near Line h.)		
1·52	..	..	180° 0′	146,543	158,845	193,037	2·310	·658
1·51	..	..	166° 51′	145,579	157,800	191,767	2·280	·662
1·50	..	..	161° 23′	144,615	156,755	190,497	2·250	·667
1·49	..	..	157° 12′	143,651	155,710	189,227	2·220	·671
1·48	..	..	153° 39′	142,687	154,665	187,957	2·190	·676
1·47	..	..	150° 32′	141,723	153,620	186,687	2·161	·680
1·46	..	..	147° 42′	140,759	152,575	185,417	2·132	·685
1·45	..	..	145° 6′	139,795	151,530	184,147	2·103	·690
1·44	..	..	142° 39′	138,830	150,485	182,877	2·074	·694
1·43	..	..	140° 22′	137,866	149,440	181,607	2·045	·699
1·42	..	..	138° 12′	136,902	148,395	180,337	2·016	·704
1·41	..	..	136° 8′	135,938	147,350	179,067	1·988	·709
1·40	..	..	134° 10′	134,974	146,305	177,797	1·960	·714
1·39	..	..	132° 16′	134,010	145,260	176,527	1·932	·719
1·38	..	..	130° 26′	133,046	144,215	175,257	1·904	·725
1·37	..	..	128° 40′	132,082	143,170	173,987	1·877	·729
1·36	..	..	126° 58′	131,118	142,125	172,717	1·850	·735
1·35	..	..	125° 18′	130,154	141,080	171,447	1·823	·741
1·34	..	..	123° 40′	129,189	140,035	170,177	1·796	·746
1·33	..	180° 0′	122° 6′	128,225	138,989	168,907	1·769	·752
1·32	..	165° 56′	120° 33′	127,261	137,944	167,637	1·742	·758
1·30	..	155° 38′	117° 35′	125,333	135,854	165,097	1·690	·769
1·28	..	148° 42′	114° 44′	123,405	133,764	162,557	1·638	·781
1·26	..	142° 39′	111° 59′	121,477	131,674	160,017	1·588	·794
1·24	..	137° 36′	109° 20′	119,548	129,584	157,477	1·538	·806
1·22	..	133° 4′	106° 45′	117,620	127,494	154,937	1·488	·820
1·20	..	128° 55′	104° 15′	115,692	125,404	152,397	1·440	·833
1·18	..	125° 3′	101° 50′	113,764	123,314	149,857	1·392	·847
1·16	..	121° 26′	99° 29′	111,835	121,224	147,317	1·346	·862
1·14	..	118° 0′	97° 11′	109,907	119,134	144,777	1·300	·877
1·12	..	114° 44′	94° 55′	107,979	117,044	142,237	1·254	·893
1·10	..	111° 36′	92° 43′	106,051	114,954	139,698	1·210	·909
1·08	..	108° 36′	90° 34′	104,123	112,864	137,158	1·166	·926
1·06	..	105° 42′	88° 27′	102,195	110,774	134,618	1·124	·943
1·04	..	102° 53′	86° 21′	100,266	108,684	132,078	1·082	·962
1·02	..	100° 10′	84° 18′	98,338	106,593	129,538	1·040	·980
1·00	180° 0′	97° 31′	82° 17′	96,410	104,503	126,998	1·000	1·000
0·98	157° 2′	94° 56′	80° 17′	94,482	102,413	124,458	·960	1·020
0·96	147° 29′	92° 24′	78° 20′	92,554	100,323	121,918	·922	1·042
0·94	140° 6′	89° 56′	76° 24′	90,625	98,233	119,378	·884	1·064
0·92	133° 51′	87° 32′	74° 30′	88,697	96,143	116,838	·846	1·087
0·90	128° 19′	85° 10′	72° 36′	86,769	94,053	114,298	·810	1·111
0·88	123° 17′	82° 51′	70° 44′	84,841	91,963	111,758	·774	1·136
0·86	118° 38′	80° 34′	68° 54′	82,913	89,873	109,218	·740	1·163
0·84	114° 17′	78° 20′	67° 6′	80,984	87,783	106,678	·706	1·190
0·82	110° 10′	76° 8′	65° 18′	79,056	85,693	104,138	·672	1·220
0·80	106° 16′	73° 58′	63° 31′	77,128	83,603	101,598	·640	1·250
0·78	102° 31′	71° 49′	61° 45′	75,200	81,513	99,058	·608	1·282
0·76	98° 56′	69° 42′	60° 0′	73,272	79,423	96,518	·578	1·316
0·74	95° 28′	67° 37′	58° 16′	71,343	77,333	93,979	·548	1·351
0·72	92° 6′	65° 32′	56° 32′	69,415	75,242	91,439	·518	1·389
0·70	88° 51′	63° 31′	54° 50′	67,487	73,152	88,899	·490	1·429
0·68	85° 41′	61° 30′	53° 9′	65,559	71,062	86,359	·462	1·471
0·66	82° 36′	59° 30′	51° 28′	63,631	68,972	83,819	·436	1·515
0·64	79° 36′	57° 31′	49° 48′	61,702	66,882	81,279	·410	1·562
0·62	76° 38′	55° 34′	48° 9′	59,774	64,792	78,739	·384	1·613
0·60	73° 44′	53° 38′	46° 30′	57,846	62,702	76,199	·360	1·667
0·58	70° 54′	51° 42′	44° 51′	55,918	60,612	73,659	·336	1·724
0·56	68° 6′	49° 48′	43° 14′	53,990	58,522	71,119	·314	1·786
0·54	65° 22′	47° 54′	41° 37′	52,061	56,432	68,579	·292	1·852
0·52	62° 40′	46° 2′	40° 0′	50,133	54,342	66,039	·270	1·923
0·50	60° 0′	44° 10′	38° 24′	48,205	52,252	63,499	·250	2·000
0·45	53° 30′	39° 33′	34° 27′	43,385	47,026	57,149	·203	2·222
0·40	47° 9′	35° 0′	30° 31′	38,564	41,801	50,799	·160	2·500
0·35	40° 58′	30° 30′	26° 38′	33,744	36,576	44,449	·123	2·857
0·30	34° 56′	26° 4′	22° 46′	28,923	31,351	38,099	·090	3·333
0·25	28° 58′	21° 40′	18° 56′	24,103	26,126	31,749	·063	4·000
0·20	23° 4′	17° 18′	15° 7′	19,282	20,901	25,400	·040	5·000
0·15	17° 14′	12° 58′	11° 19′	14,462	15,676	19,050	·023	6·667
0·10	11° 29′	8° 38′	7° 34′	9,641	10,450	12,700	·010	10·000
0·05	5° 44′	4° 18′	3° 46′	4,821	5,225	6,350	·003	20·000

COMPARISON OF THE FAHRENHEIT AND CENTIGRADE THERMOMETERS.

Fahr.	Centigr.	Fahr.	Centigr.	Fahr.	Centigr.	Fahr.	Centigr.	Fahr.	Centigr.
°	°	°	°	°	°	°	°	°	°
212	100	158	70	104	40	50	10	- 4	- 20
210·2	99	156·2	69	102·2	39	48·2	9	- 5·8	- 21
210	98·89	156	68·89	102	38·89	48	8·89	- 6	- 21·11
208·4	98	154·4	68	100·4	38	46·4	8	- 7·6	- 22
208	97·78	154	67·78	100	37·78	46	7·78	- 8	- 22·22
206·6	97	152·6	67	98·6	37	44·6	7	- 9·4	- 23
206	96·67	152	66·67	98	36·67	44	6·67	- 10	- 23·33
204·8	96	150·8	66	96·8	36	42·8	6	- 11·2	- 24
204	95·56	150	65·56	96	35·56	42	5·56	- 12	- 24·44
203	95	149	65	95	35	41	5	- 13	- 25
202	94·44	148	64·44	94	34·44	40	4·44	- 14	- 25·56
201·2	94	147·2	64	93·2	34	39·2	4	- 14·8	- 26
200	93·33	146	63·33	92	33·33	38	3·33	- 16	- 26·67
199·4	93	145·4	63	91·4	33	37·4	3	- 16·6	- 27
198	92·22	144	62·22	90	32·22	36	2·22	- 18	- 27·78
197·6	92	143·6	62	89·6	32	35·6	2	- 18·4	- 28
196	91·11	142	61·11	88	31·11	34	1·11	- 20	- 28·89
195·8	91	141·8	61	87·8	31	33·8	1	- 20·2	- 29
194	90	140	60	86	30	32	0	- 22	- 30
192·2	89	138·2	59	84·2	29	30·2	- 1	- 23·8	- 31
192	88·89	138	58·89	84	28·89	30	- 1·11	- 24	- 31·11
190·4	88	136·4	58	82·4	28	28·4	- 2	- 25·6	- 32
190	87·78	136	57·78	82	27·78	28	- 2·22	- 26	- 32·22
188·6	87	134·6	57	80·6	27	26·6	- 3	- 27·4	- 33
188	86·67	134	56·67	80	26·67	26	- 3·33	- 28	- 33·33
186·8	86	132·8	56	78·8	26	24·8	- 4	- 29·2	- 34
186	85·56	132	55·56	78	25·56	24	- 4·44	- 30	- 34·44
185	85	131	55	77	25	23	- 5	- 31	- 35
184	84·44	130	54·44	76	24·44	22	- 5·56	- 32	- 35·56
183·2	84	129·2	54	75·2	24	21·2	- 6	- 32·8	- 36
182	83·33	128	53·33	74	23·33	20	- 6·67	- 34	- 36·67
181·4	83	127·4	53	73·4	23	19·4	- 7	- 34·6	- 37
180	82·22	126	52·22	72	22·22	18	- 7·78	- 36	- 37·78
179·6	82	125·6	52	71·6	22	17·6	- 8	- 36·4	- 38
178	81·11	124	51·11	70	21·11	16	- 8·89	- 38	- 38·89
177·8	81	123·8	51	69·8	21	15·8	- 9	- 38·2	- 39
176	80	122	50	68·2	20	14	- 10	- 40	- 40
174·2	79	120·2	49	66	19	12·2	- 11	- 41·80	- 41
174	78·89	120	48·89	66·4	18·89	12	- 11·11	- 42	- 41·11
172·4	78	118·4	48	64	18	10·4	- 12	- 43·60	- 42
172	77·78	118	47·78	64·6	17·78	10	- 12·22	- 44	- 42·22
170·6	77	116·6	47	62	17	8·6	- 13	- 45·40	- 43
170	76·67	116	46·67	62·8	16·67	8	- 13·33	- 46	- 43·33
168·8	76	114·8	46	60	16	6·8	- 14	- 47·20	- 44
168	75·56	114	45·56	60	15·56	6	- 14·44	- 48	- 44·44
167	75	113	45	59	15	5	- 15	- 49	- 45
166	74·44	112	44·44	58	14·44	4	- 15·56	- 50	- 45·56
165·2	74	111·2	44	57·2	14	3·2	- 16	- 50·80	- 46
164	73·33	110	43·33	56	13·33	2	- 16·67	- 52	- 46·67
163·4	73	109·4	43	55·4	13	1·4	- 17	- 52·60	- 47
162	72·22	108	42·22	54	12·22	0	- 17·78	- 54	- 47·78
161·6	72	107·6	42	53·6	12	- 0·4	- 18	- 54·40	- 48
160	71·11	106	41·11	52	11·11	- 2	- 18·89	- 56	- 48·89
159·8	71	105·8	41	51·8	11	- 2·2	- 19	- 56·20	- 49
								- 58	- 50



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JOURNAL

OF THE

ROYAL MICROSCOPICAL SOCIETY.

JUNE 1890.

TRANSACTIONS OF THE SOCIETY.

V.—*Contribution to the Freshwater Algæ of North Wales.*

By Wm. West, F.L.S., Lecturer on Botany and Materia Medica at the Bradford Technical College.

(*Read* 16*th April*, 1890.)

Plates V. and VI.

In 1881, an excellent list of species of Desmids found at Capel Curig was published in the 'Midland Naturalist' by Mr. A. W. Wills. Since then my esteemed and enthusiastic friend Mr. J. H. Lewis, F.L.S., of Liverpool, has most kindly sent me many good and repeated gatherings which he has made at the same place, as well as at Festiniog, Dolgelly, Llyn Padarn, Dolbadarn Castle, Llandudno, Moel Fammau, and on Snowdon. I have also to thank my son, G. S. West,

---

EXPLANATION OF PLATES V. AND VI.

(Explicatio iconum.)

a = front view (a fronte visa).
b = vertical view (a vertice visa).
c = side view (a latere visa).

All the figures are drawn from nature to a uniform scale of 400 diameters (icones omnes 400/1).

Plate V.

Fig. 1.—*Gonatozygon minutum* nov. sp.
„ 2.—*Desmidium coarctatum* Nord. var. *cambricum* nov. var.
„ 3.—*Staurastrum margaritaceum* Meneg. var. *coronulatum* nov. var.
„ 4.— „ *bacillare* Bréb. β *obesum* Lund.
„ 5.— „ *cumbricum* nov. sp.
„ 6.— „ „ „ var. *cambricum* nov. var.
„ 7.— „ *osteonum* „
„ 8.— „ *coarctatum* Bréb. var. *subcurtum* Nord.
„ 9.— „ *iotanum* Wolle.
„ 10.—*Arthrodesmus tenuissimus* Arch.
„ 11.—*Staurastrum furcatum* Ehrb. var.
„ 12.— „ *anatinum* Cooke & Wills.
„ 13.—*Micrasterias Americana* (Ehrb.) Ralfs var. *Lewisiana* nov. var.
„ 14.—*Staurastrum muricatum* Bréb. var. *acutum* nov. var.
„ 15.— „ *Ophiura* Lund. forma *nonaradiata*.
„ 16.— „ *cyrtocerum* Bréb. forma *tetragona*.

for the large and most varied gatherings which he made his chief object during two summer holidays spent in this rich district; it is in fact entirely owing to his gatherings that I have been induced to write this paper, and as he has also rendered me the most valuable help during the preparation of this article, I tender him my hearty thanks. His gatherings were made at many places, the following being the chief:—Snowdon, Llyn Idwal, Llandudno, Llyn Ogwen, Bethesda, Bettws-y-coed, Llanfairfechan, Penmaenmawr, Twll Du, Aber, and the following places in Anglesea:—Llyn Coron, Bodorgan, Newborough Rabbit Warren, Maltraeth Yard, and Holyhead. Of course he could not resist also making a large series of gatherings at that happy hunting ground first investigated by Mr. Wills, namely Capel Curig, which is certainly about the richest locality ever found in Britain.

The species mentioned for Twll Du were collected at an elevation of 2000 feet.

The gelatinous investment noticed in many species was especially conspicuous in *Cosmarium Scenedesmus* Delp., *Staurastrum Sebaldi* Reinsch, and *S. longispinum* Bail., the investment round the latter being relatively larger than, and quite as conspicuous, as that of *S. tumidum* Bréb.

The gathering at Llyn Coron proved to be the richest in diatoms; it was chiefly from washings of *Elatine Hydropiper* and *E. hexandra*. Some rare species were obtained from washings of *Dicranum fulvellum* (Dicks.) Sm. and *Nardia emarginata* Ehrb., which were collected at over 2000 feet on Snowdon.

Fig. 17.—*Docidium elongatum* nov. sp.
„ 18.—*Cosmarium orbiculatum* Ralfs.
„ 19.— „ *isthmium* nob.
„ 20.—*Staurastrum spiniferum* nov. sp.
„ 21.—*Xanthidium cristatum* Bréb. var. *spinuliferum* nov. var.
„ 22.—*Staurastrum controversum* Bréb. var.
„ 23.—*Closterium striolatum* Ehrb. forma *recta*.

PLATE VI.

Fig. 24.—*Penium spirostriolatum* Bark.
„ 25.—*Cosmarium tetraophthalmum* (Ktz.) Bréb. var. *subrotundum* nov. var.
„ 26.—*Euastrum verrucosum* Ehrb. var.
„ 27.—*Staurastrum denticulatum* (Näg.) Arch.
„ 28.— „ *dubium* nov. sp.
„ 29.—*Docidium* sp.
„ 30.—*Cosmarium cœlatum* Ralfs. var. *hexagonum* nov. var.
„ 31.— „ *controversum* nov. sp.
„ 32.—*Staurastrum margaritaceum* Meneg. var.
„ 33.—*Euastrum crassum* Ktz. var.
„ 34.—*Micrasterias Jenneri* Ralfs. var. *simplex* nov. var.
„ 35.—*Staurastrum proboscideum* Bréb. var. *subglabrum* nov. var.
„ 36.— „ *cumbricum* nov. sp.
„ 37.— „ „ „ var. *cambricum* nov. var. forma *minor*.
„ 38.—*Xanthidium Brebissonii* Ralfs, forma.
„ 39.— „ *aculeatum* Ehrb., forma.
„ 40.—*Arthrodesmus octocornis* Ehrb., var.

As I do not want to make a repetition of lists, I enumerate none of the species that were recorded in the list of Mr. Wills, except where they are from new localities. I have seen, from other localities, all comprised in his list, except the fourteen species and one variety which follow:—

Desmidium cylindricum Grev. (*Didymoprium Grevillei* Ktz.), *Micrasterias oscitans* (Hass.) Ralfs, *M. pinnatifida* (Ktz.) Ralfs, *M. angulosa* Hantsch, *Euastrum binale* Ralfs var. *angustatum* Wittr., *Cosmarium Nymannianum* Grun., *C. variolatum* Lund., *C. Holmiense* Lund. var. *læve* N. & W., *C. cambricum* Cke. & Wills, *C. coronatum* Cke. & Wills, *Closterium attenuatum* Ehrb., *Penium Nägelii* Bréb., *Staurastrum læve* Ralfs, *S. cristatum* Näg., *S. grande* Buln.

Dr. Cooke also records the following for "North Wales" or "Wales" in his British Desmids:—*Desmidium quadrangulatum* Ralfs ("Wales"), *Closterium Pritchardianum* Arch. ("Wales"), *Micrasterias Crux-melitensis* (Ehrb.) Meneg. ("Wales"), *Euastrum rostratum* Ralfs ("Wales"), *Cosmocladium saxonicum* De Bary, *Cosmarium pseudonitidulum* Nord. var. *obsoletum*, *C. læve* Rabh. var. *septentrionale* Wille, *C. Turpini* Bréb. and var. *cambricum* Josh., *Calocylindrus attenuatus* (Bréb.) ("Wales"), *C. turgidus* (Bréb.) Kirch. ("Wales"), *Staurastrum furcatum* (Ehrb.) Pritch. var. *candianum* Delp., *S. subcruciatum* Cke. & Wills.

I also saw the following species from Capel Curig, which are not new records, but are here enumerated to make this list as complete as I am able:—*Sphærozosma vertebratum* Ralfs, *Docidium nodosum* Bail., *Spirotænia obscura* Ralfs, *Micrasterias fimbriata* Ralfs, *M. radiosa* Ag., *Euastrum gemmatum* Bréb., *Calocylindrus connatus* Kirch., *Staurastrum megacanthum* Lund., *S. aristiferum* Ralfs, *S. Sebaldi* Reinsch, *S. vestitum* Ralfs, *S. longispinum* Bail., *S. brasiliensis* Lund., *S. Ophiura* Lund., *S. Cerastes* Lund., *S. Artiscon* (Ehrb.) Lund., *S. furcigerum* Bréb., *S. arachne* Ralfs, *S. tetracerum* Ralfs, *Dimorphococcus lunatus* Braun, *Cœlastrum cambricum* Arch., *Characium Sieboldi* Braun.

I therefore believe that the following list, together with the species just enumerated, will form a tolerably complete list of those species of Freshwater Algæ hitherto observed for North Wales.

The classification here adopted is a modification of the one in Bennett and Murray's 'Cryptogamic Botany'; it has been selected after much consideration, and practically differs but little from their arrangement; it is also not very far removed from that of Goebel. Satisfactory linear arrangement seems impossible.

The many examples of *Micrasterias furcata* Ag. which were seen agreed well with the figures given by Ralfs, but none were seen which tallied with those in Cooke's 'British Desmids.' An example was observed which had been dividing, and which had the new half approaching very closely to *M. Crux-melitensis* (Ehrb.) Meneg.

A variety of *Euastrum verrucosum* Ehrb. with a more gaping sinus than usual, and a sub-rectangular polar lobe, is figured, fig. 26.

As the figures of *Staurastrum anatinum* Cooke & Wills, as published by Cooke differ so greatly, I thought it best to give a figure of the form which was abundantly seen from Capel Curig; Cooke's figure in 'Grevillea' is nearer the form herein figured than the one in his 'British Desmids,' fig. 12. The extremities of the processes often appear as in fig. 12 *d*, caused by the spines being placed somewhat vertically over each other.

A figure of a *Docidium* is given which I have not been able to identify satisfactorily. Fig. 29.

Those species and varieties prefixed by an asterisk are hitherto unrecorded for Britain.

Since this was in manuscript, two of the species which would have been new records for Britain, have been published as occurring in Northern Scotland, by Mr. Roy ('Scottish Naturalist,' Jan. 1890). These interesting species are *Cosmarium subcrenatum* Hantsch, and *C. contractum* Kirch.

The following contractions are used for the chief localities:—A. for Llyn Coron, Anglesea; Do. for Dolbadarn Castle; B. for Bethesda; F. for Festiniog; C. for Capel Curig; P. for Llyn Padarn; D. for Dolgelly; S. for Snowdon.

ALGÆ.

Class Florideæ.

Order Helminthocladieæ.

Genus *Batrachospermum* Roth.

B. moniliforme Roth. A., C.
B. vagum (Roth.) Ag. B.

Class Convervoideæ Heterogamæ.

Order Œdogoniaceæ.

Genus *Œdogonium* Link.

Œ. cryptoporum Wittr. F.
Œ. pluviale Nord. C.
Œ. tenellum Ktz. C.

Several other species of this genus were seen, but not in proper condition for satisfactory identification.

Genus *Bulbochæte* Ag.

B. setigera Ag. C., A., Llyn Idwal.
B. rectangularis Wittr. C.

Class Confervoideæ Isogamæ.

Order Confervaceæ.

Genus *Conferva* (Linn.) Link.

C. fontinalis Berk. Llandudno.
C. tenerrima Ktz. A., Do., F., Llyn Idwal.
C. bombycina Ag. Llyn Idwal.

Genus *Microspora* Thur.

M. fugacissima Thur. A., C., Do.
M. vulgaris Rabh. S., Do.
M. floccosa Thur. F., Aber.

Genus *Cladophora* Ktz.

C. glomerata (Linn.) Ktz. Llanfairfechan.

Genus *Chætophora* Schrank.

C. elegans (Roth.) Ag. B.

Order Ulvaceæ.

Genus *Enteromorpha* Link.

E. intestinalis (Linn.) Link. Maltraeth Yard.

Order Ulotrichaceæ.

Genus *Ulothrix* Ktz.

U. tenerrima Ktz. C., B.
U. radicans Ktz. C., Bettws-y-coed, Conway Castle.

Genus *Hormiscia* Aresch.

H. moniliformis (Ktz.) Rabh. A.
H. zonata (Web. & M.) Aresch. A., C.
H. æqualis (Ktz.) Rabh. var. *catenæformis* Ktz. C.
H. bicolor (Eng. Bot.). Llanfairfechan.

Order Chroolepideæ.

Genus *Microthamnion* Näg.

M. vexator Cooke. C., Holyhead.

Class Conjugatæ.

Order Mesocarpaceæ.

Genus *Mesocarpus* Hass.

M. depressus Hass. Do.
M. parvulus (Hass.) De Bary. C., P., S.
var. *angustus* Hass. C., A.
M. scalaris (Hass.) De Bary. S.
M. pleurocarpus De Bary. A.

Genus *Staurospermum* Ktz.

S. viride Ktz. P.

Order Zygnemaceæ.

Genus *Spirogyra* Link.

S. crassa Ktz. B.
S. nitida (Dillw.) Link. A.
S. longata Vauch. B., P., Aber.
S. flavescens Cleve. Do., P., C.
S. Weberi Ktz. C.
S. tenuissima Hass. C.

Genus *Zygnema* Ktz.

Z. cruciatum (Vauch.). B., C.
Z. stellinum (Vauch.) Ktz. C., A.
Z. Vaucherii Ag. B., Llyn Idwal.
Var. *subtile* Rabh. Llyn Idwal.
Z. anomalum (Hass.). S., B., Bettws-y-coed.

Genus *Zygogonium* Ktz.

Z. ericetorum De Bary var. *terrestre* (*Z. ericetorum* Ktz). Frequent.

Var. *aquaticum* (*Z. Agardhii* Rabh.). Frequent.

Order Desmidiaceæ.

Genus *Gonatozygon* De Bary.

**G. pilosum* Wolle. C.

This was only 11 μ in diameter, Wolle's were 15 μ.

G. Ralfsii De Bary. P.
G. Brebissonii De Bary. Do., B., P.
G. minutum nov. sp. Fig. 1.

G. cellulis subcylindricis, apicem versus angustatis, utroque polo constrictis, vicies longius quam latum, cytodermate dense subgranulato.

Lat. medio, 3·7 μ; infra apices, 2·5 μ.

About twenty times as long as broad, slightly swollen towards the middle and constricted under the apices, cytoderm densely but slightly granulate. C.

I have also collected this species at Brothers Water, in Westmoreland, and at Riccall, in the East Riding of Yorkshire.

Genus *Sphærozosma* Corda.

S. excavatum Ralfs. S., P., Do.
S. pygmæum Cooke. C., Do.

**S. depressum* (Bréb.). (*Spondylosium depressum* Bréb.). C., Do.

Lat. 10 μ.

S. pulchellum (Arch.). (*Spondylosium pulchellum* Arch.). S.

Genus *Onychonema* Wallich.

O. Nordstedtiana Turn. C.

Genus *Hyalotheca* Ehrb.

H. dissiliens (Sm.) Bréb. Common.

This was seen with zygospores from Capel Curig.

Var. *minor* Delp. C.

H. mucosa Mert. P., Do.

**H. undulata* Nord. C.

Lat. 7·5–9 μ; long. 13·5–16 μ.

Genus *Gymnozyga* Ehrb.

G. moniliformis Ehrb. (*Bambusina Brebissonii* Ktz.). A., S., Do., F., D.

Genus *Desmidium* Ag.

**D. coarctatum* Nord. var. CAMBRICUM nov. var. Fig. 2.

Var. cellulis brevioribus et apicibus latioribus.

Long. 22·5–27 μ; lat. 42–45 μ; lat. isthmi 35–37·5 μ; lat. apic. 17·5–20 μ; crass. 35 μ.

This chiefly differs from the type in the cells being shorter and having broader apices. C.

This variety is somewhat doubtfully placed under this species, which it seems to connect with *Desmidium cylindricum* Grev., the shape of the cells in front view being nearer the latter, but the breadth of the apices bringing it nearer the former. The side view shows the apices to be only about half the thickness of the cells, corresponding in this respect with *D. coarctatum* Nord. (in 'Freshwater Algæ of New Zealand and Australia,' p. 25, plate ii. fig. 3), with which it also agrees in having the constriction reduced to a mere retuseness in the side view. It differs from *D. quadratum* Nord. in the form of the cells in side view, as well as in the relative breadth of the apices in the same view, and it is well distant from *D. graciliceps* (Nord.) Lagerh. and *D. majus* Lagerh. in the different shape of its cells. *D. laticeps* Nord. has the same length of cells, but their breadth and thickness is almost twice as great, and the apical breadth is three and a half times as great.

D. Swartzii Ralfs. A., D.

D. aptogonium Bréb. Do., A., S., P.

Genus *Docidium* Bréb.

D. coronatum Bréb. C.

Long. 430 μ; lat. 38–40 μ.

D. Ehrenbergii Ralfs. P., Do., Penmaenmawr.

Some peculiar and large forms of this species were noticed which were somewhat inflated towards the base of the semicells.

Long. 448 μ; lat. medio 32·5 μ.

var. *granulatum* Ralfs. C.

var. ELONGATUM nov. var.

25plo longius quam latum.

Long. 575 μ; lat. medio semicellularum 22·5 μ.

This variety has the frond about twenty-five times longer than broad. C.

D. clavatum Ktz. Do., A., B.

D. nodulosum Bréb. Do.

D. truncatum Bréb. P.

D. baculum Bréb. A., Do.

D. minutum Ralfs. Do.

*var. *gracile* (Wille). (*Penium minutum* Cleve β *gracile* Wille).

Long. 182 μ; lat. 9–10 μ. C.

D. ELONGATUM nov. sp. Fig. 17.

D. quadragies longius quam latum, ad utrumque polum sensim attenuatum, apicibus truncatis, medio non inflato.

Long. 330 μ; lat. medio 8·5–9 μ; ad apicem 6 μ.

Frond about forty times as long as broad, the straight sides gradually tapering from the uninflated base of each semicell to the truncate apex. C.

Genus *Closterium* Nitzsch.

C. didymotocum Corda. P., Do.

Lat. 28–42 μ.

C. obtusum Bréb. C.

Lat. 12·5 μ.

C. lunula Ehrb. D., Do.

C. acerosum (Schrank.) Ehrb. Do., A., D., B.

C. lanceolatum Ktz. C., Do.

C. turgidum Ehrb. A., D., S.

C. prælongum Bréb. C.

C. macilentum Bréb. C.

Lat. 11 μ.

C. gracile Bréb. D., Do.

C. Ehrenbergii Meneg. Moel Fammau.

C. moniliferum Ehrb. F., B., S.

C. Jenneri Ralfs. P., Do., F.

C. Leibleinii Ktz. P., A., B.

C. Dianæ Ehrb. Frequent.

C. Venus Ktz. D., P., Do., A., C.
C. cynthia Not. P.
Lat. 13 μ.
C. Archerianum Cleve. C., P.

Specimens of this were observed from Llyn Padarn up to 25 μ in diameter.

C. costatum Corda. D., Do., P.
C. decorum Bréb. C.
C. striolatum Ehrb. D., P., Do., A., B.
forma *recta*, fig. 23.
Non curvata, rectissima.
Lat. 33 μ.

This differs from the type in having no curvature; several examples were seen, and were turned over and over. P.

C. intermedium Ralfs. P., Do.
C. angustatum Ktz. D., F.
C. juncidum Ralfs. P., Do., D.
C. lineatum Ehrb. D., S.
C. rostratum Ehrb. Do., P., A.
C. setaceum Ehrb. P., Do.
C. Kützingii Bréb. A., P.
C. Cornu Ehrb. Do.
*forma *major* Wille. C.
C. acutum Bréb. Do., S. D.
C. subulatum (Ktz.). C.

Genus *Penium* Bréb.

P. margaritaceum Bréb. P., B., Do., A., Llyn Idwal.
Lat. 11–25 μ.
var. *punctatum* Ralfs. P.
P. cylindrus Bréb. P., Do., F. B.
P. spirostriolatum Bark. C., P., F. Fig. 24.

As this species appears to vary in different localities, some figures are given.

I also give the dimensions of some of the figures that were drawn.

I have noticed this variability from Maine, N. Ireland, Scandale in the Lake District, and Glen Shee and Craig an Lochan in Scotland. The *parallel* striæ can often be seen on both the upper and under surfaces of the empty cylindrical frond, and then they appear as if they crossed each other.

22·5 × 188 μ from Festiniog.
23·5 × 182 μ from Llyn Padarn.
19 × 202 μ from Capel Curig.
20 × 227 μ from „ „
22·5 × 130 μ from Festiniog.
25·5 × 128 μ from Capel Curig.

P. digitus Bréb. S., D., P., Do., B., F.
P. interruptum Bréb. Do.
P. closterioides Ralfs. A., Do.

This species sometimes has one or two bands, which show as distinct papillæ on the margin of the central part of the cell.

A small form was also seen; long. 98 μ, lat. 22 μ.

P. navicula Bréb. Do., F.
P. Brebissonii Ralfs. Common.
P. oblongum De Bary. S.
P. truncatum Bréb. F., B., Twll Du.
P. Mooreanum Arch. B.
P. minutissimum Nord. C., F.
P. cucurbitinum Bisset. S.

Genus *Cylindrocystis* Meneg.

C. diplospora Lund. F., C., B., Llyn Idwal.
C. crassa De Bary. C., B., F., D.

Genus *Tetmemorus* Ralfs.

T. Brebissonii Ralfs. Common.
var. β *turgidus* Ralfs. S.
var. γ (De Bary) Arch. Twll Du.
T. granulatus Ralfs. Common.
T. lævis Ralfs. S., Do., D., F., Twll Du.

Genus *Spirotænia* Bréb.

S. condensata Bréb. F., P., Do., D.
S. truncata Arch. C.
Long. 50 μ; lat. 12·5 μ.

Genus *Micrasterias* Ag.

M. mucronata (Dixon) Rabh. D., S.
M. americana (Ehrb.) Ralfs. S.
var. *recta* Wolle. Do.
var. LEWISIANA nov. var. Fig. 13.
Var. lobis polaribus subintegris et latioribus, incisuris angustioribus infra lobos polares.

This has the end lobes subentire and wider, the infra-apical incisions are narrower also than in the var. *recta* Wolle, which it approaches. P.

This is a very distinct variety, and very distant from "forma *major* Reinsch," with which it is worth comparing, as this latter seems to be at the other extreme.

M. denticulata Bréb. D., S., P., Do., B.
M. rotata (Grev.) Ralfs. P., Do.

M. papillifera Bréb. P., Do.

A form of this was often seen from Llyn Padarn with cells always longer than broad.

M. truncata Corda. P., A., Do., S.

A form of this species was seen from Llyn Padarn, which might be termed glanduliferous, as each tip of the divisions bears an apparent gland. Another peculiar variety of this species was seen with a gaping sinus and narrower isthmus.

M. crenata Bréb. Do., B.
M. Jenneri Ralfs. D.
var. SIMPLEX nov. var. Fig. 34.
Var. lobis quinque semicellulæ leviter concavis et incisuris brevioribus.

This chiefly differs from the type by having each of the five lobes of the semicell but slightly concave, and the incision not so deep. D.

Genus *Euastrum* Ehrb.

**E. verrucosum* Ehrb. var. *simplex* Josh. A.
Long. 65 μ; lat. 60 μ; lat. apic. 27–30 μ.
E. oblongum Grev. Do., S., D., B., P.
E. crassum Ktz. D.

A form of this was frequent, which had a marked protuberance about half-way up the side of the front view of each semicell. Fig. 33.

E. pinnatum Ralfs. C.
E. humerosum Ralfs. P.
E. ventricosum Lund. D.

This rare species was in great abundance in a gathering made by J. H. Lewis at Dolgelly.

Long. 80–95 μ; lat. 52–60 μ; crass. 27–29 μ.
E. affine Ralfs. C., B., Do., P.
E. ampullaceum Ralfs. P.
E. insigne Hass. D., S.
E. didelta Ralfs. S., P., Do., A., B., D.
E. cuneatum Jenner. A., S., F., Llyn Idwal.
E. ansatum (Ehrb.) Ralfs. S., P., B., D., Do., F.
E. sinuosum Lenor. S., C.
E. pectinatum Bréb. P., A., D., B.
E. elegans Bréb. Do., S., P., A., F.
var. *bidentata* Näg. C., P., B.
**E. pseudelegans* Turn. C.

This had the five central markings confluent; it also had the second from each end of the four marginal markings somewhat indistinct.

E. crassicolle Lund. C., D., P.
Long. 28 μ; lat. 15 μ.
E. binale Ralfs. F., A., Do., B, P., Llyn Idwal.
var. *elobatum* Lund. C., S., F., D., B.
forma *minor* W. West. F., C.
Long. 10 μ; lat. 7·5 μ.
E. denticulatum (Kirch.) Gay. C., P.
E. venustum Bréb. C.

Genus *Cosmarium* Corda.

C. sublobatum (Bréb.) Arch. Bettws-y-coed, Twll Du.
C. quadratum Ralfs. S.

Specimens of this were seen 42 μ by 62 μ.

C. plicatum Reinsch. S.
var. *sinuosum* Lund. C.
C. Hammeri Reinsch. D.
C. homalodermum Nord. S.
C. anceps Lund. F.
C. granatum Bréb. P., B.
C. cucumis Corda. B, S., Llyn Idwal.
C. circulare Reinsch. S.
Long. et lat. 58 μ.
C. Ralfsii Bréb. S., A., D., Do., F.
C. pyramidatum Bréb. F., B., A., Do.
C. pseudopyramidatum Lund. B., A.
C. galeritum Nord. A.
C. pseudonitidulum Nord. Bettws-y-coed.
C. nitidulum Not. B.
C. subtumidum Nord. B.
Long. 31 μ; lat. 27·5 μ; crass. 16 μ.
**C. tumidum* Lund. C.
Long. 30–33 μ; lat. 27–29 μ.
C. Phaseolus Bréb. Llyn Ogwen.
**C. Scenedesmus* Delp. C.
C. gotlandicum Wittr. C.
C. bioculatum Bréb. B., P., S., D., F., A.
C. tinctum Ralfs. B., F., P., A.

A form of this was seen with the vertical view having the middle somewhat tumid, like that of *C. tinctum* Ralfs β *intermedium* Nord., as described and figured in his 'Freshwater Algæ of New Zealand and Australia,' published in Stockholm, 1888.

C. pygmæum Arch. C.
C. truncatellum Perty. B.

C. exiguum Arch. C.
C. Meneghinii Bréb. D., B., P., S., Do.
var. *angulosum* (Bréb.) Rabh. (*Cosmarium angulosum* Bréb.). A.
*var. *simplicissimum* Wille. A.
C. striatum Boldt. A.

This rare species has been previously noticed in Scotland.

C. Regnesii Reinsch. C.
C. crenatum Ralfs. Do., B.
C. undulatum Corda. B., A.
C. tetragonum Näg. Bettws-y-coed.
var. *Lundellii* Cooke. C.
C. tetraophthalmum (Ktz.) Bréb. P., B., Do.

The form of this figured by Cooke has fewer granules than that given by Ralfs; the Welsh forms noticed were nearer the figures of the latter, but the forms I see more often have generally a few more—though rather smaller—granules than the figure of Ralfs, and the semicells are somewhat *subpyramidal* and *shortly subtruncate*, hardly "semiorbicular."

var. SUBROTUNDUM nov. var. Fig. 25. Newborough Warren.

Var. sinu apertissimo semicellulis subrotundis facto.
Long. 137 μ; lat. 79 μ; isth. 20 $\mu \times 35$ μ.

This differs from the type in the open sinus caused by the subrotund semicells.

C. Brebissonii Meneg. B., D., P., Do., Newborough Warren.
C. conspersum Ralfs. B., D., A.
C. quadrum Lund. C.
C. quaternarium Wittr. & Nord. P.
C. margaritiferum (Turp.) Meneg. B., P., S., A., Llandudno.
C. Portianum Arch. C., P., A., Do.
C. reniforme (Ralfs) Arch. C.
C. Logiense Biss. B., Bettws-y-coed.
C. punctulatum Bréb. C., B., S., P., Twll Du.
var. *rotundatum* Klebs. S.
Long. 35 μ; lat. 28 μ.
C. Blyttii Wille. C., P.
C. orthostichum Lund. C.
C. botrytis Meneg. Common.
C. præmorsum Bréb. Do., A.
C. biretum Bréb. D.
Long. 75 μ; lat. ad apices 61 μ; lat. isth. 17·5 μ.
C. CONTROVERSUM nov. sp. Fig. 31.
C. medium, granulatum, dimidiam partem circa longius

quam latum, sinu anguste lineari, semicellulis truncato-pyramidatis, granulis concentrice ordinatis, a vertice subtruncato-ellipticis elevatione centrali lata, a latere obtuso-ovatis.

Long 88 μ; lat. 60 μ; lat. isthmi 23 μ.

Frond granulate, about one-half longer than broad, sinus deep and linear, semicells truncately pyramidal, end view elliptic with a broad elevation at each side, side view obtusely ovate, granules arranged somewhat concentrically. C.

This approaches *C. ochthodes* Nord. in form; it also has some resemblance to large forms of *C. botrytis* Meneg., but the end and side views at once distinguish it from these species. It was very sparingly seen.

C. Broomei Thw. S., C., B. Do.
C. ochthodes Nord. C., S., P. B., Do., Bettws-y-coed.
**C. confusum* Cooke *β regularius* Nord. C.
C. amœnum Bréb. C.
C. Bœckii Wille. C.
C. sphalerostichum Nord. & Wittr. B., C., P.
C. subcrenatum Hantzsch. S.
C. cœlatum Ralfs. B., S., Do., P., Twll Du.
var. HEXAGONUM nov. var. Fig. 30.
Var. cellulis hexagonis, apicibus truncatis tetracrenatis, granulis centralibus in seriebus linearibus ordinatis.
Long. 43 μ; lat. 36 μ; lat. isth. 10 μ.

This differs from the semiorbicular type in having a distinctly hexagonal form, bearing four of the crenatures of each semicell at the truncate ends; the central granules are also arranged in linear series not concentric. C.

C. ornatum Ralfs. B., A.
C. cristatum Ralfs. C.
C. quinarium Lund. C.
C. isthmochondrum Nord. C.
C. quadrifarium Lund. C.
forma *hexasticha* (Lund.) Nord. C.
C. hexalobum Nord. B.
C. cyclicum Lund. S.
C. speciosum Lund. C., Bettws-y-coed.
C. subspeciosum Nord. C.
C. orbiculatum Ralfs. P., Bettws-y-coed. Fig. 18.
**C. isthmium* nob. Fig. 19.
Lat. 25–26 μ.

This is the same as *C. excavatum* Nord. var. *duplo-major* Lund., as described and figured by Wolle (Desm. U.S.A., p. 77, pl. liii. figs. 14 and 15). As I do not believe this species to be a variety of

C. excavatum Nord. (Desm. Brasil., tab. iii. fig. 25), I propose the present suggestive name. A figure of the preceding species is given for comparison with this one. C.

C. moniliforme Turp. S.
C. contractum Kirch. C.
C. globosum Buln. A., S.

Genus *Calocylindrus* De Bary.

C. cylindricus Ralfs. P.
C. pseudoconnatus Nord. B.
C. cucurbita Bréb. Frequent.
C. palangula Bréb. C.
C. Thwaitesii Ralfs. D.
C. curtus Bréb. C., B., F.
C. De Baryi Arch. C.
C. strangulatus Cooke & Wills. C.

Genus *Xanthidium* Ehrb.

X. armatum Bréb. P., D., A., S.
X. aculeatum Ehrb. Do., P., S.
Long. 74 μ; lat. 62–75 μ; from Snowdon.
Long. 64 μ; lat. 62 μ; crass. 28 μ; from Llyn Padarn.

A peculiar form of this is figured, which some may think belongs to the next species by reason of the shape of the basal angles of the semicells; still the spines are scattered in the same way as those of the species under which it is placed. Fig. 39.

X. Brébissonii Ralfs. P.

Fig. 38 represents a form which differs from that usually seen.

X. antilopeum Bréb. C., P., Do.

Large forms of this species were seen from Capel Curig up to 78 μ in diameter.

X. cristatum Bréb. var. SPINULIFERUM nov. var. Fig. 21.
Var. cum quattuor vel quinque spinis parvioribus additis inæqualiter ordinatis intra marginem semicellulæ singulæ.

This has from four to five additional spines rather unequally disposed just within the margin of the front view of each semicell. C.

Genus *Arthrodesmus* Ehrb.

A. octocornis Ehrb. S.

A variety with wide and short cells is figured. Fig. 40.

A. incus Hass. var. *convergens* Arch. C.
var. *divergens* Arch. C., F.

A. convergens Ehrb. C., A.
A. tenuissimus Arch. C.

As this is a rare species, a figure is given. Fig. 10.

Genus *Staurastrum* Meyen.

S. dejectum Bréb. var. *lunatum* Ralfs. P., A.
S. mucronatum Ralfs. C.
S. connatum (Lund.) Roy & Biss. C.
S. apiculatum Bréb. C., A., P.
S. Dickiæi Ralfs. C., P.
S. brevispinum Bréb. C.
S. cuspidatum Bréb. D., F.
**S. pseudocuspidatum* Roy & Biss. C.
S. O'Mearii Arch. S., C., F.
**S. bacillare* Bréb. *β obesum* Lund. C.
Long. 17–18 μ. Fig. 4.
S. oligocanthum Bréb. C.
**S. denticulatum* (Näg.) Arch. F. Fig. 27.
S. avicula Bréb. F.
var. *aciculiferum* W. West. F.
S. furcatum Ehrb. C., F., P.

A faintly punctate variety of this species is figured, having the lateral bifid processes almost reduced to two spines, the other "bifid processes" being sharply bispinate. Fig. 11.

var. *armigerum* Bréb. P., Do.
S. pseudofurcigerum Reinsch. P.
S. Reinschii Roy. F., C.
S. Brébissonii Arch. C.
S. pilosum Näg. Do., B., C., F., P.
S. teliferum Ralfs. P., Do.
**S. gladiosum* Turn. C.
S. SPINIFERUM nov. sp. Fig. 20.

S. parvum, semicellulis ellipticis cum octo spinis (circa) ad marginem semicellulæ singulæ, a vertice triangulare cum spinis novem, lateribus leviter concavis.

Long. 25 μ; lat. 22 μ; lat. isth. 7·5 μ.

Segments elliptic, with about eight spines in the periphery of each segment, end view triangular, sides very slightly concave, showing two spines between each apical one. F.

S. hystrix Ralfs. C.
S. CUMBRICUM nov. sp. Figs. 5 and 36.

S. magnum, tertiam partem longius quam latum, semicellulis late ellipticis, a vertice triangulare; lateribus leviter convexis cum spinis velatis sed paucis ad sinum, multis longioribus ad angulos.

Long. 76–85 μ; lat. 55–65 μ; lat. isthm., 25 μ; spinarum long. ad angulos 11–15 μ.

Frond rather large, one-third longer than broad, semicells broadly elliptical, end view triangular, with slightly convex sides, beset with spines except at the constricted part, many of which are much longer about the apices of the angles. C.

var. CAMBRICUM nov. var. Fig. 6.

Var. semicellulis subangularibus et isthmo angustiori.

Long. 83 μ; lat. 60 μ; lat. isth. 20 μ.

This differs from the type by having the semicells somewhat angular, and the isthmus narrower. C.

var. CAMBRICUM nov. var. forma *minor*. Fig. 37. C.

Long. 62 μ; lat. 48 μ; lat. isthmi 13 μ.

I first noticed this species in a gathering from Lindeth in Westmoreland a few years since, and it has been named in a manuscript for some time. I have since noticed it in a gathering from Capel Curig along with its variety *cambricum*. It differs from *St. Pringsheimii* Reinsch in its larger size, and in its relatively sharper spines of varying lengths. It differs from *St. senticosum* Delponte in being longer than broad, whereas the latter is broader than long, and also has its long spines more uniformly arranged. *St. Notarisii* Delponte differs in having its uniform spines regularly arranged as well as in its narrower sinus. *St. saxonicum* Buln. differs in its relatively broader isthmus and its shorter uniform spines.

S. Pringsheimii Reinsch. P.

S. Royanum Arch. (*S. setigerum* Cleve). C.

S. spongiosum Bréb. B., P., Do.

S. Griffithsianum (Näg.) Arch. C., Do.

S. asperum Bréb. C., F.

S. saxonicum Reinsch. S.

**S. coarctatum* Bréb. var. *subcurtum* Nord. C. Fig. 8.

S. muticum Bréb. B., S.

S. orbiculare Ralfs. A., B., F., P.

S. OSTEONUM nov. sp. Fig. 7.

S. minutum, sinu latissimo et obtuso, semicellulis rotundato-ellipticis, a vertice triangulare, angulis rotundatis et lateribus concavis.

Long. 14 μ; lat. 6·5 μ; lat. isthmi 3 μ.

Minute, front view shaped like a dumb-bell, end view trigonal with slightly concave sides, cytoderm smooth. C.

S. pygmæum Bréb. C., S., F,, Bodorgan.

S. lanceolatum Arch. C.

S. inconspicuum Nord. C.

This characteristic but rare species was often noticed, and it showed no variation.

S. striolatum Näg. C., B.
S. muricatum Bréb. S., Do., A., D.
var. ACUTUM nov. var. Fig. 14.
Var. spinis brevibus (nec granulis), semicellulis truncato-pyramidatis.
Long. 62–70 μ; lat. 48–52 μ.

This differs from the type in the acute though short spines in place of "conic granules," as well as in the trapezoid or truncately pyramidal semicells. S.

This is the form I mentioned in "The Freshwater Algæ of N. Yorkshire" (Journ. Bot., Oct. 1889), as being a distinct form noticed from several places.

S. punctulatum Bréb. Frequent.
S. turgescens Not. F.
S. pileolatum Bréb. D., C.
S. capitulum Bréb. D.
S. Meriani Reinsch. P.

All the specimens seen were 5-ended.

S. alternans Bréb. P., A.
S. dilatatum Ehrb. C., P., Do.
S. tumidum Bréb. P., Do., D.
S. aversum Lund. Llanfairfechan.
S. brachiatum Ralfs. D.
**S. scabrum* Bréb. C.
S. tricorne (Bréb.) Meneg. F., A., S., P.
var. β Ralfs. C.
**S. Haaboeliense* Wille. C.
S. cyrtocerum Bréb. Do.
forma *tetragona*. Fig. 16.
Forma a vertice tetragona. D., Do.
S. inflexum Bréb. S., A., F.
S. polymorphum Bréb. S., B., F. Llyn Idwal.
**S. gracile* Ralfs β *nanum* Wille. C., S.
S. paradoxum Meyen. A., B., Llandudno.
var. *longipes* Nord. A.

A form of this variety was seen with rather longer processes than usual.

S. Ophiura Lund. forma *nonaradiata*. Fig. 15.
Forma a vertice nonaradiata.

End view with nine rays. C.

Of this beautiful species, two forms were noticed along with the type, one, a nine-rayed form, was seen several times, the other, a very long and slender armed one, measured 145 μ across the arms. Cooke and Wolle describe the end view as 7 (rarely 6 or 8) rayed; the forms from Capel Curig are almost all 8-rayed.

S. proboscideum Bréb. Llyn Ogwen.
var. SUBGLABRUM nov. var. Fig. 35.
Var. margine undulato nec spinis truncatis vestitis, radii apicibus integris.

This differs from the type in being undulately rough and not adorned with truncate spines, as well as in the entire apices of the processes. C.

S. controversum Bréb. D., S., P. Fig. 22.

A figure of a variety of this variable species is given.

S. aculeatum Meneg. P.
S. DUBIUM nov. sp. Fig. 28.
S. submagnum, latius quam longum, scabro-granulatum, semicellulis fusiformibus, constrictione profunda, radiis productis tricuspidatis et inflexis, a vertice triangulare, ad basem semicellulæ cum annulo singulo granulorum.
Long. 40 μ; lat. 70 μ; lat. isth. 13 μ.

This species is nearly twice as broad as long, deeply constricted with rough granules, processes inflexed, granulate and tricuspidate, semicells somewhat fusiform, base annularly granulate, vertical view triangular. C.

This will no doubt prove a controversial species; it is near *S. Manfeldtii* Delp., but smaller and with thicker processes; it is also more regularly granulate. It also comes near *S. pseudosebaldi* Wille, but lacks the basal inflation and the bifurcate spines. The front view is like *S. vestitum* Ralfs, but the end view has not the characteristic spiny adornments of the sides of that species. It is not like *S. Sebaldi* Reinsch, but the end view does approach the var. *ornatum* Nord., as well as the form *novizelandica* Nord. of the latter variety, yet the centre of the concave sides of the end is much rougher, and the processes are thicker than the above-mentioned form as well as shorter than those of the var. *ornatum*, and more inflexed than either. It also has some resemblance to *S. bifurcum* Josh., but the arms are more inflexed, and the outline is more regular. It is also relatively shorter than all these species except *S. vestitum* and one of the original figures of *S. bifurcum*.

S. oxyacanthum Arch. C., B.
S. Sebaldi Reinsch, var. *ornatum* Nord. C.
S. eustephanum (Ehrb.) Ralfs. C.
S. sexangulare Buln. C.

S. sexcostatum Bréb. P., S.
S. margaritaceum Meneg. Do., S., F., B.

A form which showed short spines irregularly disposed at the apices is figured from Capel Curig. Fig. 32.

var. CORONULATUM nov. var. Fig. 3.
Var. cum annulo granulorum parvorum ad apices truncatos semicellularum.

This has the apices of the semicells truncate and bordered by a circle of small granules. P.

**S. iotanum* Wolle. C. Fig. 9.

This tiny species may easily escape observation. Its arms are similar to those of *St. tetracerum* Ralfs, but much finer and more delicate, the end view being also triradiate. Its form in front view is not unlike those of *St. O'Mearii* Arch. and *St. pterosporum* Lund., but it is smaller, and has arms and not spines.

Class MULTINUCLEATÆ.

Order SIPHONEÆ (Cœloblastæ).

Genus *Vaucheria* DC.

V. sessilis Vauch. Penmaenmawr.

Class CŒNOBIEÆ.

Order PANDORINEÆ.

Genus *Pandorina* Ehrb.

P. morum Ehrb. B., C.

Order PEDIASTREÆ.

Genus *Pediastrum* Meyen.

P. angulosum Ehrb. C.
P. Boryanum Turp. A., Do., Llandudno, Bodorgan.
var. *granulatum* Ktz. A., C.
P. bidentulum A. Braun. C.
P. constrictum Hass. A.
P. pertusum Ktz. A.
P. Ehrenbergii A. Braun. A., C.

Order SORASTREÆ.

Genus *Cœlastrum*.

C. microsporum (Näg.) Braun. C.

PROTOPHYTA.

Group SCHIZOPHYCEÆ.

Class PROTOCOCCOIDEÆ.

Order EREMOBIEÆ.

Genus *Dictyosphærium* Näg.

D. Ehrenbergianum Näg. C., F., A.

Genus *Botrydina* Bréb.

B. vulgaris Bréb. A.

Genus *Apiocystis* Näg.

A. Brauniana Näg. C.

This species may probably now have a place in the Class Cœnobieæ. An excellent paper has just appeared in the 'Journal of the Linnean Society,' by Mr. S. Le M. Moore, which is well illustrated, new features in its life-history being portrayed, the results of which point to this plant as being "a degenerate type of Volvocineæ." The long cilia which are described should be specially looked for by algal students. Mr. Moore thinks this species has only been seen in England twice before, at Wimbledon and in Cornwall. I have gathered it at Scarborough Mere and Brothers Water; it is also on record for two places in the West Riding. (Since the above was written, Mr. A. W. Bennett has stated in this Journal that Mr. Roy finds it also near Aberdeen. P., 9 Feb. 1890.)

Genus *Nephrocytium* Näg.

N. Agardhianum Näg. C.
N. Nægelii Grun. S., B.

Genus *Ophiocytium* Näg.

O. cochleare Braun. C., B.

Genus *Hormospora* Bréb.

H. transversalis Bréb. C.

Order PROTOCOCCACEÆ (including Palmellaceæ).

Genus *Protococcus* Ag.

P. viridis Ag. Common.

Genus *Pleurococcus* Meneg.

P. vulgaris Meneg. Common.

Genus *Palmella* Lyngb.

P. mucosa Ktz. C.
P. hyalina Bréb. F., C.

Genus *Chlorococcum* Fries.

C. gigas Grun. P.

Genus *Glœocystis* Näg.

G. ampla Ktz. B., A., P.
G. vesiculosa Näg. Do., Bettws-y-coed.
G. rupestris Rabh. Llyn Idwal.
G. botryoides Ktz. C.

Genus *Schizochlamys* A. Br.

S. gelatinosa A. Braun. F., Bettws-y-coed.

Genus *Eremosphæra* De Bary.

E. viridis De Bary. C., A.

Genus *Botryococcus* Ktz.

B. Braunii Ktz. A., Penmaenmawr.

Genus *Urococcus* (Hass.) Ktz.

U. insignis (Hass.) Ktz. (*Chroococcus macrococcus* Rabh.). F.

I agree with Nordstedt in considering these two as forming but one species. I have noticed varying forms from N.W. Ireland, Yorkshire, the Lake District, and Scotland.

Genus *Rhaphidium* Ktz.

R. aciculare A. Braun. C., Llyn Idwal.
R. falcatum Corda. C., B., A.

Genus *Scenedesmus* Meyen.

S. obtusus Meyen. C., A., B.
S. acutus Meyen. A., C., S., P.
var. *obliquus* Rabh. B.

S. quadricauda Bréb. A., C., Llandudno.

Genus *Polyedrium* Näg.

P. gigas Wittr. D.
P. tetraedricum Näg. C.
P. longispinum (Perty) Rabh. Bettws-y-coed.
P. enorme (Ralfs) De Bary. C.

Class Cyanophyceæ or Phycochromaceæ.

Sub-class Nostochineæ.

Order Nostocaceæ.

Genus *Nostoc* Vauch.

N. macrosporum Meneg. C.

Genus *Sphærozyga* (Ag.) Ralfs.

S. elastica (Ralfs). F.

Genus *Anabæna* Bory.

A. Smithii (Thur.) Nord. and Wittr. Twll Du.

Order Rivulariaceæ.

Genus *Rivularia* Roth.

R. echinata (Eng. Bot.). Twll Du.

Order Scytonemaceæ.

Genus *Tolypothrix* Ktz.

T. ægagropila Ktz. C.
var. *pygmæa* Ktz. Twll Du.

T. coactilis Ktz. C.

Genus *Scytonema* Ag.

S. myochrous Ag. B., Bettws-y-coed, C.

Genus *Stigonema* Ag.

S. panniforme Ag. C., Twll Du.
S. mamillosum Ag. C.

The last two species are probably lichens.

Order Oscillariaceæ.

Genus *Oscillaria* Bosc.

O. tenerrima Ktz. C.
O. tenuis Ag. C.
O. limosa Ag. P.
O. irrigua Ktz. Do.
O. nigra Vauch. D., Do.
O. Frölichii Ktz. C., Twll Du, Bodorgan.

Genus *Lyngbya* Ag.

L. littoralis Carm.. Llandudno, in a pool near the sea.
L. vulgaris Kirch. A., Do.

Genus *Inactis* Ktz.

I. sp. This occurred at an elevation of about 2000 feet near Twll Du, on dripping rocks, forming large *dark red* patches; the filaments were from 1·2 to 2·5 μ in thickness. It is probably a variety of *I. Cresswellii* Thur. It is certainly different from *I. tinctoria* Thur., which I have recently seen on *Myriophyllum* from the Lake District.

Genus *Spirulina* Link.

S. oscillarioides Turp. C.

Sub-class Chroococcaceæ.

Order Chroococcaceæ.

Genus *Chroococcus* Näg.

C. cohærens Näg. A., F., C., Bettws-y-coed.
C. turgidus Näg. S., C., F., Llyn Idwal.

Genus *Glœocapsa* Ktz.

G. polydermatica Ktz. C.
G. quaternata Ktz. Near Llyn Coron.
G. magma Ktz. Dripping rocks, Twll Du.

Genus *Merismopedia* Meyen.

M. violacea Ktz. C.
M. glauca Näg. P., C., S.

Genus *Aphanocapsa* Näg.

A. rivularis (Carm.) Rabh. Penmaenmawr.

Genus *Microcystis* Ktz.

M. protogenita (Bias.) Rabh. C.
M. marginata Kirch. C.

Genus *Cœlosphærium* Näg.

C. Kützingianum Näg. C.

Genus *Gomphosphæria* Ktz.

G. aponina Ktz. C.

Class Diatomaceæ.

Genus *Cyclotella* Ktz.

C. operculata Ktz. A.
C. Kützingiana Thw. A.

Genus *Melosira* Ag.

M. varians Ag. Frequent.
M. arenaria Moore. A., C., S.

Genus *Campylodiscus* Ehrb.

C. Echineis Ehrb. (*C. cribrosus* Sm.) var. *Cesatianus* Rabh. A.

Genus *Surirella* Turp.

S. linearis Sm. Do., D., B., C., P., Bettws-y-coed.
S. biseriata (Ehrb.) Bréb. C., A., P., B., Moel Fammau.
S. angusta Ktz. C., P.
S. splendida (Ehrb.) Ktz. C., A.
S. nobilis Sm. Moel Fammau.
S. ovata Ktz. B.
S. minuta Bréb. C., A.
S. pinnata Sm. C., P.
S. gracilis Grun. C.

Genus *Cymatopleura* Sm.

C. Solea (Bréb.) Sm. A.

Genus *Epithemia* Bréb.

E. turgida (Ehrb.) Ktz. A., S., Llandudno, Newborough Warren.
E. Westermanni (Ehrb.) Ktz. Llandudno.
E. granulata Ktz. A.
E. Hyndmanii Sm. A.
E. Sorex Ktz. A.
E. gibba (Ehrb.) Ktz. A., Llandudno, Newborough Warren.
E. ventricosa Ktz. A., Llandudno.
E. Zebra (Ehrb.) Ktz. A.
E. Argus (Ehrb.) Ktz. Llandudno, Newborough Warren.
E. alpestris Sm. A.

Genus *Eunotia* Ehrb.

E. gracilis Sm. A.
E. monodon Ehrb. S.
E. diodon Ehrb. S., P.
E. triodon Ehrb. C.
E. tetraodon Ehrb. C., P.
E. diadema Ehrb. C.

Genus *Himantidium* Ehrb.

H. Arcus Ehrb. S.
H. majus Sm. C., S., Twll Du.
H. gracile Ehrb. B., S., A., C., Do., Llyn Idwal, Twll Du.

H. pectinale Dillw. S.
H. undulatum Sm. C., B.

Genus *Cymbella* Ag.

C. Ehrenbergii Ktz. A.
C. cuspidata Ktz. A., P.
C. turgida Greg. A., C.
C. maculata Ktz. A., B.
C. affinis Ktz. C., B.

Genus *Cocconema* Ehrb.

C. lanceolatum Ehrb. A., S., Do.
C. cymbiforme (Ktz.) Ehrb. A., B.
C. Cistula Hempr. A., Llandudno.
C. parvum Sm. A., S., B.

Genus *Encyonema* Ktz.

E. cæspitosum Ktz. A.

Genus *Amphora* Ehrb.

A. minutissima Sm. A.
A. ovalis Ktz. P., A., Newborough Warren.

Genus *Cocconeis* Ehrb.

C. Pediculus Ehrb. A.
C. Placentula Ehrb. A.
C. Thwaitesii Sm. Bettws-y-coed.

Genus *Achnanthes* Bory.

A. exilis Ktz. C.

Genus *Denticula* Ktz.

D. tenuis Ktz. C.

Genus *Odontidium* Ktz.

O. hiemale (Lyngb.) Ktz. C., Bettws-y-coed, Llanfairfechan.
O. mesodon Ktz. A.
O. mutabile Sm. A.

Genus *Fragilaria* (Lyngb.) Ag.

F. capucina Desmaz. Bodorgan, Moel Fammau.
F. virescens Ralfs. A.

Genus *Diatoma* DC.

D. vulgare Bory. Bodorgan.
D. grande Sm. Llyn Idwal.
D. elongatum Ag. Do., C., Llyn Idwal, Penmaenmawr, Llyn Ogwen.

Genus *Synedra* Ehrb.

S. lunaris Ehrb. C., F., Llyn Idwal.
S. biceps Ktz. D.
S. Smithii Pritch. (*S. acicularis* Sm.). Llandudno.
S. ulna Ehrb. A., C., Do., B., Llyn Idwal, Llanfairfechan.
S. splendens Ktz. (*S. radians* Sm.). Frequent.
S. obtusa Sm. A.
S. delicatissima Sm. A.
S. capitata Ehrb. D., A., Llyn Idwal, Holyhead.

Genus *Asterionella* Hass.

A. formosa Hass. A., C., Llyn Idwal.

Genus *Amphipleura* Ktz.

A. pellucida Ktz. A.

Genus *Nitzschia* Hass.

N. Amphioxys Sm. A., C.
N. vivax Sm. A.
N. constricta (Ktz.) Pritch. (*N. dubia* Sm.) A.
N. parvula Sm. C.
N. sigmoidea Sm. A., P., Llandudno, Bettws-y-coed, Llanfairfechan.
N. curvula (Ehrb.) Sm. C., P.
var. *subcapitata* (Hantzsch) Rabh. C.
N. linearis (Ag.) Sm. A., Bodorgan.
N. tenuis Sm. S., A., Holyhead.
N. minutissima Sm. A.

Genus *Nitzschiella* Rabenh.

N. acicularis (Sm.) Rabh. (*Nitzschia acicularis* Sm.). P.
N. gracilis (Bréb.) Rabh. (*Nitszschia tænia* Sm.). Llandudno.

This only occurred in this locality associated with *Lyngbya littoralis* (Carm.) in a pool not far from the sea.

Genus *Navicula* Bory.

N. cuspidata Ktz. Do., C.
N. rhomboides (Ehrb.) Greg. A., C., B., S., Llyn Idwal.
N. serians Ktz. C., P.
N. elliptica Ktz. (*N. ovalis* Sm.). A.
N. limosa Grun. C., A., Holyhead.
N. gibberula Sm. A.
N. obtusa Sm. (*N. hebes* Ralfs). A.
N. inflata Ktz. C., A., B.
N. Amphisbæna Bory. A.

N. sphærophora Ktz. A.
N. Semen Ehrb. A.
N. affinis Ehrb. C., Llandudno.
N. Amphirhyncus Ehrb. P., C., Do.
N. producta Sm. P., Do.
N. angustata Sm. C., B., Llandudno.
N. cryptocephala Ktz. D., P.
N. dicephala Ehrb. C., A.
N. binodis Ehrb. A.

Genus *Pinnularia* Ehrb.

P. nobilis Ehrb. C., S., Do.
P. major Sm. C., S., Do., Llyn Idwal, Penmaenmawr, Holyhead.
P. Rabenhorstii Ralfs (*P. interrupta* Rabh.). C.
P. Tabellaria Ehrb. var. *acrosphæria* Rabh. (*P. acrosphæria* Rabh.). C., Holyhead.
P. gibba Ehrb. A., Do., C.
P. lata Sm. A.
P. viridis (Ehrb.) Sm. Common.
P. alpina Sm. C., Twll Du.
P. radiosa (Ktz.) Rabh. A., Llyn Idwal, Bodorgan.
var. *angusta* (Grun.) Rabh. (*Navicula angusta* Grun.). A.
P. viridula (Ktz.) Rabh. C., Llyn Idwal, Holyhead.
P. acuta Sm. A.
P. mesolepta Sm. C., D., P.
P. divergens Sm. D., B., S., A.
P. Brebissonii (Ktz.) Rabh. (*P. stauroneiformis* Sm.). A., C., S., P.

Genus *Frustulia* (Ag.) Rabh.

F. saxonica Rabh. forma *aquatica* Rabh. (*Navicula crassinervia* Bréb.). C., S.

Genus *Pleurosigma* Smith.

P. attenuatum (Ktz.) Sm. A.
P. acuminatum (Ktz.) Grun. var. *lacustre* (Sm.) Rabh. (*P. lacustre* Sm.). Newborough Warren.

Genus *Stauroneis* Ehrb.

S. Phœnicenteron (Nitzsch) Ehrb. P., C., Do., Moel Fammau.
S. gracilis Sm. Do., C., P., Newborough Warren.
S. anceps, Ehrb. A.
S. dilatata Sm. A.

Genus *Pleurostaurum* Rabh.

P. Legumen (Ehrb.) Rabh. (*Stauroneis linearis* Sm.). C.

Genus *Gomphonema* Ag.

G. tenellum Ktz. Bettws-y-coed.
G. dichotomum Ktz. A., Bettws-y-coed.
G. capitatum Ehrb. A.
G. constrictum Ehrb. Do., S., A.
G. acuminatum Ehrb. D., C., A., Llyn Idwal.
G. intricatum Ktz. A.

Genus *Meridion* Ag.

M. circulare (Grev.) Ag. A., Llyn Ogwen.
M. constrictum Ralfs. Llandudno.

Genus *Tabellaria* Ehrb.

T. flocculosa (Roth.) Ktz. Common.
T. ventricosa Ktz. B., C., S., Do., Llyn Ogwen.
T. fenestrata (Lyngb.) Ktz. C., A., S., Llyn Idwal, Penmaenmawr.

Genus *Tetracyclus* Ralfs.

T. lacustris Ralfs. C.

This list, together with those records previously mentioned of Messrs. Cooke and Wills, enumerates 545 species and 45 varieties and forms.

Note by A. W. Bennett, F.L.S.

As Mr. West has been kind enough to send me his MS., together with some of his slides, perhaps I may be allowed to append the following notes. The neighbourhood of Capel Curig is certainly one of extraordinary richness, especially in Desmids, not only in species but in individuals; and Mr. West has worked it with great care and knowledge. Compared with the richest locality with which I am personally acquainted, Skelwith in Westmoreland, it is certainly considerably more productive. It may help to give an idea of the extent to which Mr. West's paper enlarges our knowledge of the geographical distribution of Desmids, if I append the following list of species found by him (in addition to those marked with an asterisk) which have no locality in Great Britain assigned to them in Dr. Cooke's work, although some of them have since been found in other spots by myself or other observers:—Gonatozygon Brebissonii, Sphærozosma pulchellum, Docidium coronatum, Closterium obtusum, prælongum, gracile, Cynthia, Kützingii, and subulatum, Penium spiro-striolatum and Mooreanum, Cylindrocystis diplospora, Spirotænia truncata, Micrasterias mucronata, Euastrum venustum, Cosmarium homalodermum, truncatellum, exiguum, Regnesii, orthostichum, quinarium, and hexalobum, Calocylindrus palangula, Xanthidium antilopeum, Arthrodesmus tenuissimus, Staurastrum O'Mearii, oligocanthum, furcatum, Griffithsianum, pygmæum, lanceolatum, striolatum, capitulum, aversum, Ophiura, cerastes, and sexangulare.

Micrasterias furcata Ag. occurs in several of the gatherings from Capel Curig; both the typical form and one with longer arms.

Euastrum verrucosum Ehrb. The typical form occurs, as well as Joshua's var. *simplex.*

Euastrum Jenneri Arch. Capel Curig.

Cosmarium isthmium West. I very much doubt whether this can be maintained as a distinct species. It seems to me to agree with *C. orbiculatum* Ralfs in size as in other important points. The width of the isthmus is probably merely an indication of an early stage in the process of division.

Staurastrum brasiliense Lund. This rare and beautiful desmid occurs in several of Mr. West's slides.

Staurastrum Ophiura Lund. I can quite corroborate Mr. West's statement that all the specimens of this very rare and beautiful desmid observed from his gatherings are 8- or 9-rayed, the former being much the most common. It is somewhat singular that, although Dr. Cooke describes it as "7 (rarely 6 or 8) rayed," he figures it as 8-rayed. The papillæ in the centre I find to be numerous, scattered, and simple, not few, quadrifid, and arranged in a coronet; in fact, the Welsh specimens agree with both Cooke's and Wolle's figures better than with their descriptions.

Staurastrum cerastes Lund. In several slides from Capel Curig.

Staurastrum vestitum Ralfs. Capel Curig.

SUMMARY

OF CURRENT RESEARCHES RELATING TO

ZOOLOGY AND BOTANY

(*principally Invertebrata and Cryptogamia*),

MICROSCOPY, &c.,

INCLUDING ORIGINAL COMMUNICATIONS FROM FELLOWS AND OTHERS.*

ZOOLOGY.

A. VERTEBRATA:—Embryology, Histology, and General.

a. Embryology.†

Weismann's Theory of Heredity.‡—There have been some complaints on this side of the Atlantic as to the manner in which a recent discussion on this subject has been conducted in the columns of 'Nature.' We have not, however, noticed there any sentences comparable to some used by Mr. J. A. Ryder, who urges that the Lamarckian philosophy of transformism offers a hypothesis of heredity as "a substitute for the preposterous one of the isolation of germ-plasma," which Mr. Ryder regards as "in the most obvious conflict with the principle of the conservation of energy. An isolated germ-plasma is as undemonstrable as the presence of bow-legged goblins in the moon. . . . Biologists who commit themselves to an acceptance of the biological vagaries of Weismann array themselves against the modern rigorously scientific tendency to examine the problem of biology from the standpoint of the physical." "A colossal fabric of speculative rubbish must be consigned to the limbo of untenable and forgotten hypotheses in what is represented by the misguided labours of the advocates of the existence an unalterable germ-plasma."

Human Embryo.§—Sig. G. Chiarugi describes the anatomy of a human embryo which measured only 2·6 mm. in length, and was apparently from three to four weeks old. The embryo was marked by a deep dorsal concavity, difficult to explain. There was a marked disproportion between the elongation of the spinal cord, notochord, and gut on the one hand, and that of the lateral parietes on the other. The

* The Society are not intended to be denoted by the editorial "we," and they do not hold themselves responsible for the views of the authors of the papers noted, nor for any claim to novelty or otherwise made by them. The object of this part of the Journal is to present a summary of the papers *as actually published*, and to describe and illustrate Instruments, Apparatus, &c., which are either new or have not been previously described in this country.

† This section includes not only papers relating to Embryology properly so called, but also those dealing with Evolution, Development, and Reproduction, and allied subjects.

‡ Amer. Natural., xxiv. (1890) p. 92.

§ Atti Soc. Tosc. Sci. Nat., x. (1889) pp. 66-94 (2 pls.).

state of the different systems, and also of the amnion and umbilical cord, are described. Finally, the author notes the abundant occurrence of cells which, instead of definitely contoured nuclei, contained small, spherical, isolated granules.

Structure of the Placenta in Man and Monkeys.*—Prof. W. Waldeyer recurs to two previous communications on the structure of the placenta in *Homo* and in the catarrhine monkey *Inuus nemestrinus*. To his first question, whether the intervillous spaces normally contain maternal blood, he gives an emphatically affirmative answer. He passes to the relation of uterine blood-vessels to the placenta, distinguishing the arteries and veins. The third part of his paper deals with the epithelium of the villi and the lining of the intervillous and other spaces. Ten opinions about the epithelium and five in regard to spaces are chronicled, and the paper, which is in great part a historical critique, closes with a brief reference to the origin of the decidua and the relation of the placenta of *Inuus* to that of *Homo*.

Development of Platydactylus.†—Dr. L. Will has had the opportunity of studying the development of *Platydactylus mauritianus*. He finds that the process of gastrulation is much more primitive than in any Reptile hitherto examined, while the great extent of the archenteron allies it to Amphibia. The differences observed may be explained by the different relations of the yolk. A comparison of the Gecko-gastrula with that of Urodeles shows that the blastopore of Reptiles corresponds to the whole blastopore of Amphibia. It has hitherto been largely a matter of hypothesis to say that the primitive groove is formed by the lips of the blastopore, but the Gecko has proved the point. It can now also be shown that the cephalic process of the primitive stripe in other Amniota is nothing more than the solid archenteric invagination of the Gecko. In other points, the study of the development of the Gecko leads to the same general results as those to which Van Beneden has been lately brought by a study of the development of the Chiroptera.

Amphibian Blastopore.‡—Mr. T. H. Morgan has studied the embryos of *Bufo lentiginosus*, *Rana halecina*, and *Amblystoma punctatum*. In the last of these it seems that the blastopore was situated in the posterior part of the medullary groove, and partially surrounded by a continuation of its walls on each side; that it was then overarched in its anterior part by a continuation of the medullary folds; that, on account of its elongation, its posterior end escaped this closing over; and that by the shutting in of the medullary folds the digestive tract came to communicate with the neural tube by the anterior end of the blastopore, and with the exterior by the posterior end of the blastopore.

This Amphibian appears to present us with an idea of the changes which have in general taken place in the phylogeny of the blastopore. The author is forced to believe that the neurenteric canal is a rudimentary organ which at some time had an important function; it has remained partly stable in position, though the anus has wandered far from its original station. It is very probable that the neural tube once

* Arch. f. Mikr. Anat., xxxv. (1890) pp. 1–51 (2 pls.).
† SB. K. Preuss. Akad. Wiss. Berlin, 1889, pp. 1121–8.
‡ Studies from Biol. Lab. John Hopkins Univ., iv. (1890) pp. 355–77 (3 pls.).

formed a water-tube, and in that of adult frogs the ciliated epithelium may still be seen to drive carmine-granules towards the tail.

Lepidosteus.*—Mr. E. L. Mark has had the opportunity of studying the development of *Lepidosteus*. He finds that both the egg-membranes are radially striated, and he corrects some observations of Balfour and Parker. The villi of one membrane are each composed of three parts —head, stalk, and roots; the last of these project into the pore-canals of the zona. The single micropyle of the egg has been overlooked by previous observers; the micropylar apparatus embraces a funnel and a canal; the former results from an infolding and a reduction in thickness of both the villous layer and the zona radiata.

The granulosa of the mature ovarian egg consists of a single layer of polygonal cells, except in the region of the funnel, where it forms a plug of cells that completely fills the funnel. A single large granulosa cell forms the apex of the plug, and occupies the bottom of the funnel.

An egg-membrane comparable structurally and genetically with the zona radiata of bony fishes is to be found in representatives of all the groups of fishes; it is fugitive in Selachians and *Lepidosiren*, and probably in viviparous Teleosteans. The zona is produced by the ovum, not by the follicular cells, and is traversed in all cases by pore-canals, which rarely branch. An egg-membrane, genetically but not always structurally, comparable with the villous layer of *Lepidosteus*, is found in several other cases; it, also, is produced by the ovum, and earlier than the zona.

As to the function and history of the micropylar apparatus, the author suggests that the micropyle, being evidently a provision for the fertilization of the ovum, may owe its present structure to two tendencies which to some extent conflicted; one was induced by the advantages of protection to the egg, the other by the necessity of some provision for the penetration of the fertilizing element. An optimum condition is reached when the penetrable area is reduced to a minimum, and that is the diameter of the head of a spermatozoon. The funnel may be a partial compensation for such reduction. The micropylar plug may mechanically determine the presence and form of a funnel. The micropylar cell may serve to form the canal by resorption, or to prevent the occlusion of the canal by less penetrable matter at the time of oviposition.

Structure of Spermatozoa.†—Prof. G. A. Piersol discusses the structure of spermatozoa, and especially those of *Amphiuma tridactylum*. In those of that Batrachian the tail presents the most interesting modifications. Starting with a sharply-cut transverse edge with a width of about 0·001 mm., it extends as a blade-like appendage to a length of 0·2 mm., increasing to a width of 0·0018 mm. or more at the broadest part. The lower margin of the blade is formed by a relatively thick chief axial-fibre, while along the upper edge there is a secondary, thinner and shorter, fibre. When these fibres separate they are united by an extremely delicate but rigid membrane, which is perfectly smooth. Along the entire lower border of the chief fibre a beautiful gill-like membrane is attached, "the graceful folds of whose free edge form a

* Bull. Mus. Comp. Zool., xix. (1890) pp. 1–127 (9 pls.).

† University Medic. Mag. Philadelphia, 1889, 20 pp. (sep. copy), 1 pl.

picture in elegance unequalled by the similar membranes of any of the newts."

The author is of opinion that ripe mammalian spermatozoa are devoid of recognizable structure, and that the numerous and complicated peculiarities which have been described belong to developing elements.

β. Histology.*

Cell-Theory, Past and Present.†—Prof. Sir W. Turner took the cell-theory, past and present, as the subject of his inaugural address to the Scottish Microscopical Society; while Protoplasm and the Cell-Doctrine was the subject of Mr. C. F. Cox's ‡ annual address to the New York Microscopical Society.

Influence of Nucleus on Protoplasm.§—Dr. B. Hofer has made a number of experiments on the influence of the nucleus on protoplasm. His results may be shortly summarized thus:—

The cell-nucleus has a direct influence on: (*a*) the movement of protoplasm, in which, indeed, the capacity for movement dwells, though it can only be developed in its characteristic forms by its relations to the nucleus; in other words, the nucleus is a regulating centre for movement; (*b*) digestion in so far as a secretion of digestive juices is only possible when nucleus and protoplasm work together.

The cell-nucleus has no direct influence on the respiration of protoplasm or the function of the contractile vacuole.

Biology of the Cell.‖—Sig. E. Verson calls attention to the regular changes undergone by the cells of a special mass in the larva of the silkworm. These cells lie below the stigmata, on the fourth to the eleventh rings of the body, between the musculature and hypodermis; they are arranged in groups of twenty-five to forty, and may correspond to the so-called œnocytes of Wielowiejski. As soon as the process of ecdysis begins, the nucleus of these cells loses its rounded form and becomes constricted at points; it diminishes considerably in size, and clear vacuoles filled with fluid appear around it in the protoplasm; these vacuoles get nearer and nearer to the periphery, and finally open to the exterior. The lumen of the nucleus shrivels up to a narrow cleft. Various other changes, best seen in specimens stained with ammoniacal carmine, are effected, but at last the nucleus is reconstituted, and the whole cycle recommences.

Phagocytes of Alimentary Canal.¶—Dr. A. Ruffer finds that the wandering cells of the lymphoid tissues of the alimentary canal have the power of proceeding to the free surface of such tissues, and of taking into their interior lower micro-organisms and foreign matter such as charcoal. These wandering cells may be either small and mono- or polynucleated cells (microphages), or large mono-nucleated cells (macrophages); the latter are developed from the small mono-nucleated

* This section is limited to papers relating to Cells and Fibres.
† Edinburgh, 1890, 44 pp.
‡ Journal New York Micr. Soc., vi. (1890) pp. 17–44.
§ Jenaische Zeitschr. f. Naturw., xxiv. (1889) pp. 105–76 (2 pls.).
‖ Zool. Anzeig., xiii. (1890) pp. 91–2.
¶ Quart. Journ. Micr. Sci., xxx. (1890) pp. 481–505 (1 pl.).

lymphocytes, and are able to swallow the former (leucocytes), and to destroy and digest them. Within the interior of both, micro-organisms are rapidly destroyed, and these last are never found living free between the cells or in the blood-vessels and lymphatics. The destruction of micro-organisms in the normal lymphoid tissues of the alimentary tract resembles in all particulars the destructive process which follows the inoculation of pathogenic organisms into resistent animals.

Histology of Striped Muscle.* — Mr. C. F. Marshall gives an account of his further † observations on the histology of striped muscle. He finds that the transverse portions of the network of the striped muscle-fibre are directly connected with the muscle-corpuscles. The nerve-ending appears to be connected with the muscle-network, and chiefly with its longitudinal bars. The development of the network takes place at a very early stage in the development of the fibre and is, from the first, developed in its permanent form. It developes first at the surface and grows centripetally, and it does not appear to be connected with the muscle-corpuscles till the fibre is fully developed. Each muscle-fibre appears to be developed from a single cell, and not by a coalescence of cells. *Dytiscus*, the Dragon-fly, and the Crayfish were used for investigation, while the development of the network was studied in embryos of the trout and rat.

γ. General.

Classification of the Metazoa.‡—Prof. E. Haeckel, at the conclusion of his report on the Deep-sea Keratosa, gives a synopsis of the Metazoa which differs somewhat from most of the classifications in vogue in this country.

A. First Main Branch.

CŒLENTERIA.

Phylum I. GASTRÆADA.

Classes: 1. Physemaria; 2. Cyemaria (Orthonectidæ, Dicyemidæ).

Phylum II. SPONGIÆ (PORIFERA).

Classes: 1. Malthospongiæ; 2. Silicispongiæ; 3. Calcispongiæ; or, perhaps, better: 1. Protospongiæ (Tubulosæ); 2. Metaspongiæ (Vesiculosæ).

Phylum III. CNIDARIA (ACALEPHÆ).

III. *a*. Subphylum 1. HYDROZOA.

Classes: 1. Hydropolypi; 2. Hydromedusæ; 3. Siphonophora.

III. *b*. Subphylum 2. SCYPHOZOA.

Classes: 4. Scyphopolypi; 5. Anthozoa; 6. Scyphomedusæ.

* Quart. Journ. Micr. Sci., xxxi. (1890) pp. 65-82 (1 pl.).
† See this Journal, 1887, p. 935.
‡ Reports of the Voyage of H.M.S. 'Challenger,' xxxi., Part lxxxii. (1889) pp. 90-2.

Phylum IV. PLATODA.

Classes: 1. Turbellaria; 2. Trematoda: 3. Cestoda; 4. Ctenophora (?).

B. Second Main Branch.

CŒLOMARIA (CŒLOMATA vel BILATERIA).

Phylum V. Helminthes (Vermes).

V. *a*. Subphylum 1. ARCHELMINTHES.

Classes: 1. Trochozoa; 2. Rotatoria.

V. *b*. Subphylum 2. STRONGYLARIA.

Classes: 3. Nematoda; 4. Acanthocephala; 5. Chætognathi.

V. *c*. Subphylum 3. RHYNCHOCŒLA.

Classes: 6. Nemertinea; 7. Enteropneusta.

V. *d*. Subphylum 4. PROSOPYGIA.

Classes: 8. Bryozoa; 9. Phoronida; 10. Brachiopoda.

Phylum VI. MOLLUSCA.

VI. *a*. Subphylum 1. COCHLIDES.

Classes: 1. Placophora; 2. Gastropoda; 3. Scaphopoda; 4. Pteropoda.

VI. *b*. Subphylum 2. CONCHADES.

Class 5. Acephala.

VI. *c*. Subphylum 3. TEUTHODES.

Class 6. Cephalopoda.

Phylum VII. ECHINODERMA.

VII. *a*. Subphylum 1. THECOSTELLÆ.

Classes: 1. Holothuriæ; 2. Echinida.

VII. *b*. Subphylum 2. PECTOSTELLÆ.

Classes: 3. Cystidea; 4. Crinoidea; 5. Blastoidea.

VII. *c*. Subphylum 3. ANTHOSTELLÆ.

Classes: 6. Ophiuræ; 7. Asterida.

Phylum VIII. ARTICULATA.

VIII. *a*. Subphylum 1. ANNELIDA.

Classes: 1. Hirudinea; 2. Chætopoda; 3. Gephyrea; 4. Myzostomida.

VIII. *b*. Subphylum 2. CRUSTACEA.

Classes: 4. Caridonia (Carides); 5. Aspidonia (Merostomata).

VIII. *c*. Subphylum 3. TRACHEATA.

Classes; 6. Onychophora; 7. Myriapoda; 8. Arachnida; 9. Insecta.

Phylum IX. CHORDONIA.

IX. *a*. Subphylum 1. TUNICATA.

Classes: 1. Copelata; 2. Ascidiæ; 3. Thaliæ.

IX. *b*. Subphylum 2. VERTEBRATA.

Classes: 1. Acrania; 2. Cyclostoma; 3. Pisces; 4. Dipneusta; 5. Amphibia; 6. Reptilia; 7. Aves; 8. Mammalia.

Sensitiveness and Adaptability of Organisms to Saline Solutions.*—Dr. J. Massart finds that the organic excitation produced by saline and other solutions varies according to the molecular weight and molecular structure of the substance. The repulsion, studied with most precision in Bacteria, is inversely proportional to the molecular weight, and directly proportional to the "isotonic coefficient," or the attraction of the substance for water. The unity chosen in estimating this last factor is a third of the attraction exercised on water by a molecule of nitrate of potassium. Massart experimented not only on Bacteria, but on Infusorians, *Hydra*, the skin of the frog, and the conjunctiva of man. The latter is sensitive, not only to solutions more concentrated than tears, but also to others less so; it may be anæsthetized as regards pain and touch, while remaining quite sensitive to degrees of concentration. He gives numerous illustrations of adaptability of Bacteria, Infusorians, &c., to concentrated solutions, the adaptation being due to a permeation of the protoplasm by the dissolved substance. An appendix contains many interesting facts in regard to the comparative sensitiveness of small organisms. A method is suggested by which this variable sensitiveness might be taken advantage of to secure the isolation of desired specimens and the elimination of others.

Natural History of Victoria.†—Prof. F. M'Coy has issued part 19 of the Prodromus; three plates are devoted to Bryozoa, and three to the large Melbourne Cuttle-fish (*Sepia apama* Gray).

B. INVERTEBRATA.

Marine and Freshwater Invertebrate Fauna of Port Jackson and Neighbourhood.‡—Mr. T. Whitelegge has published a list of the invertebrates found in fresh or salt water at or near Port Jackson. This will be very useful in the colony, and is instructive to zoologists generally. A good deal has still to be done before anything like a complete census of this fauna can be attempted. Attention is drawn to one starfish which offers peculiar opportunities to the embryologist; it inhabits the zone between high and low water mark; the eggs are deposited under stones in little rock-pools, and the young, when hatched out, never leave the spot until they assume the form of the adult.

Mollusca.

American Mollusca.§—Mr. W. H. Dall has published a preliminary catalogue of the shell-bearing Marine Molluscs and Brachiopods of the

* Arch. de Biol., ix. (1889) pp. 515–70.
† 'Prodromus of the Zoology of Victoria,' xix. (1889) pp. 297–327 (pls. 181–90).
‡ Sydney and London, n. d. [read 3rd July, 1889], 8vo, 161 pp.
§ Bull. U.S. Nat. Mus., No. 37 (1889) 221 pp. (74 pls.).

south-eastern coast of the United States, to which are added illustrations of many of the species. The systematic conchologist will be glad to have this work.

β. Pteropoda.

Cymbuliopsis Calceola.*—Mr. J. I. Peck gives an account of the anatomy and histology of this Pteropod, serial sections of which were made. The tentacles are, at best, mere knob-like structures with rudimentary sensory apparatus at their base. All the tissues of the animal are exceedingly translucent, so that the course of the œsophagus may be followed from a surface view. The visceral nucleus is dark brown and rounded, and contains the digestive and reproductive organs, while on its dorsal surface are laid the heart and nephridium. The primitive molluscan foot cannot be recognized in the adult, but its successor, the fin, has attained a very large size, and is moved by muscles which are laid in regular intercrossing bands a little beneath the epithelial surface of either side; the thickness of the fin is due to the branching network of connective-tissue cells which is so characteristic of molluscan histology. The pallial cavity is on the ventral side, and is made by the large fold of the mantle which extends from the dorsal part of the animal beneath the fin, thickening between its two epithelial layers into the hyaline "casque." Part of the inner layer of the mantle is specialized into the pallial gland or "shield" of thecosomatous pteropods. The genus seems to be typical of the family to which it belongs.

γ. Gastropoda.

Anatomy and Histology of Renal Organs of Prosobranch Gastropods.†—M. R. Perrier has an extended memoir on this subject. The urinary apparatus of Prosobranchs primitively consists of two symmetrical organs identical in structure and function; each consists of a sac, which communicates on the one hand with the pericardium, and on the other with the exterior. Absolute symmetry, however, is never seen in them. In the Diotocardia (with the exception of the Neritidæ) and in the Heterocardia the organ of one side never communicates with that of the other; their orifices, which are also always distinct, are situated at the tips of papillæ which project into the mantle-cavity. *Fissurella* is the only Prosobranch which retains any of the primitive symmetry; but the left organ is much reduced, and does not communicate with the pericardium. The two kidneys have the same function. In all the rest the right kidney is the true renal organ, while the left, which is remarkable for its plasticity, always undergoes modifications in position or constitution. In *Patella* the two kidneys have renal functions, but the left, which is quite small, lies between the pericardium and the right kidney, and it appears to have lost its communication with the pericardium.

In the Heteronephridiata (*Haliotis*, Trochidæ) the left kidney undergoes a complete change, being converted into the papillary sac. It seems to have become an important reserve-organ, which communicates

* Stud. Biol. Lab. John Hopkins Univ., iv. (1890) pp. 335–53 (2 pls.).
† Ann. Sci. Nat., viii. (1889) pp. 61–315 (9 pls.).

only with the pericardium; the right organ, which has alone the depuratory function, has lost this communication. This right kidney is placed in the course of the blood which comes from the lacunæ of the body to pass to the gills. In *Haliotis* all the blood traverses it; in the Trochidæ part only; in the Monotocardia it receives but a small part of the blood, and a special vascular area is formed for it with afferent and efferent passages which are independent of the general circulation. The left kidney of the Diotocardia, as well as that of *Patella* and the Heteronephridiata, has a vascular system directly connected with the auricle or auricles. The Neritidæ have only one kidney.

The Monotocardia have a single renal cavity and a single excretory orifice. The latter is simple and is placed at the base of the pallial chamber. To this rule *Valvata* and *Paludina* alone form exceptions; they have an excretory canal which opens by an orifice placed at the anterior edge of the mantle. The kidney is not a large gland, nor is it acinous. Its secreting epithelium is arranged on lamellæ or trabeculæ which form a spongy mass; the lamellæ are attached to the lateral walls and the urinary cavity is free in the centre. In freshwater Prosobranchs (*Neritina*, *Paludina*) the glandular mass is, as a rule, considerably developed. It fills the urinary cavity, and the kidney has then the appearance of a large spongy body; *Cyclostoma* and *Valvata* are exceptions to this rule.

The glandular mass, that is to say the active part of the kidney, is divided into two glands which are quite distinct—the kidney properly so called, and the nephridial gland. The latter has almost always the form of a band which extends along the pericardium, and sometimes also along the base of the branchial cavity. Its colour is different from that of the kidney. It is hollowed out by a lacuna which is bounded, especially on the side nearer the urinary cavity, by a layer of powerful muscles, the function of which is to regulate the circulation in the organ. This lacuna is a diverticulum of the auricle, with which it freely communicates; it is partially obliterated by connective tissue, the essential elements of which are large cells; these are arranged in the meshes of a plexus of stellate connective cells. The function of this gland is to modify the constitution of the blood either by pouring into it definite products or formed elements. It is, therefore, an organ of reserve or lymphatic gland. On the side near the renal cavity the nephridial gland is lined by an epithelium which projects into its interior, where there are branched canals which are always well separated from the blood-lacuna. The nephridial gland may be considered as representing the left kidney of the Diotocardia. *Patella* is an intermediate form.

In most of the Tænioglossata the glandular mass of the true kidney is homogeneous in structure, but in a few (*Natica*, *Cypræa*) there are signs of differentiation. The Stenoglossata have the organ divided into two lobes, and further modifications and differentiations may be traced.

There are two types of renal gland-cells; that of the first is to be seen in the Diotocardia. They are very generally ciliated; sometimes they contain no foreign concretions, but at others the bodies excreted by the cell condense in the form of small concretions, of which there are often a number. The renal gland-cells of the Monotocardia, on the other hand, do not produce a diffused concretion. The excreted liquids become concentrated into one place so as to form a spherical vacuole, which is placed near the periphery of the cell. This vacuole increases in size, and the salts contained in suspension in the liquid which forms it condense into a large concretion or, sometimes, into several smaller masses. The cells are not, as a rule, ciliated, but the presence or absence of cilia is a secondary matter.

The mechanism of the urinary secretion varies as the secretion is diffuse or vacuolar; in the former case it seems to be merely effected by osmosis, but in the latter the vacuole escapes from the cell and falls into the renal cavity surrounded by a delicate protoplasmic envelope. The cell is reformed after the expulsion of the vacuole, and continues to exercise its function.

M. Perrier applies the results he has obtained to a classification of the Prosobranch Gastropods, and, in an appendix, he institutes a comparison between the renal organ of these and that of other Molluscs. He is led by it to agree with de Meuron in comparing the larva of a Mollusc with that of an Annelid, with this difference, that in place of a chain of a number of somites there are in the Mollusca only two.

Blood and Lymph-gland of Aplysiæ.*—M. L. Cuénot finds that the blood in the heart of the Atlantic *Aplysia depilans* is distinctly rosy. This coloration is due to the presence of an albuminoid, and has no relation to the absorption of oxygen. The albuminoid, which is distinct from hæmocyanin, may be called hæmorhodin. The blood of the Mediterranean *A. punctata* is quite different, for it contains colourless hæmocyanin. The amœbocytes appear to be formed by the crista aortæ. This is a large hollow dilatation of the anterior aorta which has something of a glandular appearance; it is inclosed with the heart in the pericardium. When an injection is forced in, it swells up like an erectile organ, but returns to its normal dimensions when the pressure ceases. Its wall is formed by a thick felting of connective tissue and of elastic fibres which anastomose and divide in all directions. Among these are masses of nuclei, a large number of which are surrounded by protoplasm; these are evidently mature amœbocytes which are ready to pass into the blood. Somewhat similar structures have been observed in *Philine* and *Scaphander.*

Pleurophyllidiidæ.†—Dr. R. Bergh gives a systematic review of this group; in the forms newly examined by him he observed that the buccal armature varies in the different species in a way never noticed in any other group of Nudibranchs.

Structure and Functions of Cerata in some Nudibranchiate Molluscs.‡—Prof. Herdman here enters into some greater details as to the structure and functions of the cerata of Molluscs, than in the report we noticed some months since.§ Full illustrations are now given.

* Comptes Rendus, cx. (1890) pp. 724–5.
† Abh. Zool.-Bot. Gesell. Wien, 1889, pp. 1–14 (2 pls.).
‡ Quart. Journ. Micr. Sci., xxxi. (1890) pp. 41–63 (5 pls.). See also Rep. Brit. Assoc., 1889 (1890) pp. 630–3.
§ See this Journal, 1889, p. 627.

Organization of Sinistral Prosobranchiate Gastropoda.*—MM. P. Fischer and E. L. Bouvier have examined some of these "left-handed" Molluscs. In *Neptunea contraria* it was found that all the organs which are placed on the right in dextral Prosobranchs are on the left, and *vice versâ;* correlated modifications were observed in the organization of the animal, in, for example, the ganglia and the nerve-branches.

Molluscoida.

β. Bryozoa.

Bryozoa of Japan.†—Dr. A. Ortmann has a paper on the Bryozoa collected by Dr. L. Döderlein in Japan, a region from which only three species were previously known. Of the 137 species reported on, 85 are said to be new, and three of these require new genera to be established for their reception.

Asexual Multiplication of Endoproctal Polyzoa.‡—Dr. O. Seeliger has investigated the formation of the Polyzoon stock, the budding at the free end of the main stolon, the branching of the stolon, the formation of new buds between the old, and finally the regeneration of the polype head. His general conclusions may be summed up as follows:—As in other classes, the budding process is condensed in contrast with the ordinary development. In *Loxosoma* the buds go free; in *Pedicellina* they are fixed and become mature at their points of origin; in all cases they grow without metamorphosis, and exhibit none of the provisional larval structures. In the bud there is no process comparable to segmentation, for it starts as a two-layered rudiment, with epithelial ectoderm and with mesenchyme, but with the development of the inner layer much belated. In every forming bud, the "polypide" originates from a fresh invagination of ectoderm, which is probably, to begin with, referable to a single cell. If this fact be connected with Nitsche's observation that the mesenchyme in *Loxosoma* was derived from the ectoderm, then O. Schmidt's paradox about the buds of *Loxosoma* becomes intelligible—that the process is not a budding, but the direct development of an ovum which has passed into the ectoderm, and there starts the apparent bud. Neither Nitsche's observation nor Schmidt's conclusion is, however, to be accepted. According to Seeliger, the budding is a process of gastrulations repeated by the ectoderm on various regions of the adult animal or of its stolon.

At the apex of the stolon, where large ectodermic cells lie, an evagination occurs which begins a bud. At the apex of this, the ectoderm is invaginated to form the "polypide." A few mesoderm cells of the stolon have wandered into the cavity of the bud, where they multiply so rapidly as to fill the space. The polypide invagination is divided into two regions, an upper one which never loses its connection with the ectoderm layer, and a lower one which remains connected with the latter by a narrowing aperture which becomes the mouth. The upper part represents the atrium, and from it the tentacles arise with immigrant mesenchyme cells. By an evagination of the atrial wall the ganglion is

* Comptes Rendus, cx. (1890) pp. 412–4.
† Arch. f. Naturg., lvi. (1890) pp. 1–74 (4 pls.).
‡ Zeitschr. f. Wiss. Zool., xlix. (1889) pp. 168–208 (2 pls., 6 figs.).

formed, which soon frees itself and developes fibrillar substance in its centre. The lower part becomes the stomach and mid-gut. How far the hind-gut arises from another evagination of the atrium is undetermined. The mesoderm elements become connective-tissue and muscle-cells, and also form the gonads, whose paired rudiments lie laterally to the large ganglion. The process is thus comparable to gastrulation, for the mother animal supplies no endodermic rudiment. In this last respect the budding of Polyzoa differs markedly from that of Cœlenterata or Tunicata, where the endoderm plays an important part.

Arthropoda.

Morphology of Compound Eyes of Arthropods.*—Mr. S. Watase describes the structure of the ommatidium in *Serolis*, *Talorchestia*, *Cambarus*, *Homarus*, and *Callinectes;* describes the compound eye of *Limulus*,† and discusses the phylogeny of the ommatidium. He comes to the conclusion that the structure of the ommatidium of the compound eye of *Serolis* shows that it may be reduced to a simple ectodermic invagination of the skin. The same interpretation may be applied to the other Crustacea mentioned, and finds a strong support in the fact that, in *Limulus*, the ommatidium is an open pit of the skin.

By supposing that the ommatidial pit of *Limulus* became deeper, and that this increase in depth was accompanied by modifications in the structure and arrangement of the component cells, it becomes probable that the ommatidium of the compound eye of an Arthropod is an independent invagination of the skin. If this be so, the unit of the compound eye is not so complex a structure as some have supposed, and the enormous increase in the number of the ommatidia is merely an example of the well-known phenomenon of the duplication of a single unit.

α. Insecta.

Early Stages in Development of Ova of Insects.‡—Dr. H. Henking commences a series of memoirs with an account of the ovum of *Pieris brassicæ*, with remarks on the sperm and spermatogenesis. It is, however, unnecessary to give the details as the results attained are very much those already given for *Musca vomitoria* by the author and by Blochmann.§

Abdominal Appendages in Hexapoda.‖—Herr E. Haase urges that the researches of various observers commencing with Kowalevsky in 1871, justify the supposition that the existing Hexapoda are to be derived from polypodous myriopodiform ancestors. He brings together the observations made by various authors on abdominal appendages in a way which will probably be found very useful.

Composition of Body of Blattidæ.¶—The same author has made an investigation into the composition of the body of the cockroach and its allies. He recognizes in the mature embryo a frontal piece which bears

* Stud. Biol. Lab. John Hopkins Univ., iv. (1890) pp. 287–334 (7 pls.).
† For a preliminary note, see this Journal, 1889, p. 747.
‡ Zeitschr. f. Wiss. Zool., xlix. (1889) [1890] pp. 503–64 (3 pls.).
§ See this Journal, 1887, p. 743; 1888, p. 573.
‖ SB. Ges. Naturf. Freunde, 1889, pp. 19–29.
¶ T. c., pp. 128–36.

the labrum as a central process, and has as lateral appendages the antennary lobes, while it is perforated posteriorly by the orifice of the mouth. The original ventral position of the antennæ has often served as an argument in favour of their being limbs, but they must not be considered as equivalent to the persistent ventral appendages. Behind the frontal piece is the definite number of true metameres; the first three of these have their appendages converted into gnathites, and the head is thus formed; then follow the three thoracic segments with their legs, and then the abdomen, made up of ten true metameres, the appendages of which disappear at an early stage. Behind these comes the "anal piece" into which neither ventral cord nor secondary body-cavity are continued, and which has a remarkable resemblance to the frontal piece. For, like it, it has two terminal appendages, ventrally placed, which later on become the cerci as they move nearer to the anus. On the anal piece there is a median dorsal lamina supra-analis, and generally two anal valves; to these in rare cases a lower opercular piece is also added.

A method of notation is suggested whereby the presence or absence of the several metameres may be indicated, and the varying characters presented by various Insects seen at a glance.

The author is of opinion that the facts which he here brings forward afford a fresh proof of the relationship of the Cockroaches with the Thysanura; while they also show that the ventral plates of the Hexapoda do not correspond to the sternal shields of the same, and as little to the ventral shields of the Chilopoda, but that they owe their origin to the fusion of abdominal leg-rudiments, flattened out into plates, with an unpaired median shield.

Embryology of Blatta germanica.*—Mr. N. Cholodkovsky has a preliminary notice of the results of his studies in the development of *Blatta germanica*. The body-cavity arises within the rudiments of the extremities, which are hollow from the beginning, and gradually becomes shut off from the nutrient yolk; eighteen pairs of hollow somites are thus formed. During the formation of the endoderm the cavity of the somites divides, as in *Peripatus*, into three portions, one of which is, in all probability, homologous with the segmental infundibulum of *Peripatus*. In the later stages of development this division disappears. The permanent body-cavity is of mixed origin, for it contains remains of the primitive somite-cavity, schizocœl-spaces, and remains of the primitive cleavage-cavity. The heart is formed in the manner described by Schimkewitsch, and its cavity is a derivative of the primitive cleavage-cavity. The fat-body and the sexual cells arise from the yolk-cells, which in certain stages of development wander into the body-cavity.

Transformations of North American Lepidoptera.†—Mr. H. Edwards has published what ought to be a very useful bibliographical catalogue of the described transformations of North American Lepidoptera. Of some groups, such as the Noctuidæ, very little is yet known, but the subject is one of great interest and importance.

* Zool. Anzeig., xiii. (1890) pp. 137–8.
† Bull. U.S. Nat. Mus., No. 35 (1889) 147 pp.

Wing of Lepidoptera and its "Imaginal Disc."*—Sig. E. Verson refers to the general belief that the larvæ of Lepidoptera have no stigmata on the meso- and metathorax. Such an organ is, however, present, and is formed by a circlet of high hypodermal cells radially arranged around a common centre. The branch sent from the longitudinal tracheal trunk to the dorsal side of the stigmata of the second and third thoracic rings is long but delicate; its peritoneum is widened out into several berry-like saccules filled with cell-elements. In profile these rudimentary stigmates appear as a series of high hypodermal cells, which form the basis of a short blind tube. After the second ecdysis a special change occurs in these rudimentary organs. The tracheal branch connected with them sends off at various points thick tufts of capillary air-vessels, which press against the base of the cæcum. Gradually increasing in length they form a fold which continues to increase in length. The numerous tufts of tracheal capillaries extend beyond the inner surface of the two layers of which the developing wing consist ; the berry-like saccules are drawn into the wing and converted into more or less thick tubes, which will form the " veins." It is clear, therefore, that the wings of Lepidoptera must be regarded as, in the fullest sense, organs of respiration.

System of Integumentary Glands of Bombycidæ.†—Signor E. Verson gives an account of the glands he has, after much trouble, been able to make out in the larva of *Bombyx mori*. There are two upper and two lower prothoracic glands, and similarly disposed meso- and metathoracic glands. The first to the eighth (inclusive) abdominal rings have two such glands, and in the eighth ring there is also a second pair. These glands, which can be made out in the embryo, persist during the whole of the larval period, constantly increasing in size; they are unicellular and function periodically. The author gives a short account of the changes which these glands undergo, and promises details and figures.

Colour and Veins of Butterfly Wings.‡—Dr. J. F. van Bemmelen has studied the development of the wings in *Pyrameis cardui*, *Vanessa urticæ*, and *Pieris brassicæ*, in order to discover how far the ontogeny of the colouring and venation sheds light on the phylogeny. The colours do not appear suddenly, but on the minute rudiments of wings. The colouring of the unravelled pupal wings is, however, very different from that in the imaginal state, though with some characters in common. The imaginal pattern is compounded from traces of more primitive types, both as regards pigmentation and veins.

Rectal Glands in Coleoptera.§—Prof. H. T. Fernald has found in the alimentary canal of *Passalus cornutus* a structure which he considers homologous with the rectal glands of other groups of insects. He describes the details of these organs, and gives reasons for regarding them as having a valvular function. This view is based on the facts that, (1) They are the best developed and most alike in Insects which feed on solid and quite innutritious food ; in those forms with more

* Zool. Anzeig., xiii. (1890) pp. 116–7. † T. c., pp. 118–20.
‡ Tijdschr. Nederl. Dierk. Ver., ii. (1889) pp. 235–47.
§ Amer. Natural., xxiv. (1890) pp. 100–1.

concentrated or liquid food they vary greatly, and may even be wanting. (2) The valvular function would best explain the thick spiny chitinous lining and the remarkable development of the muscles. (3) Their position is also explained by this assumption, for a valve between the colon and rectum would serve to retain the food in the absorptive portions of the digestive tract till all nutriment was extracted, and then the combined action of the spines and muscles would pass the remainder on.

If these views are correct, we find the primitive valvular functions of the rectal glands in those insects which have retained their primitive food-habits, while they become vestigial, or are converted to other purposes in the more highly differentiated forms.

On Secreting Organs and Secretion of Wax in Bees.*—M. G. Carlet attempts a more definite account than has yet been given of the secretory apparatus and the secretion of wax in the bee. He comes to the conclusion that the wax is produced by the four last ventral arches of the abdomen; it is not secreted, as has been supposed, by the cuticular layer of these arches or by intra-abdominal glands, but by the cells of an epithelial membrane which he calls the waxy membrane (*membrane cirière*). This membrane is situated between two layers, the outer of which is cuticular, while the inner forms the internal investment of the anterolateral part of the ventral arch. The waxy substance traverses the cuticular layer and accumulates against its outer face, where it forms a layer of wax, which is covered by the ventral arch in front. Hitherto this passage of wax has been supposed; it has now been demonstrated.

Ecdysis and Metamorphosis of Acrididæ.†—M. J. Kunckel d'Herculais states that the egg-case of young Acrididæ is closed by an operculum admirably adapted for its purpose; this lid is raised by means of a cervical ampulla, and the same organ is of use in enabling these insects to overturn any obstacles which prevent their emergence. Moreover, it enables them to modify at will the various regions of their body, and so to escape through very small orifices. Yet, again, it is by means of this ampulla that they burst the envelope which incloses them. Freed from this, the young Acrididæ are able to make use of their limbs, and have the use of their antennæ and mouth-organs. At each successive ecdysis the membrane which unites the head and the thorax is capable of distension and of acting as a cervical ampulla; this distension is effected by the region becoming gorged with blood. The ampulla in question may, therefore, be compared to the frontal ampulla of the Muscidæ, but it has more extensive uses as it is of service when the young is still inclosed in the egg.

In a succeeding paper ‡ the author discusses the function of air in the mechanism of escape from the egg-case, and in the ecdysis and metamorphosis of the Acrididæ. He finds that, at all stages of development, these insects diminish the capacity of their general cavity by swallowing air into the digestive tract; by this means the air is driven into the cervical ampulla or into various regions of the body, and especially the elytra and wings.

* Comptes Rendus, cx. (1890) pp. 361–3. † T. c., pp. 657–9. ‡ T. c., pp. 807–9.

Biology of Chermes.*—Dr. K. Eckstein continues to write on this interesting subject; the details of the synonymy of the various species are now somewhat matter for specialists. We have on several occasions already indicated the methods of observation.†

Embryonic Development of Chalicodoma muraria.‡—Herr J. Carrière gives a brief account of the results of his investigations into the embryonic development of this Insect. The mesodermal plate, which is bounded by two grooves which converge anteriorly, consists of several layers before the period of invagination, and is not rolled into a tube as the result of this process. Shortly after the growth of the plate at its anterior end the anterior ectodermal rudiment appears in front of it and the folds in the blastoderm; later on no corresponding rudiment is seen. In both regions there is cell-growth, and, as a result, the uppermost blastoderm-layer becomes the ectoderm, and the rudiment of the endoderm is set free. From the beginning to the end of development the cells that form the endoderm and its derivatives differ both in size and appearance from those of the mesoderm and its derivatives.

The labrum consists of two independent folds which rise up on either side of the median line; they come together slowly. Each segment of the three pairs of gnathites and of the thorax, as well as the first eight segments of the abdomen, have a rudiment of a stigma, but only those of the meso- and metathorax and of the abdomen pass into the permanent stigmata. That of the anterior gnathite-bearing segment gives rise to the anterior tentorial rudiment, those of the median to the chitinous bar of the flexor mandibuli, and those of the hinder to the rudiment of the posterior tentorium. The salivary glands are derived from the rudiments of the stigma of the prothoracic segment. The first structure formed from the permanent stigmata is not the long tracheal trunk, but a short tube which ends blindly at the anterior boundary of the segment. This body calls to mind, in a very striking way, the structure of nephridia, and, indeed, the stigmata are the only organs of the Insect-body which can be compared to the efferent ducts of segmental excretory organs. The Malpighian vessels appear in the eleventh segment, but it is uncertain whether they are homologous with the rudiments of stigmata. The rudiments of the thoracic feet appear with those of the stigmata, and disappear when the embryo assumes the larval form; those of the abdominal somites do not appear till after them, and persist for a short time only.

Myrmecophilous Oak-galls.§—On the authority of Dr. H. C. M'Cook ('The Honey-ants of the Garden of the Gods,' Philadelphia, 1882), Prof. F. Delpino describes a species of ant, *Myrmecocistus melliger*, which has a caste of workers metamorphosed into honey-bags. The abdomen is distended into the size and form of a grape, and is full of honey, on which the other members of the colony feed when hungry. This ant appears to range through Mexico, New Mexico, Colorado del Sul, and possibly into California. It is of nocturnal habits, and obtains the

* Zool. Anzeig., xiii. (1890) pp. 86–90.
† See this Journal, 1889, pp. 380, 506, 745.
‡ Zool. Anzeig., xiii. (1890) pp. 69–71.
§ Malpighia, iii. (1889) pp. 349–52 (1 pl.).

honey from galls on a species of oak, *Quercus undulata*, growing on the young branches, and exuding, when young, copious drops of nectar. Prof. Riley states that nectariferous galls are also produced on the hickory, *Carya porcina*, by the attacks of a *Phylloxera*, the sweet juice probably resulting from the decomposition of tannin into gallic acid and sugar. The insect which produces the galls on the *Quercus undulata* is stated by Prof. Riley to be an undescribed species, for which he proposes the name *Cynips Quercus mellariæ*. Two Australian species of ant, *Mellophorus Bagoti* Lubb. and *Camponotus inflatus* Lubb., resemble the one above described in having the abdomen transformed into a honey-bag.

Termites of Isthmus of Panama.*—Mr. P. H. Dudley has an account of his observations on the habits of the "White Ants" of the Isthmus of Panama; the account of the battle of the white and yellow ants is particularly interesting, but the reader must refer to the original for details.

δ. Arachnida.

Spinning Apparatus of Geometric Spiders.†—Mr. C. Warburton contributes some new facts to our knowledge of the spinning apparatus of geometric spiders. A spider's line does not consist of many strands fused or woven together, but ordinarily of two or four distinct threads. The framework and the radii of circular snares are supplied by the ampullaceal glands. The acinate and pyriform glands are those which are mainly employed in binding up captured prey. The "trailing line" consists mainly of ampullaceal threads, some strengthened by others from the just-mentioned glands. The ground-line of the spiral is double only, and the two strands are bound together merely by the viscid matter which envelopes them.

He corroborates the statements of Apstein that the "attachment-discs" are furnished by the pyriform glands, that the tubuliform glands supply the silk for the egg-cocoon, that the viscid matter of the spiral is probably the product of the aggregate glands, and that, though the origin of the spiral ground-line is uncertain, it may proceed from the tubuliform orifices on the intermediate spinnerets.

Protective Resemblances in Spiders.‡—Mrs. E. G. Peckham points out that there are, among Spiders, two forms of protective modification. The first includes all cases of protective resemblance to vegetable and inorganic things—that is, all modifications of colour or of colour and form that tend to make their possessors inconspicuous in their natural relations; this she calls direct protection. Under indirect protection we have two classes: the spiders which are specially protected themselves, and those which mimic other creatures that are specially protected. Examples of the former of these two classes are afforded by spiders which become inedible through the acquisition of hard plates and sharp spines; and this modification of form is frequently accompanied by conspicuous colours, which warn their enemies that the spiders are unpalatable.

* Trans. New York Acad. Sciences, viii. (1889) pp. 85–114.
† Quart. Journ. Micr. Sci., xxxi. (1890) pp. 29–39 (1 pl.).
‡ Occasional Papers of the Natur. Hist. Soc. of Wisconsin, i. (1889) pp. 61–113 (1 pl.).

The first difficulty which is met with by a worker on this subject is that the meaning of a protective peculiarity can be determined only when the animal is seen in its natural home; the faithfulness, moreover, of a protective resemblance is much less striking when the animal is seen in the cabinet. For the details of this interesting essay we must refer the reader to the paper itself.

Sexual Selection in Attidæ.*—Mr. G. W. and Mrs. E. G. Peckham give an account of their observations on sexual selection in Spiders of the family Attidæ. However satisfactory Mr. Wallace's explanations may be when applied to birds and butterflies, they fail when applied to spiders; his theory would only partially explain the following facts. Among Attidæ males are more brilliant than females, young males nearly always resemble adult females, the males, when they differ from the females, depart from the general colouring of the group, and females, when they depart from the colouring of the group, approach the colouring of the males. Mr. Wallace's assumption that the male animal is constitutionally more active than the female is not true of spiders. On the contrary, it is the female that is the more active and pugnacious; in neither sex is there any relation between development of colour and activity; when the male is distinguished by brighter colours and ornamental appendages these adornments are not only so placed as to be in full view of the female during courtship, but the attitudes and antics of the male are at that time such as to display them to the fullest possible extent.

New Parasite of Lamellibranchs.†—Herr F. Koenike has a preliminary notice of a new parasite of *Anodonta* and *Unio* which he calls *Atax aculeatus*. It appears to have been seen by Claparède in its larval stage, but the author has been fortunate enough to obtain the adults of both sexes.

Teutonia.‡—Herr F. Koenike has published a detailed account of this new Hydrachnid from Gelnhausen in Hesse, to the preliminary notice of which we have already called attention; § only one pair of this interesting intermediate form seems to have as yet been found.

Pentastomum.‖—Signor C. Parona describes *Pentastomum Crociduræ* sp. n. from the peritoneum of *Crocidura fuliginosa*, an insect-eating mammal of Burmah; the body is 10·5 mm. long, and 1 mm. broad. It has sixty-two rings, on which are numerous dermal pores arranged in transverse rows. *Pentastomum gracile* Diesing is reported as being found in the body-cavity of *Macrodon trahira*. A bibliography of *Pentastomum* completes the memoir.

ε. Crustacea.

Excretory Apparatus of Crayfish.¶ — M. P. Marchal gives a fresh account of the "green-gland" of the Crayfish. The saccule is not, as some authors have stated, a simple sac traversed irregularly by

* Occasional Papers of the Natur. Hist. Soc. of Wisconsin, i. (1889) pp. 3–60 (3 pls.)

† Zool. Anzeig., xiii. (1890) pp. 138–40.

‡ Arch. f. Naturg., lvi. (1890) pp. 75–80 (1 pl.).

§ This Journal, 1889, p. 509.

‖ Annal. Mus. Civic. d'Istor. Nat. Genova, xxix. (1889–90) pp. 68–78 (1 pl.). See Centralbl. f. Bakteriol. u. Parasitenk., vi. (1890) p. 480.

¶ Comptes Rendus, cx. (1890) pp. 251–3.

vascular bands and septa; its cavity is divided into two principal compartments by a longitudinal median septum; the other septa are so arranged that a mould of the cavity exactly represents a racemose gland, the two chief lobes of which are determined by the large median septum. The green or cortical substance has neither the form ascribed to it by Grobben or by Wassiliew, but is a glandular plexus formed by canals, which anastomose among themselves on a unique plan. These canals give off diverticula, which swell out into ampullæ which form the vesicles of the green substance. The author accepts Wassiliew's account of the white substance, but absolutely denies the accuracy of the more recent statements of Szigethy and of Rawitz; and the same remarks apply to the communications between the constituent parts themselves.

We may regard the excretory apparatus of the Crayfish as formed of a septate sac tending to be racemose in form; of a glandular plexus which occupies the whole of the lower surface of the gland; of a twisted transparent tube; of a large white spongy cord; of a large bladder; and of an excretory canal.

Monstrilla.*—Mr. G. C. Bourne has some notes on this genus of Copepoda. Nearly all previous writers have regarded *Monstrilla* as a parasitic form, for no other reason than the absence of mouth-parts and alimentary tract. But every specimen that has been caught has been found in a free pelagic condition. The well-developed swimming feet, with their powerful musculature, and the total absence of any, except sexual, grasping organs, combine to speak against a parasitic habit. It is possible that *Monstrilla* may present an analogy with the Ephemeridæ, and the adult may be preceded by a predaceous larva having mouth-parts and an alimentary tract which, after a succession of rapid ecdyses, developes into the mature sexual form, whose only function is that of reproduction. Mr. Bourne acknowledges, however, that the undoubtedly young specimens which were taken by Dr. Norman afford no support to this suggestion, except that some of them have rudiments of gnathites which are entirely absent in adults. The Monstrillidæ may be regarded as a separate subfamily of the Corycæidæ. A new definition of the genus is given and six species are recognized; of these *M. longispinosa* from Plymouth is new.

Entomostraca of Bay of Marseilles.†—Prof. P. Gourret has a note on this subject. His recent researches have enabled him to increase the number of known Copepoda by twelve; fourteen Cirripedia are registered; the only known Ostracod is *Cypridina mediterranea* Costa, and two species of *Podon* are the only Branchiopods.

Vermes.

α. Annelida.

Polynoida of Spitzbergen.‡—Herr H. Trautzsch gives an account of eleven Polynoids collected at Spitzbergen, one of which only—*Harmothoe vittata*—is new. He afterwards proceeds to discuss their nephridia. He finds that, in their simplest condition, they are tubular

* Quart. Journ. Micr. Sci., xxx. (1890) pp. 565–78 (1 pl.).
† Arch. de Biol., ix. (1889) pp. 472–83 (2 pls.).
‡ Jenaische Zeitschr. f. Naturw., xxiv. (1889) pp. 61–104 (2 pls.).

organs, open at either end; the proximal end bores through the dissepiment of the next anterior segment, and the external orifice is at the tip of a neurally placed seta which corresponds to the hinder edge of its segment. In every nephridium there may be distinguished the funnel, the internal ascending nephridial loop, the sac, the outer loop, and the papilla. There is only one pair in a segment, and each nephridium has, contrary to Haswell's statement, only one outer orifice. These organs are found in all the segments except the first four and the last; they differ in structure in different segments, and those of the right side exhibit some differences from those of the left. The form of the anterior nephridia and of all in the young is the same; and this form is the primary one; that of the hinder nephridia and that seen during sexual maturity is a secondary one. The organs consist of two cell-layers, an outer which is peritoneal and an inner which is epithelial; the several form-elements of the latter appear to be ciliated cells, but they vary somewhat in character in different regions of the organs.

There have been many discussions as to the functions of these structures; Herr Trautzsch acknowledges that they have renal functions, and that this is primary; the anterior simpler nephridia have no other. The hinder tubes cease to be renal during the period of sexual activity, when they take on as a secondary duty the office of conveying sperm or ova; or, in other words, they undergo a change of function. At the same time the generative products are not driven to the exterior by the activity of the nephridia, but chiefly by contractions of the surrounding muscles.

New Genus of Oligochæta.*—Prof. A. G. Bourne describes a new worm, *Chætobranchus*, found in mud from a pond in Madras town. The worm attracted him by its branchial processes, which could be seen with the naked eye. The most remarkable feature is the presence of dorso-lateral processes, of which there is a pair to each of the anterior segments; they are obviously branchial in function. Each is virtually a hollow prolongation of the body-wall; the epidermis is bounded externally by a distinctly visible cuticle, through which very fine cilia project; at the extremity are a few stiff processes which are doubtless sensory in function. Into each of the longer processes (about the first fifty) there runs a loop of the lateral vessel.

Entirely contained within each process are the processes of the setæ, all in the case of the more anterior, or some in that of the more posterior, which belong to the dorsal bundle; there are no muscular structures in the branchial processes, which are kept fairly rigid, are moved by the dorsal setæ, and thus serve the worm as locomotor organs. There seems to be no doubt that this worm has been noticed by Semper, and the author proposes to call it *Chætobranchus Semperi*.

Anatomy of Dero.†—Mr. F. E. Beddard has some notes on the anatomy, chiefly of the reproductive organs, of a species of *Dero* (*D. perrieri*), found by Messrs. Bolton, of Birmingham. There can be no doubt that this annelid has been correctly referred to the Naidomorpha, but it has not genital setæ on the sixth segment.

* Quart. Journ. Micr. Sci., xxxi. (1890) pp. 83–9 (1 pl.).
† Proc. Zool. Soc. Lond., 1889 (1890) pp. 440–4 (3 figs.).

Embryology of Earthworm.*—Prof. E. B. Wilson gives a detailed account of his observations on the embryology of the earthworms—*Lumbricus terrestris*, *communis*, and *fœtidus*. He finds that the cleavage is unequal and variable, and results in the formation of a blastula containing a large blastocœl. The gastrula is formed by embolic invagination. The blastopore, which at first occupies the entire ventral surface, narrows to a slit-like form, when its longer axis coincides with the long axis of the body; it closes from behind forwards, but its foremost portion persists as the mouth. The germ-bands are, from the first, united in the middle line behind the posterior lip of the blastopore, but remain separate in front until the establishment of the mouth, when they extend forward, join in the median dorsal line, and thus form a complete ring surrounding the region of the primitive blastopore.

The entire mesoblast is derived from a pair of primary teloblasts that lie at the posterior ends of the germ-bands, and no mesoblastic elements arise from the ectoblast which overlies the germ-bands. The primary teloblasts are differentiated in the course of the cleavage, and are pushed into the segmentation cavity some time before the commencement of gastrulation. The cells formed by the continued proliferation of these primary cells are very early differentiated into two groups. Those of the first have histologically the character of mesothelium, form the mesoblastic parts of the germ-bands in the trunk-region, and inclose the paired cœlomic cavities; it is proposed to term them the trunk-mesoblast. The cells of the second group arise by migration from the dorsal and anterior parts of the germ-bands, and may be called the migratory mesoblast. Histologically, they have the character of mesenchyme, and form a nearly complete investment of the body in the trunk region, but they also extend forward to form the cephalic mesoblast of the prostomium.

When fully established the germ-bands consist, as in the Hirudinea, of three strata of cells:—an outer (ectoblast), one cell in thickness, which arises directly from the outer layer of the gastrula and persists as the hypodermis; an inner layer (mesoblast) consisting of granular cells derived from the two primary teloblasts, and giving rise to muscles, septa, blood-vessels, peritoneal epithelium, reproductive organs, and the inner part of the nephridia. Between these two there lies a layer which agrees in general histological character with, and is indirectly derived from the former; it gives rise to the nervous system, the outer part of the nephridia, and the setigerous glands and setæ.

This middle stratum is arranged in a series of distinct longitudinal cell-rows, which, in early stages, lie at the surface and form part of the general ectoblast, but afterwards sink beneath and are covered by the rest. Until a comparatively late stage each row terminates behind in a large cell or teloblast which is the parent of the entire row, and thus of all the structures to which the row gives rise; they may be called neuroblast, nephroblasts, and lateral teloblast, and may, collectively, be called the anterior teloblasts to distinguish them from the posterior or mesoblastic teloblasts which lie at the extreme hinder ends of the germ-bands. These anterior teloblasts first appear shortly after the completion of gastrulation, when they lie at the surface.

* Journal of Morphology, iii. (1889) pp. 387-462 (7 pls.).

The prostomium is formed by the union of the anterior ends of the germ-bands; the mesoblastic part arises by the forward growth and union in the median line of the mesoblastic bands—a process which is effected by proliferation and migration of the mesoblast cells already formed, and not by the formation of new mesoblastic elements from the superjacent ectoblast. The prostomial cavity is from the very first unpaired. The preoral or cephalic ganglia are differentiated out of the front ends of the neural rows, formed by the neuroblasts, at a time when these rows are fused with the ectoblast, and before they have met in the median line in front of the mouth. There is, therefore, no median apical plate, but only a pair of lateral ectoblastic thickenings continuous with the neural rows.

As regards the mesoblast the author is fully convinced that the whole of the "epiblastic mesoblast," which Kleinenberg believed to be derived directly from the outer layer, is simply the middle stratum which he failed to distinguish from the inner or mesoblastic stratum. This is a matter of importance owing to the views lately put forward by that author in his paper on *Lopadorhynchus*, and has some bearing on his denial of the existence of the mesoblast as a primary feature of development.

Prof. Wilson thinks that the development of *Lumbricus* can be most simply and clearly interpreted in accordance with Sedgwick's hypothesis:—(1) The ancestral form possessed an elongated ventral blastopore that gave rise to both mouth and anus by closure in the middle region; (2) the mesoblast and the nervous system originally formed a ring around this blastopore, and subsequently underwent concrescence throughout its middle portion as the blastopore closed; (3) the cœlomic cavities were arranged in a continuous series in the mesoblastic ring, each lateral cavity lying opposite a corresponding cavity on the other side of the body, and a single anterior cavity lying in front of the mouth and giving rise to the head-cavity; (4) the larval trochosphere is secondarily derived from such a form by retardation or temporary suppression of the trunk-region, and early and extensive differentiation of the head-region.

Embryology of Earthworm.*—Dr. R. S. Bergh has a preliminary notice of his recent studies on the development of the earthworm. He has particularly directed himself to an examination of the origin of the stripes of cells and primitive cells described by Wilson, but which Bergh failed to find in *Criodrilus*. In quite young embryos the number of such cells is very small. For example, in an almost spherical embryo, 0·125 mm. long, there are only two on either side; in an embryo 0·16 mm. long there were three primitive cells on either side, and it is only from the two inner on either side that quite short cell-rows arise. Later on the median of the three primitive cells divides into two, and all four begin to produce cells. It is, for various reasons, very probable that all the eight primitive cells arise from a single cleavage-sphere.

The primitive cells, and the rows to which they give rise, are at first quite superficial in position, and the three primitive cells are to be

* Zool. Anzeig., xiii. (1890) pp. 186-90.

found in the same place, even when the young are one and a half mm. long. The cell-rows, however, are ordinairly covered by epidermal cells, with which they have not the least connection.

Although the author agrees with Wilson in believing that row I. (of Wilson's nomenclature) passes into the ventral ganglionic chain, he does not find that the development of that apparatus is as simple as is ordinarly stated. A plexus of nerve-cells is developed along the middle ventral line long before the cells of the "neural row" develope into nervous elements. These ventral cells are ordinarly uni- or bipolar. The author is of opinion that these nervous cells have a different genetic history from the neural cells, and that they arise from ordinary ectodermal cells.

The author traces briefly the history of the other rows, and expresses a hope that he will soon be able to publish his results in detail.

Anatomy of Earthworms.*—The more important points in Mr. F. E. Beddard's paper, in addition to the description of three new species of *Acanthodrilus*—*A. antarcticus*, *A. Rosæ*, *A. Dalei*—and of one new *Perichæta*—*P. intermedia*—appear to be the following:—

He describes the ciliation of the spermathecal appendix in *A. Rosæ*, and the presence in *Eudrilus* of two pairs of ovaries connected by oviducts with a single aperture on either side; these oviducts are continuous with the ovaries. *P. intermedia* differs from most species of *Perichæta* in having a single pair of nephridia in each segment, and in having a tubular atrium like that of *Acanthodrilus*; it has also functional egg-sacs, wherein the ova undergo their development surrounded by a follicular epithelium, and with a mass of germinal cells attached to one pole, as in some members of the "limicolous" division of the Oligochæta. *Perichæta* is provided with a peripheral nerve-plexus which is specially developed in the neighbourhood of the setæ; *Acanthodrilus* has a subintestinal, and *Perichæta* and *Thamnodrilus* a subneural blood-vessel.

An account is given of the minute structure of the spermathecæ and the spermathecal appendices in *Perichæta* and *Acanthodrilus*; spermatozoa are only found in the appendices, the epithelium of which has largely undergone degeneration into a viscous substance, in which the spermatozoa are imbedded. The former of these two genera has epidermic glands, which are, possibly, equivalent to the capsulogenous glands of *Lumbricus*; and both of these possess organs which probably correspond to the so-called pericardial glands of *Lumbriculus*; they consist of a network of capillaries with numerous spherical dilatations which are crowded with cells. The whole network forms a compact series of organs clothed with chloragogen cells, which, though limited to the anterior segments, exhibit a more or less perfect metameric arrangement. Special glycogenic organs appear to exist in *Ac. georgianus* in the form of a series of paired sacs attached to the septa.

The Rings of Piscicola.†—Dr. S. Apáthy has reinvestigated the relation of rings to somites in *Piscicola piscium*. That there are three rings to a somite is an old error; that there are a dozen was the

* Quart. Journ. Micr. Sci., xxx. (1890) pp. 421–79 (2 pls.).
† Zool. Anzeig., xii. (1889) pp. 649–52.

author's previous conclusion; now, however, he maintains that there are fourteen. But the fourteen are derived from a primitive twelve, so that *Piscicola* forms no exception to the rule of three which persists among Rhynchobdellidæ.

Phymosoma varians.*—Mr. A. E. Shipley has published an account fuller than that which we have already † noticed of the structure of this Gephyrean. He now, further, urges that there are reasons for maintaining *Phoronis* in its old position as a form closely allied to the more normal Gephyrea inermia. In addition to points already emphasized by Lankester, he urges that the skeletal tissue found in *Phymosoma* has its homologue in *Phoronis*, while the thin membranous web which forms the "collar" of *Phymosoma* appears to correspond very closely with the calyx or web which surrounds the base of the head in *Phoronis*. The absence in the unarmed Gephyrea of mesenteric partitions in the post-oral body-cavity may be accounted for by the twisting of the intestinal loop in the more normal genera; and the radial muscles are, in all probability, the remains of a mesentery which, in the ancestral form, was continuous.

β. Nemathelminthes.

Filaria sanguinis hominis.‡— Prof. C. Sibthorpe gives a short account of this worm, and figures drawings made by Prof. A. G. Bourne; the latter adds a description of his preparations. One is that of the caudal extremity of the male which has never yet been described. The spicules would appear to differ from those of any known nematode.

The Nematode of Beetroot.§—Dr. J. Ritzema Bos writes the history of the beetroot disease, as elucidated by the researches of Kühn, Strubell, ‖ and others. Millipedes such as *Iulus*, beetles such as *Atomaria linearis*, fungi such as *Sporidesmium putrefaciens* and *Peronospora schachtii* were known to attack the beetroot, but the prevalent disease was usually regarded as a consequence of soil-exhaustion by continuous beetroot crops. With great patience Kühn demonstrated that this was not the real cause, and Strubell, by tracing the disease to a nematode parasite—*Heterodera schachtii*—verified the opinion which even in 1859 was expressed by Schacht. This worm is not far removed from the genus *Tylenchus*, to which Ritzema Bos has recently given so much attention, and has allied species in *H. radicicola*, which forms galls on many plants, and *H. javanica* from the sugar-cane. A discussion of its characters and life-history (already recorded in this Journal) forms the second part of the present paper, which closes with an account of preventive measures.

Nematodes in Vinegar.¶—Dr. G. Lindner discusses the occurrence and hygienic import of the Anguillulidæ which are common in weak or impure vinegar. They are "monogenic," and included among the Rhabditidæ. The males and females respectively measure 1–1·5 mm.

* Quart. Journ. Micr. Sci., xxxi. (1890) pp. 1–28 (4 pls.).
† See this Journal, 1889, p. 642.
‡ Proc. Roy. Irish Acad., i. (1889) pp. 202–5 (1 pl.).
§ Biol. Centralbl., ix. (1890) pp. 673–83, 705–16 (11 figs.).
‖ See this Journal, 1888, p. 737.
¶ Centralbl. f. Bakteriol. u. Parasitenk., vi. (1889) pp. 633–8, 663–8, 694–9.

and 1·5–2·5 mm. in length. The worms move actively in a fluid medium, creep slowly in thick concoctions, or coil together in complicated knots. Dr. Lindner kept *Anguillula oxophilæ* in various cultures; they thrive well on a diet of white of egg, withstand even tolerably strong vinegar, are killed at once by pure acetic acid, are very slightly perturbed by artificial digestive cultures, live well on fruits, bulbs, &c. The females reproduce viviparously or oviparously, according to the nutritive medium and temperature, but soon die after reproduction; nor are the males long-lived. They flourish best between 16° and 30° C., and are killed by a temperature over 42° C., or under the freezing point; on light and air they are very slightly dependent, but to drought very sensitive. After desiccation for three or four hours no revivification even of the eggs was observed. Differences in size followed differences of culture, and the worms have great powers of adaptation to most diverse conditions. Their natural home seems to be in moist mud and in putridity, but they are rare in drinking or running water. That millions of germs float in the air is a fable. How they get into the vinegar is uncertain, but they probably insinuate themselves at certain stages of its manufacture from brandy. In vinegar prepared from wine by the quick process they are very rare. Dr. Lindner describes some infection experiments, and reasonably urges that, although the "vinegar-eels" are not exactly dangerous, it is at once safer and more appetising to make sure either that the vinegar is of the better sort, or at least boiled and filtered.

Parasites in the Blood of the Dog.*—Dr. P. Sonsino finds that the dog is subject to infection by at least one species of Nematode, which discharges myriads of embryos into the circulation. This hæmatozoon is *Filaria hæmatica* (Gruby and Delafond) or *F. immitis* (Leidy), and inhabits not only the right cavity of the heart or pulmonary artery, but also the subcutaneous connective tissue, intermuscular connective, and various parts of the vascular system. The intermediate host is the louse *Hæmatopinus pilifer*, which receives the *Filaria* embryos from the dog's blood. It seems that even the fœtal dog may be infected by the parasite. Sonsino agrees with Grassi in maintaining that *Tænia cucumerina* of the dog has two intermediate epizoic hosts, *Trichodectes latus*, and also the above-mentioned louse, the latter being probably infected in its larval stage.

Filaria immitis.†—Herr O. Deffke reports the case of a five-year old dog, born in Japan, and brought thence to Germany, which suffered from chronic interstitial nephritis. Fifty examples of *Filaria immitis* were found in the right auricle and ventricle; a large number of embryos were found in the blood, but no eggs were detected. The substance of the kidney was seriously affected.

Ascaris halicoris.‡—Herr C. Parona reports on the Nematodes collected at Assab by Dr. V. Ragazzi. In one host twenty-six examples of *A. halicoris* were seen, and in another sixty-four; this species resembles

* Atti Soc. Tosc. Sci. Nat., x. (1889) pp. 20–65 (1 pl.).

† Monatshefte f. Prakt. Thierheilkunde, i. (1889) 16 pp. (4 figs.). See Centralbl. f. Bakter. u. Parasitenkunde, vii. (1890) p. 515.

‡ Annali di Mus. Civico, vii. (1889) 14 pp. (1 pl.). See t. c., p. 514.

in many points *A. lumbricoides*, but the cellular layer of the intestine forms high folds, and a longer cæcal sac is connected with the œsophagus. Three other Nematodes are also noticed.

γ. Platyhelminthes.

Australian Land Planarian.*—Mr. A. Dendy gives an account of the anatomy of *Geoplana spenceri*, a new land Planarian remarkable for the intense blue colour of its ventral surface. We are not justified as yet in recognizing more than two genera of Australian land Planarians, *Geoplana* with many, and *Rhynchodesmus* with only two eyes. It has been lately observed by Mr. C. C. Brittlebank that these creatures live on animal food, as Moseley has already urged.

Fresh-water Triclades have the superficial muscular system more highly developed and containing more layers than the terrestrial forms; on the other hand, the latter have a much more extensive deep muscular system than the former; this is, doubtless, in correlation with the changed habitat and the thicker form of body.

The lining epithelium of the alimentary canal consists primitively of a single layer of amœboid cells which take in and digest food-particles. At the anterior end of the alimentary canal whither, probably, only a little food can find its way, the cells retain their amœboid character and remain in a single layer. Nearer the mouth, where there is more food to be digested, the cells become so numerous that they are set in irregular heaps. As they become densely charged with granules (excretory products) and their protoplasm dwindles away they become mere thin-walled bags, full of granules; the wall of the cell ruptures and the granules are discharged into the alimentary canal and are ejected through the mouth. The author gives a careful account of the views of preceding writers and of his own observations on the rhabdites; as to their function he suggests only that they may make their possessor extremely unpalatable, and may also serve to increase the stickiness of the slime.

All the organs of the body are described in detail.

New Land Planarians from Sunda Islands.†—Dr. J. C. C. Loman describes the land Planarians found by Prof. M. Weber in his travels in Java and Sumatra. Fourteen new species, two of which belong to *Bipalium*, two to *Geoplana*, and two to *Rhynchodesmus*, are described. *B. ephippium*, *G. nasuta*, and *R. megalophthalmus* were subjected to a close anatomical investigation, the results of which are here given. The genus *Dolichoplana* Moseley does not present sufficient differences in its musculature from *Rhynchodesmus* to justify us in regarding it as distinct. The eye of this last genus presents structural characters which indicate that it is of much higher organization than the ordinary Turbellarian eye. On the whole the anatomical characters of these three genera are strikingly similar.

Interpretation of Cestodes.‡—Prof. C. Claus discusses the morphological and phylogenetic interpretation of tapeworms. Starting from *Caryophyllæus*, which he regards as homologous with a Trematode, he

* Trans. Roy. Soc. Victoria, 1889, pp. 50-94 (4 pls.).

† 'Zoologische Ergebnisse einer Reise in Niederländisch-Ost-Indien, herausgegeben von Dr. Max Weber,' Leiden, Heft i. (1890) pp. 131–58 (2 pls.).

‡ Arbeit. Zool. Inst. Univ. Wien (Claus), viii. (1889) pp. 313-26.

traces the gradual complication of life-history on to the Tæniidæ, and finally to *Echinobothrium*, whose liberated joints persist for some time and even increase in size. "The development of the Acalephæ may be defined as alternation of generations which in certain cases by contraction and abbreviation becomes metamorphosis; while the development of the Cestodes is to be interpreted as metamorphosis, which by the individualization of certain products of growth may give rise to variously complicated forms of alternation of generations." The sporocysts and rediæ in the development of *Distomum* are heterogonic, sporogonic larvæ, with parthenogenetic or pædogenetic reproductive cells; they are morphologically equivalent to the cercariæ, as the latter are to the cysticercoids of Cestodes. Claus elaborates these comparisons, and brings the life-histories of Trematodes and Cestodes into relation with the phylogenetic development of their hosts.

Helminthological Notes.*—Dr. P. Sonsino discusses those species of *Distomum* which are allies of *D. conus* Creplin. The genus *Distomum* s. str. is characterized by the position of the genital aperture between the oral and the ventral sucker. A subgenus *Dicrocœlium* is then distinguished, in which the intestinal cæca are prolonged as far as the posterior end of the body. Within this subgenus the members of one section have terminal posterior testes, behind the oviducal folds and ovary, and one behind the other. Finally, the section thus specified includes the group of which *D. conus* is type. In these the ventral sucker is smaller than the oral, the short œsophagus bifurcates far in front of the ventral sucker, the anterior fourth of the body has a markedly conical form, and all the members live in the bile ducts of carnivorous mammals or of man. The testes are ramified in *D. endemicum* and *D. sinense*, lobed in *D. conus* and *D. felineum*, aggregated in *D. campanulatum* and *D. conjunctum*, doubtful in *D. truncatum*.

Parasites of the Salmon.†—Herr F. Zschokke has studied the parasites of the salmon, partly with the hope of thereby verifying the statement that the fish fasts as it ascends the rivers, and even after spawning is over. In forty-five salmon from the Rhine, eleven species of parasites were found, which were almost wholly the wonted guests of marine hosts, e.g. *Agamonema capsularia*, *Ascaris clavata*, *Distomum varicum*, *D. reflexum*, *Tetrarhynchus solidus*, *Rhynchobothrium paleaceum*, &c. The author found a new species of *Distomum*, *D. miescheri*; he identified *Bothriocephalus infundibuliformis* and *B. proboscideus*, and dissents from Küchenmeister's conclusion that the salmon is the principal intermediate host of *B. latus*, for no very young larvæ of this species were present. It is noteworthy that no parasites occurred below the pyloric cæca, a fact which suggested that the fasting fish loses in the river many of the guests which are found in the intestine during marine life. Notes on the eleven parasites are communicated.

Peculiar Tetrarhynchid Larva.‡—Herr E. Lönnberg found in the abdominal cavity of a *Gadus virens* a single example of the *Tetrarhynchus*

* Atti Soc. Tosc. Sci. Nat., vi. (1889) pp. 273–85.

† Verh. Naturf. Gesell. Basel, viii. (1890) pp. 761–95 (1 pl.).

‡ Bihang til Svenska Vet. Akad. Handlingar, xv. 4, No. 7 (1889) 48 pp. (3 pls.). See Centralbl. f. Bakteriol., vii. (1890) p. 346.

linguatula found by P. J. van Beneden in *Scymnus glacialis*. He was able to distinguish a scolex, a body, and a small round appendix at the hinder end; the body was marked by deep transverse grooves, but there was no sort of segmentation. The appendix contained rudiments of both male and female organs. He thinks this form should be separated from the Tetrarhynchidæ, and formed into a new genus allied to the Bothriocephalidæ. It may be called *Cœnomorphus*, and defined thus:—"Scolex magnus bothriis duobus oppositis, dorso-ventralibus, angustis, rimæformibus, limbo calloso, capiti immersis. Proboscides quatuor perbreves, crassæ, subclavatæ, uncinis armatæ, in vaginas retractiles. Bases vaginarum oblongæ. Collum cylindricum. Corpus depressum, tæniiforme, rugosum, sed inarticulatum, appendice postica rotundata." The author regards this form as being a cestode-nurse of very considerable size in which the genital organs are beginning to be developed, and which has mature sperm before there are any indications of segmentation.

Cysticercoid with Caudal Appendages in Gammarus pulex.*—Dr. O. Hamann describes some tailed cysticercoids which he found in *Gammarus pulex*. The investment by which they were contained was attached to the digestive tract; the cysticercoids were about 1·3 mm. long, and 0·5 mm. of this was taken by the tail. The author gives an account of the various stages of development that he was able to observe. The other host appears to be the Duck.

δ. Incertæ Sedis.

Two new Species of Rotifers.†—Mr. D. Bryce states that *Metopidia rhomboidula* might be easily passed over as *M. triquetra*, but the lorica has almost the shape of the ace of diamonds. *Euchlanis subversa* is, as its specific name is meant to show, a *Euchlanis* turned upside down, the ventral plate being considerably the larger, and strongly turned up at the sides.

Echinodermata.

British Fossil Crinoids.‡—Mr. F. A. Bather has commenced a series of papers on British Fossil Crinoids. After a historical introduction he gives a statement as to the terminology which he intends to adopt—a matter of some importance in the present state of this group. The plate is illustrative of the structure of the dorsal cup in the genera of Fistulate Crinoids.

Genesis of Actinocrinidæ.§—Mr. C. R. Keyes has been led by his study of the Actinocrinidæ to some conclusions which are, he thinks, of much wider bearing. He finds that it is clearly indicated that a large proportion of the genera date back much further geologically than actual observation shows. At times, in the phylogenetic history of a group, variations appear to go on with broad and rapid strides, and the

* Jenaische Zeitschr. f. Naturwiss., xxiv. (1889) pp. 1–9 (1 pl.).
† Science-Gossip, 1890, pp. 76–9 (5 figs.).
‡ Ann. and Mag. Nat. Hist., v. (1890) pp. 306–34 (1 pl.).
§ Amer. Natural, xxiv. (1890) pp. 243–54 (3 pls.).

organisms survive through rapidly changing physical conditions. When the changes of environment became too rapid, the forms either ceased to exist or retrograded, became depauperate, and finally extinct; this may be illustrated by *Batocrinus*, *Dorycrinus*, and *Dichocrinus*. Variation may go on in one portion of an organism without materially affecting other parts. The Actinocrinidæ show a decided tendency throughout their existence to increase the distal extent of their rays. This was accomplished by simple branching of the free arms, as in *Megistocrinus*, by the lateral expansion of the arms, as in *Eretmocrinus*, or by radial extension of the calyx-brachials, as in *Teleiocrinus* and others.

Ambulacral and Adambulacral Plates of Starfishes.*—Mr. J. W. Fewkes comes to conclusions regarding the homologies of these plates, which differ from the generally received doctrines. He finds that there is no difference in the way the mouth-parts of typical representatives of the groups known as Asteriæ Ambulacrariæ or A. Adambulacrariæ are developed. The arm of a starfish is made up of somites, and the water-vascular system of vessels may be supposed to be primarily surrounded by a calcification. The theoretical ring of calcification is most closely reproduced in its typical form in the plates surrounding the mouth. The ambulacrals and adambulacrals are portions of the annular calcification of successive segments, and are serially homologous. The ambulacrals of starfishes are not represented in sea-urchins except around the mouth, when they appear as auricles. The adambulacrals of starfishes represent the ambulacrals of sea-urchins and complete the external portion of the problematical ring of calcification, which is absent in Asteroids. The marginal plates of *Asterias* are homologous with the so-called adambulacrals of sea-urchins.

With regard to spines it seems to Mr. Fewkes to be necessary to distinguish the ordinary spines of the adambulacral arm-plates, the hook-shaped spines found on each side of the terminal in some young Ophiurids, or on the adults of others, the fins of *Ophiopteron*, and the fan-shaped spines of *Asterias*.

French Holothurians.†—M. E. Hérouard gives an account of the Holothurians found on the coast of France. He regards a Holothurian as an Echinoderm whose plane of symmetry does not correspond to that of the Spatangoids; the left ventral radius of the latter is the homologue of the median ventral radius of a Holothurian. The inter-radius which corresponds to the madreporite of Echinoids is, therefore, in the median dorsal line.

The integument presents three zones, the innermost of which is muscular; the intermediate one is formed of an inner nervous and an outer connective layer, and belongs to the "amœbophorous system"; the outermost layer is connective, is very strong, and contains the calcareous corpuscles; it plays the part of a protective organ like the test of an Echinoid. In some species there is a circumanal apparatus, the radial plates of which are the homologues of the ocular plates of Echini. The calcareous corpuscles are always formed of a hexagonal plexus, and

* Proc. Boston Soc. Nat. Hist., xxiv. (1889) pp. 96–117.
† Arch. Zool. Expér. et Gén., vii. (1889) pp. 535–704 (8 pls.).

those of the young are often more varying and complicated than those of the adult.

In the mesentery we have to distinguish a dorsal part divided into two, the upper of which depends from the pharynx and œsophagus, and represents the œsophageal mesentery of Echini, and the wall of the hydrophoric sac of Starfishes; there are lateral and ventral parts and an intermediate or internal mesentery, the development of which is proportional to the depth of the intestinal loop. The endothelium of the general cavity contains stomata. The "aquopharyngeal bulb," which is situated at the superior extremity of the digestive tube, contains, in the Pedata, an axial part—the pharynx, and a peripheral part which is formed by the calcareous corona and the central parts of the aquiferous apparatus. These two parts are separated by the circumpharyngeal sinus, which is an appendage of the general cavity. The upper extremity of this sinus forms the circumbuccal sinus.

The aquiferous system of the Pedata is similar to that of Echinoids; it is made up of a ring situated at the base of the pharynx, to which are appended the sand-canal or canals and the Polian vesicles; each of the radial vessels given off from it consists of three portions—one dilated, one coronal, and one ambulacral. The two latter have, at their sides, more or fewer orifices which establish communication between the vessel and the ambulacral tubes; all these orifices are provided with a valve. The tentacles are ambulacral tubes depending from the coronal portion, and adapted to special functions. The aquiferous apparatus is essentially locomotor, and is entirely distinct from the amœbophorous system. The endothelium of the former system, as well as that of the general cavity, only adheres to the subjacent layer by filiform prolongations, and thus a subepithelial lacuna is formed.

In addition to the nerve-trunks common to them and Echini, Holothurians have five internal ambulacral bands, the upper ends of which bifurcate and bend inwards to the aquopharyngeal bulb. The superficial nerve-plexus of Echini is represented by a deep nervous plexus. The amœbophorous system, like that of Echini, is formed by a system of free and one of connective lacunæ. The former is composed of a circumpharyngeal ring, of an internal marginal lacuna, and of an external marginal lacuna, with which a genital lacuna is connected; there are also five radial lacunæ. The second system is placed in the median zone of the wall of the body, of the digestive tube, and of the gonads, in the axis of the circumpharyngeal and circumcloacal tracts, and in the mesenteries. The dendritic organs are, primarily, hydrostatic in function, but are also respiratory and excretory, and probably serve also for amœbocystogenesis. The Cuvierian organs are glandular, and not defensive, as has been asserted by various writers.

Excavations by Sea-Urchins.*—Mr. J. W. Fewkes thinks that the excavations sometimes made by *Strongylocentrotus drobachiensis* on the coast of Grand Manan are made by means of its teeth and spines, combined with motions of the animal produced by waves and tide. Though primarily protective, the holes also serve to contain a sufficient quantity of water when the animal is uncovered.

* Amer. Natural., xxiv. (1890) pp. 1–21 (1 pl.).

Madreporic System of Echinoderms.*—Prof. M. M. Hartog draws attention to the fact that M. Cuénot, in his anatomical studies on Ophiurids, first ignored and then misquoted him.

Cœlenterata.

Alcyonaria of the 'Challenger.'†—Prof. T. Studer has issued a report of some specimens of Alcyonaria found after the main report went to press. Three new species of *Siphonogorgia*, a new *Bebryce*, and a new Plexauroid are among the forms here described.

Antipatharia of the 'Challenger.'‡—Mr. G. Brook has published a report on this slightly known group which is of great interest to the student. He treats of the general morphology of these zoophytes under the heads of: (1) the homologies of the mesenteries; (2) complete and incomplete mesenteries; (3) dimorphism; (4) colony formation; (5) cœnenchyma; (6) skeleton formation; (7) origin and arrangement of spines; and (8) retrogressive development.

The old classification of known forms into two groups is retained, but that which contains *Gerardia* only is now called Savagliidæ, and a new division has to be made for *Dendrobrachia* g. n., which is called Dendrobrachiidæ. The Antipathidæ, which form, of course, the great bulk of the group, are divided into the Antipathinæ, which contains the genera *Cirripathes* (emended), *Stichopathes* g. n., *Leiopathes* and *Antipathes* (emended), *Antipathella*, *Aphanipathes*, *Tylopathes*, *Pteropathes*, and *Parantipathes*—all new; in the Schizopathinæ we find the new genera *Schizopathes*, *Bathypathes*, *Taxipathes*, and *Cladopathes*. Several species are still relegated to the group "incertæ sedis," and a few are called "species dubiæ."

No species belonging to the family Antipathinæ has yet been obtained from depths exceeding 900 fathoms; the Schizopathina, on the other hand, are chiefly abyssal forms, and in them a considerable increase in depth is associated with a simplification in the type of corallum and a greater isolation of the dimorphic zooids.

Bilaterality in Corals.§—Dr. A. Ortmann describes *Cylicia tenella* Dana, in which most of the calices are excentric in relation to the columellæ, and bilateral in the disposition of their septa. He interprets this as a primitive character, consonant with such other features in *Cylicia* as the imperfect colonies and the simple structure of the individual calices. His general theory of bilaterality is that it was the primitive condition, most marked in solitary Rugosa, often seen in the younger less compressed members of a colony, and cropping up occasionally in such forms as *Cylicia*.

Development and Relationships of Actiniæ.‖—Dr. Th. Boveri has studied the development of several Hexactiniæ, Edwardsiæ, and Ceriantheæ. As type of the Ceriantheæ he investigated *Arachnactis albida*,

* Zool. Anzeig., xiii. (1890) pp. 136–7.

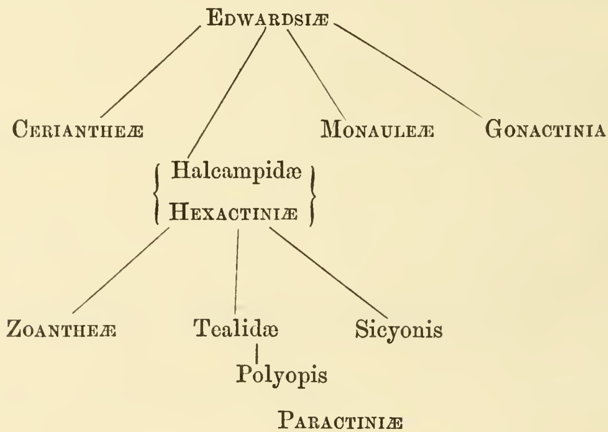
† Reports of the Voyage of H.M.S. 'Challenger,' xxxi. Part lxxxi. (1889) 31 pp. and 6 pls.

‡ Reports of the Voyage of H.M.S. 'Challenger,' xxxi. Part cxxxi. (1889) 222 pp. and 15 pls.

§ Zool. Anzeig., xii. (1889) pp. 643–6.

‖ Zeitschr. f. Wiss. Zool., xlix. (1889) pp. 461–502 (3 pls.).

and found that it exhibits a distinct *Edwardsia*-stage in which the dorsal and ventral pairs of septa have their muscle-layer on the sides turned towards the median plane, while the muscle fibrils of the lateral septa are disposed on the same side as those of the dorsal septum. Of Hexactiniæ with a bilateral disposition, *Cereactis aurantiaca* was studied, along with other larvæ of the biradiate type. An *Edwardsia*-stage was again detected. Boveri therefore derives Ceriantheæ and Hexactiniæ from *Edwardsia*-like forms. He believes the *Cerianthus*-type to have arisen from an *Edwardsia*-like form by the appearance of new pairs of septa between the dorsal directive pair. Similarly, he finds in species of *Halcampa* illustrations of the transition from Edwardsiæ to Hexactiniæ. For the various groups of Actiniæ he proposes the following genealogical scheme:—



Hoplophoria coralligens.*—Dr. H. V. Wilson gives a description of a new Actinian found in the Bahamas, which is, unfortunately, based on a single female specimen. After a short account of its anatomy, the author discusses the morphology of the stinging organs. At first sight they appear to be modified tentacles, but each organ is derived from a chamber which also gives rise to one of a cycle of tentacles, and the longitudinal musculature of the tentacles is ectodermal, while that of the stinging organs is endodermal. In position and essential structure the four stinging organs of *Hoplophoria* agree with the marginal sacs of *Actinia mesembryanthemum*, and the author regards the two structures as homologous. The ancestor of the new genus very probably had a circle of small sacs, but when the habit of living in a hole was acquired, certain of these sacs were transformed into large and formidable weapons, while the rest were lost.

In many points *Hoplophoria* agrees with the Antheidæ, but differs in the possession of only four marginal sacs, which are highly developed, in that only the six primary pairs of mesenteries reach the œsophagus, while only four mesenteries bear generative organs, but these several points have, it is argued, but little classificatory importance.

* Studies from Biol. Lab. John Hopkins Univ., iv. (1890) pp. 379–87 (2 pls.).

Thelaceros rhizophoræ.*—Mr. P. Chalmers Mitchell describes a new genus of Actinians obtained by Dr. Hickson in a mangrove swamp in Celebes. It appears to form the type of a definite family closely allied to the Corallimorphidæ, which may be called Thelaceridæ, and thus defined:—Hexactiniæ without a sphincter, cinclides, or acontia; with numerous accessory rudimentary tentacles, so that more than one tentacle communicates with a radial chamber; the normal tentacles are covered by small compound hollow protuberances. The accessory tentacles are rudimentary. The Thelaceridæ appear to have protected themselves by a sudden vertical contraction, by which they withdrew themselves into the mud, and a continual selection favoured those with strong longitudinal muscles. The oral disc remaining uncontracted, the tentacles were, in correlation with this habit, peculiarly modified. The author calls attention to our incomplete knowledge of other Stichodactylinæ, and suggests that the Discosomidæ, with the abnormal radially arranged tentacles and unretractile disc, and the Cryptodendridæ, may possibly stand on either side of the Thelaceridæ.

Anatomy of Madreporaria.†—Dr. G. H. Fowler, in commencing his fifth memoir on the anatomy of the Madreporaria, remarks that the time is hardly yet ripe for a discussion of those modifications which are likely to be ultimately introduced into the systematic classification by further morphological study. He gives, therefore, simple descriptions of anatomical structure, and in this memoir deals with *Duncania barbadensis*, *Madrepora* sp., *Galaxea esperi*, *Heteropsammia multilobata*, and *Bathyactis symmetrica*. *Duncania* is found to be a true Madreporarian, and will probably be ultimately proved to be allied to such forms as *Zaphrentis*. Figures are given of the typical structure of the genus *Madrepora*. A vertical section between two polyps of *G. esperi* shows (1) the body-wall of ectoderm, mesoglœa, and endoderm; (2) a space which is part of the common cœlenteron of the colony; (3) a layer of endoderm, mesoglœa, and (?) calicoblasts, which directly overlies (4) the cœnenchyme itself.

Heteropsammia, in common with *Stephanoseris* and *Heterocyathus*, has a pear-shaped body; some species of all these genera are known to derive the curvature of the chamber from settlement on a heliciform shell, and it is also known that a large number of Gephyrea normally inhabit heliciform shells, and Dr. Fowler thinks that, in the absence of experimental proof, we are for the present justified in regarding the heliciform cavity as due, in those cases where we have no direct evidence, to the same cause as those in which our knowledge is more exact. The anatomy of the colony in the main resembles that of *Rhabdopsammia* already described by the author; the animal is diœcious.

Unlike the rest of the 'Challenger' material, the spirit specimens of *Bathyactis* are histologically useless, due, possibly, to the rapidly diminishing pressure during their sudden ascent from the great depths at which these corals live. *Bathyactis* belongs to the imperforate division, and must not, therefore, be classed with the Fungiidæ, which have been shown by Bourne to be true perforate corals.

* Quart Journ. Micr. Sci., xxx. (1890) pp. 551–63 (1 pl.).
† T. c., pp. 405–19 (1 pl.).

Development of Septa of Halcampa chrysanthellum.*—M. Faurot describes the order of development of the twelve large septa of *Halcampa chrysanthellum*; they are arranged in pairs, and are fertile in their upper part only. The smaller septa, of which there are twelve also, are all sterile.

Habits and Species of Tubipora.†—Dr. S. J. Hickson sometimes found a lump of *Tubipora* half in and half out of the water; in such cases every stage of contraction may be seen. It is very probable that the power of complete retraction into solid calcareous tubes enables the organ-pipe coral to live in places which are at times left partially dry at low water. The author was forced to conclude that only one true species is to be found at Talisse. The length and diameter of the tubes and the appearance of the horizontal platforms are not the trustworthy specific characters which they have been supposed to be. The length and diameter depend entirely upon the position of the coral on the reef.

Maturation of Ovum and Early Stages in Development of Allopora.‡—Dr. S. J. Hickson finds that, while ova and young embryos are found in the younger branches of the colony, the sperm-morulæ and spermatozoa are only found in the older, thicker branches. As an ovum growing in one of the ordinary canals enlarges it pushes out the endoderm and ectoderm of the canal in which it is formed, and thus makes for itself a diverticulum; at the same time the endoderm of the canal-wall in the immediate neighbourhood of the aperture of the diverticulum becomes thickened, and throws out five radial pouches which embrace the proximal pole of the diverticulum. The five pouches throw out secondary pouches and give rise to a nourishing lenticular mass of cells—the trophodisc. A little later, and after some changes, fertilization probably occurs. The primitive ectoderm arises in the form of a thin membrane of clear protoplasm containing only a few small yolk-spherules which separates from the distal periphery of the young embryo. This ectoderm spreads over the periphery until it entirely incloses the central protoplasm and yolk-mass, and the embryonic ectoderm-cells are formed by the splitting up of the protoplasm into columnar epithelial cells, each of which contains a single nucleus. When the embryo has a complete columnar ectoderm it is ready to escape, but the method by which this is effected has not yet been observed; probably a channel is formed for it by the absorption of a part of the superjacent calcareous skeleton.

Occurrence of Hydromedusæ and Scyphomedusæ throughout the Year.§—Prof. W. C. M'Intosh gives interesting notes on this subject, as a further contribution from the St. Andrews Marine Laboratory. The Medusæ are of importance to fisheries, owing to the vast number of ova and free planulæ to which they give rise.

Mode of Attachment of Embryos to Oral Arms of Aurelia aurita.‖—Mr. E. A. Minchin, finding that the only descriptions of the brood-capsules of this common Jellyfish—those of Claus and Agassiz—are

* Comptes Rendus, cx. (1890) pp. 249–51.
† 'A Naturalist in North Celebes' (London, 1889) pp. 128–30.
‡ Quart. Journ. Micr. Sci., xxx. (1890) pp. 579–98 (1 pl.).
§ Ann. and Mag. Nat. Hist., v. (1890) pp. 296–306.
‖ Proc. Zool. Soc., 1889 (1890) pp. 583–5 (2 pls.).

erroneous, has drawn up an account of his own observations. On the oral arms there may be seen knobs which are really little stalked capsules or pouches which contain the embryos; these capsules are simply evaginations of the groove of the oral arm, and lined, therefore, internally by endoderm, and externally by ectoderm. In the smaller capsules the walls are relatively thick, and contain a great deal of mesoglœa, while the capsules themselves open by a comparatively wide opening into the lumen of the groove; in the larger capsules the mesoglœa is scarcely visible, and the openings are much narrowed. Embryos in all stages of development up to partly-formed planulæ are to be found. In addition to those contained in the capsules, a large number are always seen lying free in the bottom of the groove or lodged in the foldings of its margin.

Composite Cœnosarcal Tubes of Hydroids.*—Dr. J. C. C. Loman discusses the composite cœnosarcal tubes of *Plumularia halecioides*, *Corydendrium parasiticum*, *Antennularia antennina*, some species of *Tubularia* and *Corymorpha*, but especially those of *Amalthæa vardoensis* n. sp. In *Tubularia* the cœnosarcal tube divides below the stomach into several peripheral branches; so is it with *Corymorpha;* but the others show diverse conditions, and in *Amalthæa vardoensis* there are offshoot canals from three different regions of the tube. In the last-named form, radial vessels proceed from the stomach to the periphery, and open between the tentacles like anal pores in Hydromedusæ. The polype-head is separated from the hydranth-stalk not only by an external depression, but internally as well by a flat annular continuation of the supporting lamella, penetrated by the small opening of the cœnosarcal tube, which at this point gives off branched anastomosing tubules upwards to the head and downwards to the stem. These canals are lined by flat endodermic cells, while the elements which line the above-mentioned radial vessels from the stomach are columnar. The latter are digestive, and perhaps excretory; the former are circulatory. The constriction is regarded by the author as comparable to strobilization, and the species in question is described as a "monodiscal strobila of a hydropolype." It has a markedly medusoid structure, and is defined off from the stalk by an almost closed ring of supporting lamella and by a deep ectodermal groove.

Hydroid Phase of Limnocodium Sowerbyi.†—Dr. G. H. Fowler made, during 1888, some observations on the hydroid phase of *Limnocodium Sowerbyi*, which was first observed by Mr. F. A. Parsons. As neither hydroid nor medusoid could be found during 1889, he now publishes his incomplete observations. The polyp has the form of a simple cylindrical tube about 6 mm. long, has a minute mouth and is always devoid of tentacles; in spite of their absence, it catches and swallows small Crustaceans and free Nematodes. There is no perisarc, and only a loose case of vegetable detritus. The ectoderm is but little differentiated; the nematocysts are, as in *Hydra*, of two kinds. The layer of mesoglœa is so thin as to be practically unrecognizable. The cells of the upper third of the endoderm are highly vacuolated and clear, and pass imperceptibly into those of the lower two-thirds, which are filled

* Tijdschr. Neder. Dierk. Ver., ii. (1889) pp. 263–84 (1 pl. and 5 figs.).
† Quart. Journ. Micr. Sci., xxx. (1890) pp. 507–14 (1 pl.).

with spherical bodies which vary in size and stain very brilliantly. It is from the lower region only that gemmation of a new hydroid takes place, and the endoderm of the hydroid-bud consists only of these cells. As the bud does not develop a mouth for some little time after it is set free, it is possible that the spherical bodies are a store of reserve nutriment. The hydroid-bud only differs from the parent in the uniformly cubical shape of the ectoderm-cells, in the absence of a mouth, of nematocysts and one or two other characters.

Only one specimen was available for the study of the gemmation of the medusoid; in it it was formed at the apex of a polyp. The author gives details as to the few observations he was able to make.

It is to be borne in mind that no free female medusoids have yet been found; it is possible that there is a kind of "male parthenogenesis" comparable to the sporogony discovered by Metschnikoff in certain *Cuninæ*, when the immature sexual cells separated themselves from the generative organs, both in males and females, and began to multiply, one set of cells becoming engulfed by another, and, thus protected, dividing and redividing to form a morula, which under certain circumstances developed into a medusa. No conclusion can yet be certainly come to as to whether this remarkable form should be placed with the Trachymedusæ or the Leptomedusæ.

Trembley's Experiments on Hydra.*—Dr. C. Ischikawa has repeated and extended Trembley's well-known experiments on turning *Hydræ* inside out. He first isolates a specimen in a watch-glass filled with water, fixes it firmly by its hinder end to a small glass rod, and then seizes the anterior end with a forked needle. The operation is very easy, and after a little practice, one can invert a *Hydra* in five or six minutes. Care must be taken that there are no Daphnid-tails in the stomach, as their sharp edges easily destroy the endodermal cells. To try and prevent the creatures returning to their original relation of parts, a bristle was passed through them.

The inverted *Hydræ* will regain their original position if it is in any way possible to them, and if they cannot they die; the bristle does not stop their activity. The return to the original position is often so rapid that it may be easily overlooked unless the creatures are continuously watched. If part of a body of a *Hydra* be cut off, the new head is always developed at the anterior end; this fact is not in accordance with Nussbaum's view that the ectodermal cells of an inverted *Hydra* creep over and cover the endoderm. The intermediate cells are not able to regenerate all the lost cells of the body; they are young ectodermal cells, and as such can only replace the lost ectodermal cells. A small piece of ectoderm completely freed from endoderm is never regenerated into a complete animal; at the same time the intermediate cells of such a piece live and multiply for some time after the operation by budding.

If a *Hydra* attempts to take food which is so large as to extend the mouth too much it turns itself inside out around it, and immediately returns to its original position; this fact is of interest as explaining the possibility of an artificially inverted *Hydra* returning to its original

* Zeitschr. f. Wiss. Zool., xlix. (1889) [1890] pp. 433–60 (3 pls.).

relation of parts. It is possible to bring two animals into a state of permanent fusion if they are attached to one another by means of bristles, or if one is placed in the other.

Evagination of Hydra.*—Herr M. Nussbaum discussing this communication of Herr C. Ischikawa's, remarks on the changes which ensue when a *Hydra* is turned inside out. He restates his old conclusion † that ectoderm does not become endoderm, nor *vice versâ;* on the contrary, the ectoderm along with the middle lamella and with the endoderm as well, grows over the evaginated original endoderm, in a fashion also observed in wound-healing. Complicated processes of coalescence, absorption, and fresh growth restore the polype to its *status quo.* Nussbaum maintains that Ischikawa has only corroborated the above explanation, although he has sought to contradict and correct it.

Initial Cells of Ovary of Freshwater Hydra.‡—M. J. Chatin finds that those observers have been misled who have asserted the presence of free nuclei in the ovary of *Hydra*. When suitable methods, such as the use of solution of dahlia, followed by weak acetic acid, are applied these nuclei are seen to have a delicate layer of protoplasm around them.

Porifera.

Deep-sea Keratosa of the 'Challenger.'§—Prof. E. Haeckel gives an account of some remarkable organisms which have been assigned to various divisions of the animal kingdom. They have been curiously modified by symbiosis with a commensal organism which is very probably in most cases (if not in all) a Hydropolyp stock. Eleven genera and twenty-six species, all of which are new, are described in this report.

Old and new Questions concerning Sponges.‖—Mr. A. Dendy, under the above heading, deals with some problems in the structure of sponges. In answer to Dr. v. Lendenfeld, he does not contend that "Sollas' membrane" is found in all Sponges, but it is most certainly present in *Stelospongus flabelliformis;* while some of Mr. Dendy's figures were diagrammatic, others were as exact representations of actual preparations as he was able to produce. Turning next to Dr. Poléjaeff's statement that we must consider the horny sponges as a palæontologically ancient group, he gives a statement as to his own observations on *Siphonochalina*, in which genus there are three species which nearly resemble one another in external form. *S. spiculosa* has large and very numerous spicules, *S. procumbens* has three distinct and abundant, while *S. ceratosa* has the spicules excessively small and slender, and reduced to the merest vestigial structures imbedded in the stout horny fibres. In *S. plicifera* and *S. maxima* some specimens may sometimes contain vestigial traces while others are entirely destitute of spicules. It is impossible to assert that some horny sponges, at any rate, are not descendants of siliceous Chalininæ.

* Arch. f. Mikr. Anat., xxxv. (1890) pp. 111–20. † Op. c., xxix.
‡ Comptes Rendus, cx. (1890) pp. 414–6.
§ Reports of the Voyage of H.M.S. 'Challenger,' xxxi., Part lxxxii. (1889) 92 pp. and 8 pls.
‖ Zool. Anzeig., xiii. (1890) pp. 14–7.

West Indian Chalinine Sponges.*—Mr. A. Dendy gives an account of the Chalinine fauna of the West Indies; of the eight species described five are new. They are interesting as exhibiting the great variability in external form to which species of sponges living in shallow, or comparatively shallow water are subject, and they illustrate in a very striking way the manner in which the siliceous spicules gradually degenerate and ultimately completely vanish as the horny skeleton becomes more and more strongly developed. This latter point has already been urged by the author and Mr. S. O. Ridley in their 'Challenger' report. From the systematic point of view we are led to the conclusion that it is no longer possible to draw a sharp line of distinction between the Chalininæ and the so-called Keratosa. The immediate cause of the disappearance of the spicules appears to be the development of spongin to such an extent as to form by itself a sufficiently strong skeleton; in such forms spicules would probably be actually harmful as tending to make rigid and brittle fibre that should be elastic and flexible. Spongin appears to develope to a large extent only in warm climates and rather shallow waters.

Development of Siliceous Sponges.†—M. Y. Delage asserts the presence of a special external cellular layer which becomes the ectoderm, and of ciliated cells which represent the endoderm in the larvæ of Siliceous Sponges. This statement disposes of the radical and incomprehensible difference which has been supposed to obtain between Calcareous and Siliceous Sponges. Observations made on the development of *Fissurella* show that the processes of development are fundamentally the same. The larva of this form may be regarded as a *Sycon*-larva which, in place of being empty within, early developed a large amount of mesoderm which filled the whole body; the ectoderm, instead of being confined to the posterior pole, extends, under the form of a layer of separated elements, over the whole of the ciliated region. As a regular invagination is made impossible owing to the presence of a central nucleus the ciliated cells make their way separately, breaking the ranks, so to speak, and later on take up their epithelial position within the interior of the body.

Protozoa.

Terricolous Protozoa.‡—Dr. Maria Sacchi has a preliminary note on terricolous Protozoa. If a little dry earth be placed on a slide, the large grains eliminated, the rest moistened with a drop of distilled water, and the usual cover-glass laid on, there is at first no appearance of life. In a short time, however, there will be signs of diatoms or algæ, and, later on, there may or may not be indications of Rhizopods and Infusorians. Sometimes, and especially when fragments of protozoic tests are seen in the earth, various forms of *Amœbæ* may be easily found. The richest earths are those collected from clefts and angles of walls or roofs; the poorest, compact vegetable humus. The species most frequently found are *Amœba princeps*, *radiosa*, *verrucosa*, *terricola*. Of the last a

* Trans. Zool. Soc. Lond., xii. (1890) pp. 349–68 (6 pls.).
† Comptes Rendus, cx. (1890) pp. 654–7.
‡ Journ. de Microgr., xiv. (1890) pp. 107–9.

number of varieties have been seen. *Arcella vulgaris* is common. *Euglypha reticulata* and various species of *Difflugia* are not rare, but ciliated and flagellate Infusoria are; only a few Monads or *Euglenæ* have been seen. The differences in the comparative abundance of Rhizopods and Infusoria are, however, not difficult to explain.

Protozoa from Cape Horn.*—M. A. Certes describes the Protozoa collected by the 'Romanche' on its expedition to Cape Horn. In his general introduction he notes the interesting fact that dry deposit, gathered in 1883 and exposed for the first time in 1888, contained germs which regained activity when placed in culture solutions. Thus, there appeared *Oikomonas mutabilis*, various monads, a flagellate Infusorian very like *Phacotus lenticularis*, some algæ, *Bacillus amylobacter*, &c. Among the Rhizopods were three new species of *Nebela*, two of *Trinema*, one of *Centropyxis*, two of *Cadium*, and four new Radiolarians.

Nucleus of Loxophyllum meleagris.†—Prof. E. G. Balbiani has closely studied the nucleus of this ciliate infusorian. He finds that it is formed of a varying number of joints or segments, of which there may be twenty or more, which are connected with one another by the enveloping membrane, but have their contents perfectly distinct. These contents consist of one or more nuclear cords which form more or less numerous convolutions, and by an intermediate substance which contains a large number of granules. Observations show that, in certain cases at any rate, the nucleus does, in a state of repose, contain a chromatic filament, or several, which are free and distinct. The nuclear cords present a very fine transverse striation analogous to that which is seen in the nuclei of the cells of the larva of *Chironomus*; this striation is probably due to the alternation of discs of chromatin with layers of achromatic substance. The addition of a weak solution of ammonia causes the nuclear cords to swell and break up into pieces, the axis of which is occupied by a homogeneous chromatic filament, or by a row of chromatic granulations, while the periphery is formed by a pretty thick layer of homogeneous achromatic substance. Nothing comparable to nucleoli was seen in the nucleus, but they are probably represented by the granulations in the nuclear fluid.

Nuclei of Urostyla.‡—Prof. R. S. Bergh describes the nuclei and the hitherto unobserved micronuclei of *Urostyla grandis* and *Urostyla intermedia* n. sp. The former are exceedingly numerous, 200 or so, and seem to be united by fine filaments; the latter number on an average ten, and are in *U. intermedia* smaller, in *U. grandis* larger than the nuclei. Before division, the breadth of the Infusorians increases and the length decreases. As the new contractile vacuole and adoral zone are formed, the distinction between nuclei and micronuclei for a time disappears; the micronuclei are afterwards seen to assume the coil stage so rarely observed in Infusorians, and also a spindle phase before they divide; the nuclei unite in a single mass, of filamentar structure and ribbon-like form, which presently exhibits fragmentation.

* Rec. Mission Sci. du Cap Horn, vi. (1889) pp. 53 (6 pls. and 9 figs.).
† Zool. Anzeig., xiii. (1890) pp. 110–5, 132–6.
‡ Arch. de Biol., ix. (1889) pp. 497–514 (1 pl.).

Bergh emphasizes the fact that the nuclei and micronuclei of Infusorians in their division differ from the nuclei of most cells in the persistence of the achromatic nuclear membrane, and in the absence of the protoplasmic asters which have been observed even in Rhizopods. Where the membrane persists, it is evident that the achromatic filaments of the nuclear spindle cannot be of external cytoplasmic origin.

Freshwater Heliozoa.*—Dr. E. Pénard, in the second part of his memoir,† continues his account of *Actinophrys sol.* Describing the liberation of an example which had been encysted during the winter, he says that in a cyst about to open there may be observed passing from the centre to the circumference a central grey matter ; this was mucilaginous and generally surrounded a circular spot, which, no doubt, represents the nucleus. More externally there is a wide ring of very small granulations, bordered by a zone of limpid plasma, without any contractile vesicle. This last zone is bounded by the internal cyst, which is delicate and extensile, and this again is separated from the external cyst by a mucilaginous material, similar to that which is found within it. The internal cyst always remains spherical, the outer generally elongates, and its ovoid form appears to be due to the powerful endosmosis which is going on. After a time it yields to the pressure within. The internal cyst distends, bursts, and is sometimes carried away. The mucilaginous liquid which surrounds the animal passes gradually to one pole, whence it slowly extends to the right and left, until at last it forms a zone of a clear grey limpid material, which soon becomes hollowed out by small vacuoles, and commences to form the ectosarc. Some of the neighbouring vacuoles increase in size, and by the loss of the partitions which divide them form a contractile vesicle.

Some hours after the emergence of the animal, the pseudopodia are distinctly visible ; they exactly resemble the pseudopodia of *Ciliophrys*, a form to which the whole animal may now be compared. In most specimens a well-marked, central, spherical nucleus was seen, but in some cases it could not be detected. The vacuoles of the ectosarc continue to exhibit differentiation, the contractile vesicle increases in size, the pseudopodia grow larger, and, in twenty-four hours, the young *Actinophrys* only differs from the adult by its smaller size. It is probable that, at this stage, it increases by fission.

A detailed description is given of *Acanthocystis pectinata* sp. n. from Wiesbaden ; *A. erinaceus* and *A. albida* spp. nn. are more shortly discussed. *Ciliophrys cærulea* sp. n. is also fully described. Some notes on these forms have already appeared in another memoir.‡

Myxosporidia.§—M. P. Thélohan has recently made observations on the Myxosporidia. These interesting organisms consist essentially of a mass of protoplasm in which are formed at a certain period reproductive bodies or spores. They are distinguished from other Sporozoa by two principal characters, namely the structural complexity which their spores may attain, and the fact that the formation of these spores does not mark the termination of the evolutionary cycle of the organism, but

* Arch. de Biol., ix. (1889) pp. 419–72 (3 pls.).
† See this Journal, *ante*, p. 50. ‡ See this Journal, *ante*, p. 193.
§ Annales de Microgr., ii. (1890) pp. 193–213 (18 figs.).

commences quite early and continues during its development. Like all the Sporozoa the Myxosporidia are parasites.

They have been found in a few Invertebrata and in certain Batrachia, but most frequently in fishes. They present themselves under two different conditions, as free mobile amœboid masses, and as more or less voluminous cysts. The free form is found usually in natural cavities (bladder, renal tubules, liver, spleen, ovary, &c.) while the encysted form is most frequently observed in the subcutaneous connective tissue, and the subepithelium of the branchiæ.

According to the author, the spores are ovoid or fusiform in shape, and of two kinds one is small, ovoid, and without polar capsules; the other is larger, encapsulated, possesses two polar bodies, a mass of protoplasm, a vacuole, and also a nucleus. The capsule, which is extremely resistant to reagents, is stainable with safranin, and possesses at its small end an aperture that serves for the exit of a filament.

In technique the author followed the lead of M. Henneguy. The best fixatives were found to be Perenyi's and Flemming's fluids. The paraffin-imbedded sections were fixed to the slide with Mayer's albumen, and then washed in xylol and absolute alcohol. After this they were stained, safranin, borax-carmine, and picrocarmine, followed by gentian-violet (Gram's or Bizzozero's method), giving the best result.

Spores, obtained by teasing out, were best treated with osmic acid and methyl-green.

The Genus Didymophyes.*—Dr. P. Mingazzini maintains the inaccuracy of the general opinion which regards *Didymophyes* as two individuals. In the young stage *Didymophyes* is a single-celled Gregarine, and the individual which unites with another posteriorly loses its individuality and becomes simply a metamere. In the union, the head is lost by fusion with the deutomerite. Encystation is preceded by a shortening and broadening of the conjugated cells, and the cysts show no nucleus.

* Atti R. Accad. Lincei—Rend., v. (1889) pp. 365–8 (4 figs.).

BOTANY.

A. GENERAL, including the Anatomy and Physiology of the Phanerogamia.

a. Anatomy.

(1) Cell-structure and Protoplasm.

Encasing of Protoplasm.*—Herr G. Haberlandt describes the process of "encasing" (Einkapselung) of the protoplasm in the hairs of various Cucurbitaceæ.

In the short stiff hairs on older leaves of *Bryonia* the protoplasm is frequently divided into two parts of nearly equal size by the secondary thickening of the cell-wall; one-half of the mass of protoplasm contains the nucleus, while the other is destitute of nucleus. If the formation of cellulose-wall proceeds, only that portion of the protoplasm which contains the nucleus forms new cell-walls. If the secondary ring of cellulose becomes only so thick that the protoplasm is merely deeply constricted, then again it is only the half of the protoplasm that contains the nucleus which becomes encased, the first cellulose-cap passing through the narrow piece which unites the two halves. Even when the free outer wall of the hair-cell is uniformly thickened, a division of the protoplasm may take place into two usually unequal halves, the portion which contains the nucleus becoming invested by a number of caps, one within another, as Krabbe has described in the bast-cells of the Asclepiadeæ and Apocynaceæ.†

A similar phenomenon is presented by the hairs on the under side of the leaves of *Sicyos angulatus* and *Momordica Elaterium*. The encasing does not depend on the size of that portion of the protoplasm, but entirely on the presence of the nucleus. The phenomenon differs only from that mentioned above in bast-cells in the latter containing several nuclei, each of which becomes invested with cellulose.

Aggregation of Protoplasm.‡—Herr T. Bokorny has confirmed Darwin's statements as to the aggregation of protoplasm in the tentacles of *Drosera* by a very minute quantity of ammonia, obtaining similar results in a large number of different plants. The phenomena may be of four kinds:—contraction of the entire protoplasm; contraction and division of the vacuole-wall alone; aggregation of the protoplasmic albumen, i. e. excretion of granules of albumen from the cell-sap; or aggregation of the albumen which is sometimes contained in the vacuole-fluid. The plants and parts of plants in which these phenomena were observed are:—*Spirogyra*, tentacles of *Drosera rotundifolia* and *dichotoma*, petals of *Tulipa suaveolens*, epidermal cells of the leaf-stalk or flower-stalk of *Primula sinensis*, stigma of *Crocus vernus*, hypodermal cells of the leaves of *Cotyledon coccinea*, epidermal cells of the pitcher of *Nepenthes phyllamphora*, *Darlingtonia californica*, and *Sarracenia purpurea*, glandular hairs of *Pelargonium*, epidermal cells of the leaf of

* SB. Akad. Wiss. Wien, xcviii. (1889) 10 pp. and 1 pl. See Bot. Centralbl., xl. (1889) p. 144.

† Cf. this Journal, 1888, p. 441.

‡ Jahrb. f. Wiss. Bot. (Pringsheim), xx. (1889) pp. 427–74 (1 pl.).

Dionæa muscipula, &c. The amount of ammonia required to produce this result is inconceivably small; in *Spirogyra* it is brought about by a solution of 1 in 10,000. Other alkaline reagents produce similar results; caffeine is especially to be recommended. All the phenomena appear to depend on a transition of the albumen of the living cell, which is in a turgescent condition, into a denser condition caused by traces of alkaline substances.

Composition of the Cell-wall.*—According to Herren Schulze, Steiger, and Maxwell, many other carbohydrates besides cellulose enter into the composition of the cell-wall. They propose to limit the term cellulose to that constituent which is only slightly attacked by very dilute mineral acids, is soluble in ammonium-copper oxide, is coloured blue by chlor-zinc iodide or iodized sulphuric acid, and which yields dextrose on saccharosis by strong sulphuric acid. The other carbohydrates differ considerably in their properties from cellulose. They appear to be insoluble in ammonium-copper oxide, and some of them yield a cherry-red fluid on warming with phloroglucin and hydrochloric acid, they are rapidly saccharized by dilute mineral acids which scarcely affect cellulose, yielding galactose, mannose, and pentaglycoses.

The authors propose for these the designation "paragalactan-like substances"; paragalactan (or paragalactin) itself, the result of heating galactose with sulphuric acid, has been obtained by them from the seeds of *Lupinus luteus*. These substances appear to enter much more readily into the soluble condition than cellulose, as, for example, in the process of germination; paragalactan is a reserve-substance in the seeds of the lupin, and it is doubtful whether true cellulose ever serves this purpose.

History of Cell-theories.†—Herr R. Altmann gives a brief *résumé* of the various theories propounded as to the constitution of the cell. He considers the animal to be far more favourable than the vegetable cell for the solution of problems as to its true nature. His general conclusions are that there is no uniform sarcode, but only a polymerous protoplasm, and that the cell is not an elementary structure, but a colony of such structures.

(2) Other Cell-contents (including Secretions).

Deposition of Starch in Woody Plants.‡—According to M. E. Wotczal, the resorption of starch in tissues when the active period of vegetation commences, begins at two opposite spots—in the youngest branches, and in the youngest roots, and proceeds from these towards the older parts in two opposite waves. But between these, in the oldest parts between stem and root, a considerable portion of reserve-starch remains unconsumed. The deposition of newly-formed starch also takes place in two opposite waves, in the reverse direction to its absorption.

* Zeitschr. f. Physiol. Chemie, xiv. (1889) pp. 227–73. See Bot. Centralbl., xli. (1890) p. 181.

† 'Zur Geschichte d. Zelltheorieen,' Leipzig, 1889, 8vo, 20 pp. See Bot. Centralbl., xli. (1890) p. 183.

‡ Arb. Naturf.-Ver. Kasan, 1888, 6 pp. (Russian). See Bot. Centralbl., xli. (1890) p. 99.

Aleurone-grains.*—Herr T. Lüdtke discusses these bodies from the following points of view:—(1) Behaviour towards reagents; (2) comparative investigation of their morphological characters; (3) the changes induced in them by the swelling of seeds in water; (4) their development in the ripening of seeds; (5) their absorption in the germination of seeds. In a fully developed aleurone-grain the following parts are to be distinguished:—(1) The membrane; (2) the ground-substance (matrix); (3) the inclosed substances, consisting of protein-crystalloids, globoids, and crystals of calcium oxalate.

Under the second head the author distinguishes the following four types:—(1) *Gramineæ-type;* grains small, without inclosed substances or globoids (Gramineæ, Cyperaceæ); (2) *Leguminosæ-type;* larger or smaller grains containing globoids (Papilionaceæ, Cæsalpinieæ, Cruciferæ, Ranunculaceæ, Liliaceæ, &c.); (3) *Umbelliferæ-type;* grains larger (5–11 μ), containing globoids or crystals (Umbelliferæ, Compositæ, &c.); (4) *Euphorbiaceæ-type;* grains of the most perfect development (Coniferæ, Palmæ, Euphorbiaceæ, Solanaceæ, Labiatæ, &c.).

Those aleurone-grains which contain no inclosures except globoids resist the action of water better than those which contain crystals. The formation of crystalloids and globoids is, according to the author, not a physico-chemical process, for all the inclosed substances are formed by the vital activity of the cell. The mode of absorption of the aleurone-grains on germination differs in different seeds, and is described in detail in a number of examples.

Carotin.†—Herr H. Immendorff finds carotin to be a normal and constant product of vegetable life, and to be always present in leaves. He gives it the formula $C_{26}H_{38}$. The mode of extracting this substance is given in detail, and the author states that it is the only yellow or yellow-red constituent of normal chlorophyll. He finds it also in etiolated leaves, and in those which have assumed their autumn tint.

M. Arnaud ‡ gives the percentage of carotin found by analysis in a number of plants. It varies with the species and with the period of growth, generally increasing up to the time of flowering, and then diminishing gradually until the fall of the leaves. According to this author, it always accompanies chlorophyll in the leaves; and, like chlorophyll, has a tendency to disappear in the dark.

Solanine.§—M. E. Wotczal gives the following as the only trustworthy microchemical tests for solanine, viz. (1) Mandalin's vanadin-sulphuric acid, i.e. 1 part of ammonia meta-vanadinate in 1000 parts of trihydrate of sulphuric acid; (2) Brandt's reagent, i.e. 3 grains of sodium selenate in a mixture of 8 ccm. of water and 6 ccm. of pure sulphuric acid; and (3) pure sulphuric acid. The first is especially a test of extraordinary delicacy; and the series of changes of colour which it brings out in a preparation containing solanine is described in detail.

* Ber. Deutsch. Bot. Gesell., vii. (1889) pp. 282–90, and Jahrb. f. Wiss. Bot. (Pringsheim), xxi. (1890) pp. 62–127 (3 pls.).

† Landwirtsch. Jahrb., xviii. (1889) pp. 506–20. See Bot. Centralbl. xli. (1890) p. 210.

‡ Comptes Rendus, cix. (1889) pp. 911–4. Cf. this Journal, 1887, p. 983.

§ Arb. Naturf.-Ver. Kasan, xviii. (1888) 103 pp.; xix. (1889) 74 pp. (Russian). See Bot. Centralbl., xli. (1890) p. 100.

Solanine was found in nine species of *Solanum* and three of *Scopolia*. In the vegetative organs it occurs in greatest abundance in the young tissues, and in the mature parts is usually entirely absent. In the floral organs, on the other hand, it continues to increase up to a certain period, and is especially abundant in the peripheral layers of the unripe fruit. Its seat is in the cell-cavity, where it occurs in the form of a soluble salt, and from which it penetrates also to the cell-wall.

The author regards solanine as a product neither of primary synthesis nor of disorganization, nor as a secretion or excretion, nor as a reserve-substance, nor as a transporting form like asparagin, but as an intermediate stage in the series of chemical changes which already-formed plastic substances undergo in the living cell. In the flowers and unripe fruits it undoubtedly also serves as a protection against consumption by animals.

Allium-Oil.*—Herr A. Voigt finds allium-oil or allyl-sulphide $[C_3H_5]_2S$ as an ethereal oil in all parts of various species of *Allium*, viz. in the stem, leaves, bulb-scales; both in the epiderm and the bundle-sheath, viz. in the bundle-sheath of the floral organs; in the outer endoderm and root-cap, in the root, the fruit, and the integument of the seeds; in the layer of the endosperm immediately surrounding the embryo. It is present at all periods of growth, and has apparently been formed in the process of metastasis. The author regards its physiological purpose to be mainly as a protection against the attacks of animals; but its presence in the vascular bundle-sheath also serves to secure a path for the conduction of water and plasmic substances.

Amount and Composition of Ash.†—Prof. C. Councler gives particulars of the proportion of ash found in the dried material from a number of herbaceous and woody plants, the amount varying from 15·35 p. c. in *Adonis æstivalis*, to 1·35 p. c. in the pine, and as low as 1·08 p. c. in branches of the same tree on which the mistletoe was parasitic, the mistletoe itself containing, in different organs, from 3·49 to 8·11 p. c. of ash. The percentage composition of the ash is also given in the different species; the mistletoe withdraws from its host especially large quantities of potassium salts and phosphates.

(3) Structure of Tissues.

Liber of Angiosperms.‡—M. H. Lecomte has made an exhaustive examination of the structure and development of the liber in the stem and leaves of the vine, lime, gourd, and many other woody and herbaceous plants. The following are the more important results:—

The liber of Angiosperms comprises two classes of elements—the essential (sieve-tubes and companion-cells) and the accessory elements (liber-parenchyme, sclerotized cells, and liber-fibres). The fibres surrounded by liber almost always differ in their histological and microchemical properties from those of the fibre outside the liber. The liber-parenchyme is often composed of elongated cells (fibres), simple or

* 'Lokalisirung d. æther. Oeles in d. Geweben d. *Allium*-Arten,' Hamburg, 1889, 8vo, 18 pp. See Bot. Centralbl., xli. (1890) p. 292.

† Bot. Centralbl., xl. (1889) pp. 97–100, 129–33.

‡ Ann. Sci. Nat. (Bot.), x. (1889) pp. 193–324 (4 pls.).

with transverse septa. The secreting canals of the liber never abut on sieve-tubes. The sieve-tubes of Angiosperms are dispersed irregularly through the primary liber. There are two distinct types of sieve-tube, those of the gourd and of the vine; but all intermediate forms may occur in the same plant. The elements separated from the sieve-tubes by tangential walls must be considered, like those separated by radial or oblique walls, as companion-cells. Besides the sieve-plates on their terminal walls, the sieve-tubes may have others, usually smaller, on their longitudinal walls. The liber-fibres may be united transversely by series of sieve-cells developed in the medullary rays. The formation of callus is due to excessive development of the thin layer of the membrane which covers the filaments of cellulose. The nucleus of the sieve-tubes usually disappears at an early period, but may sometimes be found in the parietal protoplasm of still active tubes. The contents of a sieve-tube in its active state consist of a thin layer of active parietal protoplasm, and a large central vacuole containing water and albuminoid substances in solution. The companion-cells also contain abundance of albuminoids, but neither they nor the sieve-tubes contain starch. The duration of activity of the sieve-tubes varies greatly, as also does the period of the appearance of the callus. Seedlings of the gourd kept in the dark developed abundant callus in the liber of the hypocotyl (tigellum); while those exposed to full light had their sieve-plates perforated.

Collenchymatous Cork.*—Herr H. Molisch describes a tissue of a peculiar character which he finds immediately beneath the epiderm of the fruit in several varieties of *Capsicum*. It partakes of the very different characters of cork and collenchyme, resembling ordinary parenchymatous collenchyme in its appearance, contents, and mode of thickening, but presents none of the characteristic reactions of cellulose, being, on the other hand, strongly suberized. It is two or three layers of cells in thickness, and of a golden-yellow colour.

Thyllæ.†—Herr H. Conwentz describes the structure and mode of formation of thyllæ or similar structures, especially in the wood of those fossil trees which produce amber, where they occur exclusively in the root. Their structure here is the same as that in existing plants, where they are sometimes characteristic of entire natural orders, sometimes of particular genera. They result from the growth of the closing membrane of the bordered pits which lie on the common wall of a tracheid or vessel and of a parenchyme-cell. Similar structures are found also in resin-canals, as the results of the growth of the epithele-cells into the intercellular spaces. They may also be the result of injury. A thylla has always the same physiological purpose, viz. to cut off an organ which is no longer performing its function.

Secondary Vascular Bundles of the Arborescent Liliaceæ.‡—Dr. P. Röseler gives further arguments in favour of his contention that in the arborescent Liliaceæ every rudiment of a vascular bundle

* Ber. Deutsch. Bot. Gesell., vii. (1889) pp. 364–6.
† T. c., Gen.-Versamml.-Heft, pp. 34–40. Cf. this Journal, 1888, p. 988.
‡ Bot. Ztg., xlviii. (1890) pp. 26–30. Cf. this Journal, 1889, p. 657.

contains young tracheïds from a length only slightly exceeding the height of the meristem-cells to that of fully developed tracheïds; that each young tracheïd contains only a single nucleus; and that the fully-developed tracheïds have a minimum length about ten times the height of the meristem-cells.

Intraxylary Phloem.*—Dr. Solereder has examined the anatomical structure of a number of species of Thymelæaceæ and Penæaceæ in which bicollateral vascular bundles occur, and finds intraxylary phloem to be a constant character for these families.

Stem of Compositæ.†—According to Herr Schumann, there occur in some Compositæ, as, e. g. in *Carlina acaulis*, vascular bundles which are limited in growth in consequence of being completely surrounded by a sheath of bast-fibres or similar elements, resembling wood-fibres in their form and in the nature of their walls, except that these are thicker and not so copiously pitted as in wood-fibres; no transitional forms occur except in some Carduеæ. The bast-fibres of Compositæ are almost always septated. Secondary medullary rays are scarcely ever found, except in *Solidago longifolia*, where there are a very few. The primary medullary rays are usually composed of lignified fundamental cells. The continuous ring of wood is generally very wavy. The pitting of the wood-fibres is always strongest on the tangential walls; on the radial walls it is occasionally altogether wanting. The pith is distinguished by the thinness of its walls, though occasionally a few of its cells are sclerotized. The cambium-ring is often very greatly reduced in size.

Supporting-bundles in the Stem of Cichoriaceæ.‡—From an examination of various stages of development, Dr. O. Kruch has arrived at the conclusion that the importance attributed by Van Tieghem and Morot to the pericycle is not exhibited in the case under consideration. He believes that in the stem, branches, and leaf-stalks of Liguliflоræ we have no system of sustaining bundles belonging to the pericycle, but, on the other hand, a system of mechanical cords of procambial character belonging to the sieve-portion of the vascular bundles.

Bark of Leaf-stalks.§—M. L. Morot points out that in the leaf-stalk of certain species of Simarubiaceæ and Sapindaceæ the bark derives its origin from the hypodermal layer of cells, the bark itself sometimes consisting of as many as six or eight layers.

Constituents of Lignin.‖—Herr G. Lange has subjected beech-wood and oak-wood to very careful analysis, after removing all impurities by water, 5 per cent. hydrochloric acid, alcohol, ether, ammonia, and soda-lye, and then exposing for a long period to the action of caustic potash at a temperature of 185° C., for the purpose of separating the cellulose from the lignic acids. In addition to the cellulose a substance was found soluble in alkalies, which could be separated by alcohol into two lignic acids.

* SB. Bot. Ver. München, Jan. 13, 1890. See Bot. Centralbl., xli. (1890) p. 250.
† Bot. Centralbl., xli. (1890) pp. 193-6. ‡ Malpighia, iii. (1889) pp. 358-66.
§ Journ. de Bot. (Morot), iii. (1889) pp. 407-8.
‖ Zeitschr. f. Physiol. Chemie, xiv. pp. 15-31. See Bot. Centralbl., xli. (1890) p. 23.

Structure of Loasaceæ.*—Herr R. Racine describes the histological structure of the wood of this natural order of plants, which differs in some respects from the nearly allied Cucurbitaceæ. The cambium-ring is closed, and displays only limited increase in thickness; the vascular bundles are arranged in a single circle, and are collateral in structure; the number of bundles is almost always twelve. The development of the flowers is also described.

Dioscoreaceæ.†—Herr E. Bucherer describes the anatomical and histological characters of this natural order, especially in reference to the genera *Dioscorea* and *Tamus*. The structure is described in detail of the tuber, the stem and the root, special attention being paid to the differences in the distribution and structure of the vascular bundles in the tuber and in the stem. Tubers occur in *Dioscorea sinuata*, *D. Batatas*, *Tamus elephantipes*, and *T. communis*.

(4) Structure of Organs.

Monochasia.‡—Dr. K. Schumann describes various instances of this mode of inflorescence, especially those occurring in the genus *Corchorus*. He defines a monochasium as a system of shoots in which the axis of the first order is closed, and the axis of the second order takes up its continuation; the continuation of this being again taken up by the axis of the third order, and so on. Since there is no possibility of a transition between an axis of the first and one of the second order, every shoot-system, at least in the case of flowering plants with closed buds, must be either a monopodium or a sympodium.

Pickerel-weed Pollen.§—Prof. B. D. Halsted describes the pollen of the pickerel-weed (*Pontederia cordata*). It is trimorphic, and the relative size of the pollen-grains in the three forms corresponds to the relative length of the styles. The difference in size between the largest and the smallest grains is the greatest yet described for any flower, being about 8:1.

Phylogeny of Amentaceæ.‖—Dr. L. Celakovsky discusses the phylogenetic development of the different families of Amentaceæ. The differences are the result of reduction, both in the vegetative and the reproductive organs. As respects the former, the lower portion of the lateral shoots is reduced, and the shoots become purely reproductive; and this reduction attains a higher degree when the upper reproductive portion of the main shoots is also reduced, and uniaxial or monocaulic plants become biaxial or diplocaulic. Reduction of the reproductive organs is shown by the hermaphrodite flowers becoming either male or female.

Four stages can be distinguished in the phylogenetic development of the Amentaceæ, viz.:—(1) The fertile shoots are all alike, and the flowers hermaphrodite (prehistoric); (2) the foliage-leaves are rudi-

* 'Zur Kenntniss d. Blütenentwickelung u. d. Gefässbündelverlaufes d. Loasaceen,' Rostock, 1889, 8vo, 46 pp. and 1 pl. See Bot. Centralbl., xl. (1889) p. 392.

† Haenlein u. Luerssen's Biblioth. Bot., Heft 16, 35 pp. and 5 pls.

‡ SB. K. Preuss. Akad. Wiss., xxix. (1889) pp. 555-84 (1 pl.).

§ Bot. Gazette, xiv. (1889) pp. 255-7 (1 fig.).

‖ SB. K. Böhm. Gesell. Wiss., 1889, pp. 319-43 (1 pl.) (German résumé).

mentary or altogether suppressed on the lateral shoots; the main shoot is altogether barren; the flowers are unisexual but monœcious (*Nothofagus*); (3) the foliage-leaves which subtend the fertile shoots are metamorphosed into bracts, and the inflorescence becomes a catkin, which is either bisexual (*Platycarya*) or more often unisexual (Betulaceæ, most Juglandeæ); (4) further reduction has taken place; some of the reproductive shoots are replaced by vegetative resting-buds (*Castanea*); the female inflorescences are greatly reduced and inclosed in a cupule (Cupuliferæ).

Pericarp of the Barley-grain.*—Dr. A. Zoebl gives an exhaustive description of the anatomy and histology of the integument or pericarp of the grain of *Hordeum distichum* and of the pales, chiefly from the point of view of its commercial value. The points specially described are the epiderm, the parenchyme of the pales, the awn, the layers of tissue of the pericarp itself, and the hairs on the pericarp. The author speaks of the walls of the epiderm of the pales which abut on those of the fibre-cells as being especially characterized by their abundant and strongly-developed pits.

Integument of the Seed in Geraniaceæ, Lythraceæ, and Oenothereæ.†—M. M. Brandza states that it is generally admitted that during the evolution of the ovule into the seed, the nucellus and inner integument of the ovule are absorbed by the embryo; Euphorbiaceæ, Rosaceæ and Rutaceæ being exceptions. The author, however, to test this, has chosen three distinct families of plants, and his conclusions are as follows:—(1) In the Geraniaceæ the integuments of the ovule persist, and give rise to the corresponding parts of the integument of the seed. (2) In the Oenothereæ and Lythraceæ it is the same, but the outermost layers of the nucellus also persist.

Extrafloral Nectaries.‡—Prof. F. Delpino describes the excretion of nectar from the under side of the six or seven leaves which for the time being are the uppermost on the stem of *Helianthus giganteus* and *H. tuberosus;* and a similar phenomenon, hitherto undetected, on the under side of the upper leaves of *Glycine sinensis* (Papilionaceæ). The involucral scales of *Centaurea montana* also exude an abundance of a nectariferous fluid. In all these cases the object of the extrafloral nectaries is the attraction of ants and other insects which feed greedily on the sweet fluid, and the consequent protection of the flowers.

Temporary Ascidia in Sterculia.§—Prof. F. Delpino describes the peculiar development of the pistil of *Sterculia platanifolia* after fertilization, by which the carpids separate from one another, and each swells up into a bladder of considerable size. These bladders are temporary ascidia, filled with a noisome fluid, and covered on the inner surface with multitudes of multicellular glandular hairs. The author believes these structures to have a similar purpose to the calycine ascidia described by Treub ‖ in *Spathodea campanulata*, and to perform a double function

* Abhandl. Naturf. Ver. Brünn, 1888 (1889) pp. 205–28 (20 figs.).
† Bull. Soc. Bot. France, xxxvi. (1889) pp. 417–20.
‡ Malpighia, iii. (1889) pp. 344–7. Cf. this Journal, *ante*, p 201.
§ Malpighia, iii. (1889) pp. 339–44. ‖ Cf. this Journal, 1889, p. 86.

—a digestive function and one of protecting the seeds while in the process of development from injury by ovipositing insects.

Alocasia macrorrhiza and some other Aroideæ present a somewhat similar structure in the lower part of the spathe.

Phyllodes.*—Prof. G. L. Goodale proposes to extend the use of the term phyllode, in accordance with the practice of some, but not of all writers, to all flattened petioles where there is a great reduction or entire abortion of the lamina, whether the surface of the petiole be horizontal or vertical. The so-called phyllodes of some species of *Eucalyptus* are true leaves, the lamina of which has assumed a vertical position from a twist of the leaf-stalk. Prof. Goodale suggests that the vertical position, whether of phyllode or of lamina, may be regarded as a permanent sleep-position, occurring only in shrubs or trees growing in very exposed situations or in a very dry climate, and serving to protect the foliage from excessive radiation.

Bracts.†—From a comparative examination of the bracts of plants belonging to a large number of different families, Herr F. Schmidt comes to the conclusion that they do not form a single morphological group, but are sometimes laminæ of leaves, with or without petiole, sometimes leaf-sheaths, sometimes stipules, sometimes of no definite morphological character. From a physiological point of view they are leaves which subtend flowers, and are designed either as protecting organs, or to co-operate with the petals, or as organs for the protection or the dissemination of the fruit. Bracts may be divided morphologically into two groups—those belonging to plants the leaves of which have neither leaf-sheath nor stipule, and those in which the leaves possess one or other of these accessory organs. In the first category the bracts correspond to the sheath or stipule, in the second to the lamina of the leaf.

Foliar Verticels of Spergula.‡—M. W. Russell describes the arrangement of the leaves in *Spergula arvensis*, and states that the leaves are really opposite, but the presence at their axes of short leafy branches gives them a verticillate appearance.

Anatomy of Bud-scales. §—Dr. C. R. G. Schumann gives a general account of the structure of the bud-scales in Conifers and woody Dicotyledons. They serve a double purpose—as a protection to young buds against external injury, and as a contrivance for mechanical strengthening. For the latter purpose they are often strongly cuticularized, and contain collenchymatous and sclerenchymatous elements; the latter, in the cases of *Camellia* and *Magnolia*, in the form of numerous "stone-cells." They are usually entirely destitute of stomates. Their number and thickness vary greatly, the former from four in *Sorbus aucuparia* to as many as 350 in *Pinus austriaca*. Their æstivation or relative position with respect to one another is also very variable. In some bulbs, as, for example, those of South American species of *Oxalis*, the outer scales are modified so as to serve the purpose of bud-scales,

* Amer. Journ. Sci., xxxviii. (1889) pp. 495–7.

† 'Beitr. z. Kenntniss d. Hochblätter,' Berlin, 1889, 4to, 28 pp. and 2 pls. See Bot. Centralbl., xli. (1890) p. 185.

‡ Bull. Soc. Bot. France, xxxvi. (1889) pp. 424–5.

§ Haenlein u. Luerssen's Biblioth. Bot., Heft 15, 1889, 36 pp. and 5 pls.

becoming protective organs, and losing their property of storing up reserve food-materials.

Tubercles on the Roots of Leguminous Plants.*—Prof. H. M. Ward draws attention to some results of further investigation into this subject. In some of the cultures made in the summer of 1888, the roots of the pea were infected with bacteroids from the tubercles of the bean, and this is a point of some importance in view of the belief that each species of Leguminosæ may have its own species of bacteroid. Extracts of the tubercles containing infected germs were made; and although the latter were taken from the tubercles of the bean, they infected the root-hairs of both peas and beans equally well. It is especially the young root-hairs, with extremely delicate cell-walls, that are infected, and the first sign is the appearance of a very brilliant colourless spot in the substance of the cell-wall; sometimes this spot is common to two cell-walls of root-hairs in contact, and not unfrequently several root-hairs are found all fastened together at the common point of infection. This highly refringent spot is obviously the "bright spot" referred to in a previous paper as the point of infection from which the infecting filament takes origin. It soon grows larger and developes a long tubular process, which grows down inside the root-hair and invades the cortex, passing from cell to cell. The "bright spot" is, therefore, the point of origin of the infecting filament, and, as a matter of inference from the experiments, it cannot but be developed from one of the "bacteroids" or "gemmules" of the tubercles.

The author then describes a series of water-cultures of beans infected artificially by placing the contents of tubercles on their root-hairs. These experiments have led the author to conclude that the organism which induces the development of the tubercles is so closely adapted to its conditions that comparatively slight disturbances of the conditions of symbiosis affect its well-being. It is so dependent on the roots of the Leguminosæ that anything which affects their well-being affects it also.

Some experiments with peas were also made as to the alleged connection between the development of the tubercles and the increase of nitrogen in leguminous plants, the evidence all going to show that the leguminous plant gains nitrogen by absorbing the nitrogenous substance of the bacteroids from the tubercles.

The author then compares the conclusion arrived at by Prazmowski † with his own. As to the occurrence, origin, and structure of the tubercles, they are in accordance; but there is one point of difference of extreme importance between Beyerinck and Prazmowski on the one hand, and the author on the other hand, and that is on the subject of the cultivation of the "bacterium" in nutritive media outside the host-plant—or rather the other symbiont.

Use of Anatomical Characters in the Classification of Plants.‡—M. J. Vesque gives a number of examples of the use of anatomical and

* Proc. Roy. Soc., xlvi. (1889) pp. 431–3 (1 fig.). Cf. this Journal, 1888, p. 251.
† Cf. this Journal, *ante*, p. 59.
‡ Bull. Soc. Bot. France, xxxvi. (1889) Actes du Congrès de Bot., pp. xli.–lxxvii. (5 figs.).

morphological characters in the classification of plants, in relation to the following organs:—(1) The organs of reproduction:—pollen, stigmatic papillæ, integument of the ovule and seed, endosperm and embryo; (2) The vegetative organs:—size of the cells, epiderm, hairs, stomates, crystals of calcium oxalate, laticiferous and other internal secreting organs, structure and arrangement of the vascular bundles, palisade and spongy parenchyme, sclereïds, mechanical system, &c.

β. Physiology.

(1) Reproduction and Germination.

Morphological Phenomena of Fertilization.*—M. L. Guignard sums up the conclusions of previous observers on the morphological phenomena on which depends the impregnation of the oosphere in flowering plants. His observations were made chiefly on *Lilium Martagon*, with which are compared the phenomena in *Fritillaria*, *Tulipa*, *Muscaria*, *Agraphis*, *Iris*, *Alstrœmeria*, *Aconitum*, *Delphinium*, *Clematis*, and *Viola*, and the results obtained by Van Beneden † with *Ascaris megalocephala*.

His general conclusions are in harmony with those of Strasburger rather than with those of Van Beneden, viz. that an actual coalescence of the male and female elements, and not merely their coexistence in the oosphere, is necessary to impregnation; a fusion of the nuclear cavities being apparently essential. In the fusion of the two polar nuclei to form the secondary vegetative nucleus of the embryo-sac, these two nuclei may remain distinguishable from one another, and invested each by its own delicate membrane, until the period of the commencement of cell-division, which may not take place until some days after the entrance of the pollen-tube into the embryo-sac. He finds the number of chromatic segments to be the same in the male and female nuclei, and the double number, viz. 24, is always to be detected after impregnation. In the process of division of the nuclei of the endosperm, resulting from the repeated division of the secondary nucleus of the embryo-sac, the number of chromatic segments varies considerably.

When the original nucleus of the pollen-grain divides to produce the vegetative and reproductive nucleus of the pollen-tube, and when the reproductive nucleus again subsequently divides into two, the number of chromatic segments in the two is again the same, but the cytoplasm is distributed unequally in these two new cells, and its microchemical reactions are not alike. The formation of the generative nuclei, comparable to that of the pronuclei in animals, always takes place by the longitudinal doubling of the chromatic segments. The preliminary phenomena which take place within the embryo-sac differ in a remarkable point from those which take place within the pollen-grain. In *Lilium* and probably in other plants also, the two tetrads which result from the bipartition of the primary nucleus of the embryo-sac, and which occupy the two extremities of the sac, present an important difference, which is transmitted to their derivatives. Each of the nuclei of the apical tetrad has always twelve chromatic segments, like the primary nucleus, while each of the nuclei of the basal tetrad has a larger and variable number.

* Bull. Soc. Bot. France, xxxvi. (1889), Actes du Congrès de Bot., pp. c.–cxlvi. (4 pls.), and Comptes Rendus, cx. (1890) pp. 590–2.

† Cf. this Journal, 1888, p. 423.

On the entrance of the pollen-tube into the embryo-sac, the male and female nuclei appear to exert an attractive influence on one another, dependent probably on chemical causes, similar to that which seems to guide the antherozoids of Cryptogams towards the archegone.

Embryo-sac of Compositæ.*—Herr F. Hegelmaier describes the peculiarities in the structure and development of the embryo-sac in some species of Compositæ, especially some belonging to the tribe Heliantheæ. In *Helianthus annuus*, at the time of the opening of the corolla and separation of the arms of the style, the innermost layer of cells of the thick integument has the form of a compact sheath; the elongated cavity becomes filled up by the embryo-sac, with the exception of a small space lying between its own membrane and the inclosing sheath, and caused by the disappearance of the innermost layer of cells of the nucellus. The embryo-sac is itself divided by transverse septa into a row of three cells, the central and posterior of which must be regarded as antipodals, the anterior includes the large vegetative nucleus and the egg-apparatus. The two sterile synergidæ are prolonged at their apex into slender conical points which project into the endostome. At the time of impregnation, the embryo-sac completely fills up the integument, the two posterior cells occupying from two-thirds to three-fourths of its entire space.

Bidens leucantha and *Zinnia tenuiflora* present the same peculiarities as *Helianthus annuus* in almost every respect; and others of the Heliantheæ have the same structure in its general features. In *Tussilago Farfara* the base of the embryo-sac is occupied for about one-third of its length by a group of cells resulting from cell-division; while in other genera belonging to the Cichoriaceæ the group of antipodals has developed into a parenchymatous tissue. In the dandelion they are four or five in number, and form a single row in the narrowed conical posterior end of the embryo-sac. These characters are, therefore, of but little importance for purposes of classification.

The innermost layer of cells of the integument above described, or endoderm, is especially developed in many, though not in all, ovules with a single thick integument, in which the nucellar tissue disappears entirely before impregnation, as in the Compositæ, Valerianaceæ, Dipsaceæ, Campanulaceæ, Umbelliferæ, and Araliaceæ; less often in ovules with a double integument, as in *Linum*. Its cells are elongated in the radial direction, cubical, or even tabular. The layers of cells of the integument next to the endoderm often begin to be converted into mucilage even before impregnation.

Flowering of Amorphophallus.†—Dr. O. Beccari describes the flowering and formation of the fruit in *Amorphophallus Titanum*, the flower of which is probably the largest in existence. The production of the colour and odour of decomposing raw flesh, which attracts insects for the purpose of impregnation, is ascribed to a much greater plasticity of the protoplasm in past ages than it at present manifests; this being the basis on which natural selection and the struggle for existence worked.

* Bot. Ztg., xlvii. (1889) pp. 805–12, 821–6, 837–42 (1 pl.).

† Boll. R. Soc. Toscana Orticultura, 1889 (3 figs.). See Bot. Centralbl., xli. (1890) p. 60.

Scattering of the Pollen in Ricinus.*—Prof. F. Delpino describes the mechanism by means of which the anthers of *Ricinus communis*—a strictly anemophilous species—suddenly open to discharge their pollen, and which differs from the mechanism for a similar purpose in some Urticaceæ. It consists of four distinct movements, viz.:—(1) a movement of separation resulting from the opening of the valves; (2) a movement by which the lamina of the valve changes from concave to convex on its internal face; (3) a movement by which the lamina changes suddenly from convex to concave; (4) a movement by which the valves again approach one another.

(2) Nutrition and Growth (including Movements of Fluids).

Parasitism of the Mistletoe.†—Dr. C. v. Tubeuf points out the want of definiteness in the particulars of the composition of the ash of the mistletoe hitherto recorded. In order to learn the laws which govern the drawing of the nutriment of the parasite from the host, we want to know the age of the leaves, whether one or two years, on what part of the host it is parasitic, and to have a comparison of the ash of the host and of the parasite. The author records examples of the parasitism of the mistletoe on itself, on *Loranthus europæus*, and on different species of *Quercus*.

Effect of the "Ringing" of Stems.‡—Prof. R. Hartig points out that by the "ringing" of the bark of trees below the lowest leafy branch, growth and the deposition of food-material are limited to the portion of the trunk above the ring. If the tree is young this results in its early death; but if it has already attained a considerable age, it may survive the ringing for a long period. The explanation of this appears to be afforded by the fact that the ultimate ramifications of the roots of such trees effect a union of growth with those of other uninjured trees of the same kind growing in the immediate vicinity, and from these absorb the food-material which they require for the growth of their roots and the portion below the ring.

Influence of Light on the vital conditions of plants.§—From the results of a series of experiments made on partially or entirely darkened leaves, Herr J. Busch draws the conclusion that the decomposition of chlorophyll is not a primary consequence of darkness, but that chlorophyll may remain as such unchanged for any length of time in the plant, if the cell itself remain in a living state, and that the destruction of the chlorophyll in the dark is the result of the death of the cell.

Influence of Thinning on the diametric growth in Fir-forests.‖—M. E. Mer states that thinning favours the growth both in height and in diameter of the reserved trees. It is at the base of the trunk that the

* Malpighia, iii. (1889) pp. 337–8.

† SB. Bot. Verein München, Dec. 9, 1889. See Bot. Centralbl., xli. (1890) pp. 43, 78, 80, and 135. Cf. this Journal, 1888, p. 86.

‡ SB. Bot. Ver. München, Jan. 13, 1890. See Bot. Centralbl., xli. (1890) pp. 251 and 283.

§ Ber. Deutsch. Bot. Gesell., vii. (1889), Gen.-Versamml.-Heft, pp. 25–30.

‖ Bull. Soc. Bot. France, xxxvi. (1889) pp. 412–4. Cf. this Journal, 1889, p. 669.

increase in the width is most noticed, and the amount of the increase varies according to the distance of the trees which have been cut down from those reserved.

Conduction of Water.*—Herr F. Tschaplowitz describes a series of experiments which tend to the conclusion that air-pressure and capillarity play but a very subordinate part in the movement of water in plants, the really important factors being osmose and imbibition. The experiments were made chiefly on *Spiræa opulifolia.*

Causes of the Ascent of Sap.†—Dr. J. Boehm adduces additional arguments in favour of his view that the absorption of water through the roots and the ascent of sap are the result of capillarity, the retention of the water in the parenchyme of the leaf being caused by the pressure of air. The objection that Conifers do not contain true vessels he answers by the statement that they do possess what are at least physiologically equivalent to vessels.

Literature of Transpiration.‡—Dr. A. Burgerstein completes his *résumé* of the literature of transpiration by an abstract of all papers on the subject published from 1887 to 1889. The papers referred to are eight in number, and the whole subject (including "guttation" or the exudation of drops of fluid) is discussed under a number of different headings, reference being made to the conclusions arrived at by earlier observers.

(3) Irritability.

Nutation of Seedlings.§—Herr H. Molisch describes a new apparatus for demonstrating the hydrotropism of roots. It consists of a clay funnel with curved and perforated margin, filled with moist sawdust; the roots of seedlings planted in it pass through the orifices, and grow upwards on the moist wall of the erect funnel. This form of nutation has received at present much less attention than the curvature of aerial shoots.

Irritability of the Laticiferous tissue in Lactuca.‖—Prof. F. Delpino has observed in *Lactuca virosa* and some other species of the genus, a singular extreme irritability. If, in the warm weather, the epiderm which covers the bracts and involucre is touched with an excessively delicate substance, not sufficient to rupture the epiderm, a minute drop of latex is suddenly shot out from the laticiferous tissue. This serves to explain the extraordinary immunity of these species of *Lactuca* from the attacks of insects.

Galvanotropism.¶—From the results of a detailed series of experiments, Herr J. Brunchorst draws the conclusion that the curvature

* 'Beitr. z. Lehre v. d. Wasserbewegung in d. Pflanze,' 8vo, 8 pp. See Bot. Centralbl., xli. (1890) p. 149.

† Ber. Deutsch. Bot. Gesell., vii. (1889), Gen.-Versamml.-Heft, pp. 46–56 (2 figs.). Cf. this Journal, 1886, p. 824.

‡ Verhandl. K.K. Zool.-Bot. Gesell. Wien, xxxix. (1889) pp. 399–463. Cf. this Journal, 1888, p. 259.

§ 'Das Bewegungsvermögen d. Keimpflanze,' Wien, 1889, 8vo, 27 pp. and 7 figs. See Bot. Centralbl., xl. (1889) p. 214.

‖ Malpighia, iii. (1889) pp. 355–7.

¶ 'Notizen üb. d. Galvanotropismus,' Bergen, 1889, 8vo, 35 pp. See Bot. Centralbl., xli. (1890) p. 257. Cf. this Journal, 1886, p. 101.

towards the posterior pole, which is caused by a strong galvanic current, is the result of chemical processes which take place at that pole. Curvature towards the negative pole resembles heliotropic and geotropic curvatures in the fact that it takes place when the galvanic current acts only upon the apex of the root. This may or may not be a purely chemical irritation dependent on the formation of hydrogen peroxide.

(4) Chemical Changes (including Respiration and Fermentation).

Digestion of Albuminoids by the leaves of Pinguicula.*— From a series of observations on *Pinguicula vulgaris*, Herr N. Tischutkin has come to the conclusion that the digestive processes effected by the mucilaginous secretion from the glands on the leaves is not due to any fermentative substance contained in the fluid itself, but to the action of the bacteria which always accompany the putrefaction of the organic substance. The experiments were made both with dead flies and with small pieces of boiled white of egg.

Action of Carbonic Acid on the products of Fermentation.†— M. Luidet's memoir on the influence of carbonic acid on the fermentative process discusses the question whether alcohol exerts an inhibitive influence on the vegetation of yeast. We may take as an example of his meaning the question, when wort contains 13–15 per cent. of alcohol, does therefore fermentation cease? Against this the author asks whether the chief product of saccharine fermentation, carbonic acid, does not rather, after a certain point has been reached, exert a similar inhibitive influence on the yeast. He endeavours to answer the question in the following way:—In four equal sized flasks he fermented equal quantities of wort with like amounts of yeast, and so arranged it that the carbonic acid pressure should be different in each flask; the pressure of CO_2 in the first flask being equal to 0·2 cm. of mercury, in the second to 20 cm., in the third to 43 cm., and in the fourth to 60 cm. The result showed that the carbonic acid pressure had no influence on the course or products of fermentation. The determination of the alcohol formed and the quantity of the yeast gave in all cases such identical results that the author concludes that carbonic acid development had no inhibitive influence on the vital activity of yeast.

Ferment-action of Bacteria.‡—Drs. T. Lauder Brunton and A. Macfadyen have been making a series of experiments with Koch's comma-spirillum, Finkler's comma-spirillum, a putrefactive micrococcus, scurf bacillus, and a bacillus isolated from milk by Dr. Klein. They come to the conclusion that the bacteria which liquefy gelatin do so by means of a soluble enzyme. This enzyme can be isolated, and its peptonizing action demonstrated apart from the microbes which produce it. The most active enzyme is that formed in meat-broth, and its action is hindered by acidity and favoured by alkalinity. The bacteria which form a peptonizing enzyme on proteid soil can also

* Ber. Deutsch. Bot. Gesell., vii. (1889) pp. 346–55.

† Bull. Soc. Chem. Paris, sér. iii. tom. ii. No. 4, Cf. Centralbl. f. Bakteriol. u. Parasitenk., vii (1890) p. 62.

‡ Proc. Roy. Soc., xlvi. (1890) pp. 542–53.

produce a diastatic enzyme on carbohydrate soil. The latter is not so easily separated from the microbes which produce it; but when that has been accomplished, its action on starch can still be demonstrated. This diastatic enzyme has no effect on gelatin. The bacteria are capable of evincing an adaptiveness to the soil in which they grow. The microbes are capable of digesting other similar bodies such as dextrin and muscle, but were not found to have any influence on fat.

γ. General.

Phenomena of Etiolation.*—Dr. E. Godlewski points out that it is incorrect to speak of etiolated organs as sickly, at least in their early stages. The chief characters of etiolated parts of plants, viz. smallness of the leaves and lengthening of the internodes, the smaller degree of firmness, and the larger amount of water, and, in the case of Monocotyledons, the greater breadth and smaller length of the leaves, are all of advantage to the underground parts, in diminishing the consumption of food-material. It is only when the duration of these characters is unduly prolonged in the parts exposed to the air, that the plant becomes sickly and finally dies. By observations made on *Phaseolus multiflorus*, the author demonstrated that the average proportion of water is considerably greater in the etiolated portions beneath the surface of the soil than in the parts exposed to the air.

Influence of the Sea on the Structure of Leaves.†—M. P. Lesage finds, from differences in structure in leaves of individuals of the same species grown near to or remote from the sea, that the effects of the saline air and soil are to increase the thickness of the leaf, and especially the development of the palisade-parenchyme; to diminish the intercellular spaces; and to decrease the amount of chlorophyll in the cells.

B. CRYPTOGAMIA.

Cryptogamia Vascularia.

Stem of Selaginellaceæ.‡—M. Vladescu describes the structure of the various tissues which compose the stem of Selaginellaceæ, especially those which proceed from the middle of one of the three cells which result from the third division of the original initial cell of the stem. From the further segmentation of the middle and internal of these segments proceeds a conducting tissue, consisting of the vascular tissue, the liber-tissue, and the conducting parenchyme; this last comprising the fascicular parenchyme (Strangparenchym), pericycle, endoderm, trabecular cortex, and internal cortex. The boundary, therefore, between the central cylinder and the cortex cannot, as Van Tieghem proposes, be placed between the pericycle and the endoderm; rather, all the tissues outside the liber must be referred, with Treub and Russow, to the cortex. All the tissues above described in the stem occur again in the root, and with a perfect continuity between the corresponding tissues in the two organs.

* Biol. Centralbl., ix. (1889) pp. 481–9, 617.
† Comptes Rendus, cix. (1889) pp. 204–6.
‡ Journ. de Bot. (Morot), iii. (1889) pp. 261–6.

Muscineæ.

Rhizome and Stem of Mosses.*—M. E. Bastit makes a comparison between the underground stem and the aerial leafy stem of mosses. The principal points noted are the following:—The underground stem has an epiderm provided with hairs, while the aerial stem is destitute of hairs. The underground stem has no hypoderm, while the aerial stem has one. The underground stem possesses three bundles and a very reduced cortex, with no pericyclic zone; the aerial stem possesses numerous foliar bundles, a very much developed cortex, and a pericyclic zone. Finally, in the underground stem the pith is much developed and of a uniform structure, while in the aerial stem the pith is reduced, and is separable into two regions, the one central and the other peripheral.

The following are the conclusions drawn by the author:—(1) That the stem of mosses is bounded by a true epiderm, characterized during the underground life by the production of absorbing hairs, and during the aerial life by the existence of a cuticle, and by intense cutinization of the walls. (2) The laminæ of the scales and of' the leaves are of epidermal origin. (3) The venation of the scales and the leaves is of internal origin. (4) The hypodermal zone of the aerial stem corresponds to the three peripheral angles of the rhizome. (5) The pericyclic zone of the aerial stem corresponds to the three sectors situated at the periphery of the pith of the rhizome. (6) In passing from the underground to the aerial portion, the diameter of the central cells of the pith and the lignification of their walls increase, while the peripheral elements undergo inverse modifications.

Algæ.

Genera of Florideæ.†—Prof. F. Schmitz gives a synopsis of the genera of Florideæ hitherto described, which he classifies in four series, viz. Nemalioninæ, Gigartininæ, Rhodymeninæ, and Cryptoneminæ; and the following families:—In the first, Lemaneaceæ, Helminthocladiaceæ, Chætangiaceæ, and Gelidiaceæ; in the 2nd, Acrotylaceæ, Gigartinaceæ, and Rhodophyllidaceæ; in the 3rd, Sphærococcaceæ, Rhodymeniaceæ, Delesseriaceæ, Bonnemaisoniaceæ, Rhodomelaceæ, and Cerámiaceæ; in the 4th, Gloiosiphoniaceæ, Grateloupiaceæ, Dumontiaceæ, Nemastomaceæ, Rhizophyllidaceæ, Squamariaceæ, and Corallinaceæ. These are again in many cases divided into subfamilies, and the genera enumerated under each. Under each genus the name is also given of its typical species.

Wrangelia, Naccaria, and Atractophora.‡—Herr O. E. Zerlang has carefully investigated the structure of the thallus, the reproductive organs, and the mode of fertilization, in *Wrangelia penicillata*, *Naccaria Wigghii*, and *Atractophora hypnoides*, and finds sufficient distinctive characters to keep these three genera of Florideæ apart, although agreeing in their main features.

In all three genera the fertilized oosphere itself, with or without previous fusion with adjoining cells, developes into the gonimoblast

* Bull. Soc. Bot. France, xxxvi. (1889) pp. 295–303.
† Flora, xlvii. (1889) pp. 434–56 (1 pl.). ‡ T. c., pp. 372–407 (1 pl.).

(the term given by Schmitz to the entire fertile tissue of a single cystocarp which has resulted from the development of a single impregnated initial cell, whether this cell be an impregnated oosphere or an impregnated auxiliary cell). In all three this oosphere forms branched threads which expand within a definite section of the fertile shoot along the central axis, and then put out numerous short lateral axes, radiating on all sides and projecting outwards. In all of them the terminal cells of these lateral axes congregate into a more or less dense peripheral hymenium, permeated by numerous paraphyses, and develope successively into carpospores. The differences between the three genera lie in the structure of the thallus, and in the special form of the cystocarp. In particular the cystocarp of *Naccaria* is much more complicated in structure than that of *Atractophora.*

Algæ which perforate calcareous shells.*—MM. E. Bornet and C. Flahault give a monograph of the species of algæ known to inhabit the shells of molluscs and other calcareous substances in the sea, or less often in fresh water. The species described are:—*Gomontia polyrhiza*, *Siphonocladus voluticola*, *Zygomitus reticulatus* sp. n., *Ostreobium Queketii* n. sp., *Mastigocoleus testarum*, *Plectonema terebrans* sp. n., *Phormidium incrustatum*, *Hyella cæspitosa*, *Lithopythium gangliiforme* sp. n., and *Ostracoblabe implexa* sp. n. Of these the last two are probably Fungi; all the rest belong either to the Chlorosporeæ or the Phycochromaceæ. All the species present the same general mode of development. At first they expand horizontally in the epidermal layer of the shell, either in the form of an irregular network, or radiating from a central point. From this layer proceed branches which penetrate vertically into the test, and others which elongate parallel to the original ones, finally becoming so numerous that the calcareous substance entirely disappears, when they become exposed and produce abundantly their reproductive cells.

The preparations were in all cases made by first removing the calcareous substance by means of Pérényi's fluid—4 volumes of 10 per cent. nitric acid, 3 volumes of alcohol, and 3 volumes of 0·5 per cent. chromic acid.

Ecklonia.†—Dr. G. B. De Toni gives a monograph of this boreal and Australasian genus of Phæosporeæ, with a description of each of the six known species, and of its geographical distribution.

Spines of Xanthidium.‡—Herr F. Elfving finds that the spines of *Xanthidium aculeatum* originate as hollow protuberances, and cannot therefore be formed by apposition.

Apiocystis.§—Mr. S. Le M. Moore describes the life-history of *Apiocystis Brauniana*, found growing on *Cladophora* and *Mesocarpus*. In its earliest condition it consists of a colourless sac containing a single gonid, from the distal end of which proceed two cilia, which pierce the wall of the parent-cell and extend some distance into the surrounding water. This gonid divides by a number of successive bipartitions, the original

* Bull. Soc. Bot. France, xxxvi. (1889.) Actes du Congrès de Bot., pp. cxlvii.–clxxvi. (7 pls.).

† Notarisia, iv. (1889) pp. 782–90. ‡ Bot. Notiser, 1889, pp. 208–9.

§ Journ. Linn. Soc. (Bot.), xxv. (1890) pp. 362–80 (3 pls.).

mother-cell becoming a pyriform or spheroidal zoosporange, containing a large number of biciliated zoospores, arranged upon its wall, the very long cilia projecting through apertures in the cell-wall, and attached by a narrow stalk to some filamentous freshwater alga. The gonids ultimately escape either through the rupture of the cell-wall or its dissolution, and swim about by means of their cilia. *Apiocystis* occurs also in a cœnobial phase, the cœnobe, which frequently contains only two zoospores, becoming detached, and swimming about within the zoosporange. These cœnobes are motile by means of exserted cilia proceeding from the zoospores, similar to those of the fixed zoosporange. Three distinct resting-stages, a *Palmella*, a *Glœocystis*, and a *Botryococcus* phase, are also described.

When in the fixed state, the cilia of *Apiocystis* are perfectly motionless, and the author regards the genus as a degenerate type of Volvocineæ, which has exchanged its mode of life as a motile cœnobe moving about with great rapidity by its powerful cilia, for an attached existence in which the cilia have become atrophied. Its nearest allies will be *Pandorina* and Borzì's *Physocytium*.

Nematophyton.*—Prof. D. P. Penhallow describes five species of this genus of fossil algæ from the Devonian strata of Canada, some of which have been placed in the genera *Prototaxites*, *Nematophycus*, *Nematoxylon*, and *Celluloxylon*. He describes the genus as consisting of plants with arborescent form from a branching root-like base; the stem branching, often exceeding an inch in diameter, composed of unjointed interlacing structureless cells, which branch into an intercellular system of small and closely woven filaments.

Fungi.

Development of Ascomycetes.†—Herr H. Zukal describes a series of observations on a number of Ascomycetes, including several new species, viz. *Melanospora coprophila*, *M. fallax*, *Penicillium luteum*, and *Ryparobius pachyascus*. From the history of development in some of these species he establishes a close phylogenetic connection between certain species of *Ascobolus* and *Peziza*, and the Mucorini which are destitute of a columel. In another section of the Ascomycetes, including the Tuberaceæ, Dothideæ, and many Perisporeæ and Pyrenomycetes, the wall of the receptacle appears as a modified mycele or thallus, from which there may be developed either microconids (in the spermogones), megaconids (in the pycnids), or asci.

In the ascogenous hyphæ of the Sordarieæ, the author recognizes in the first instance a physiological apparatus, which serves chiefly for supplying the asci and ascospores with protoplasm and other nutrient materials. The organism hitherto described as autonomous under the name *Helicosporangium parasiticum* (Karst.), as a parasite upon *Melanospora leucotricha*, he has now determined to be a peculiar kind of sclerote belonging to the latter species, which he calls a *microsclerote*. It is, in fact, a receptacle modified by unfavourable vital conditions, and

* Trans. Roy. Soc. Canada, vii. (1889) pp. 19–30 (2 pls.). Cf. this Journal (1889) p. 560.

† SB. K. Akad. Wiss. Wien, xcviii. (1889) pp. 520–603 (4 pls.).

occurs also on other species of *Melanospora* and *Sporormia*. After a period of rest it developes into a perithece.

From the mode of development of the asci and fructification, Herr Zukal places *Penicillium* among the Gymnoasci. The mode of ejection of the ascospores in several species of *Ascobolus* and in *Ryparobius pachyascus* is described. In the last-named a hypha is differentiated at a very early period at the base of the primary weft of hyphæ, which is identical with the scolecite of *Ascobolus*. *Thelebolus* is probably an archaic form from which both *Ryparobius* and *Ascobolus* have been derived.

Finally Zukal supports de Bary's view of the sexual origin of the fructification in a large number of the Ascomycetes.

Lowly-organized Lichen.*—Herr H. Zukal finds on *Sphagnum* and other mosses a gelatinous mass consisting mainly of the alga *Palmella botryoides* var. *heterospora*, permeated by a very delicate mycele proceeding from the peritheces of a very thin-walled Sphæriacea. A branch of the mycele ramifies to each algal cell, and becomes closely applied to it, but without penetrating it. There appears to be a symbiotic relationship between the two, the growth of the algal cells being rather promoted than hindered, and Herr Zukal regards the organism as a lichen, to which he gives the name *Epiglœa bactrospora*.

Pyrenomycetes.†—Herr K. Starbäck describes three new species of Pyrenomycetes, and proposes that the family should be divided into two groups, viz. those in which the spores are ejaculated from the perithece, and those in which they escape by the conversion of the hymenium into mucilage. The latter is probably the more common mode, but has at present been determined in only a few Pyrenomycetes. He further points out that in *Chætomium* the hairiness of the perithece is of great advantage to the fungus by promoting the dissemination of the spores by insects. The entire perithece is attached so loosely to its substratum that when an insect comes into contact with it, the entire fungus becomes attached to its body.

Trichophila, a new genus of Sphæropsideæ.‡—Herr C. A. J. A. Oudemans describes this new genus belonging to the family Leptostromaceæ, of Sphæropsideæ, with the following diagnosis:—Stroma applanatum effusum piceum, intus p. m. distincte plurilocellatum, pallidius, basi propria destitutum. The only species, *T. Myrmecophagæ*, was found among the hairs of an ant-eater.

Bommerella.§—M. E. Marchal describes the cultivation of *Bommerella trigonospora*, characterized by its singular triangular ascospores, on rabbit's dung. It produces two kinds of spore, ascospores and conids, but the one may pass insensibly into the other. There is no production of any sexual organs whatever on the mycele; the peritheces are strictly apogamous. Light appears to exercise an injurious effect on the development of the peritheces, but to favour that of the conids.

* Versamml. K.K. Zool.-Bot. Gesell. Wien, xxxix. (1889), SB. p. 78.

† Naturv. Studentsällsk Upsala, Nov. 8, 1888. See Bot. Centralbl., xli. (1890) pp. 249 and 278.

‡ Hedwigia, xxviii. (1889) p. 361.

§ Bull. Soc. Roy. Bot. Belgique, xxviii. (1889) Pt. i., pp. 261–71 (1 pl.). Cf. this Journal, 1886, p. 293.

Oedocephalum and Rhopalomyces.*—M. A. de Wevre discusses the systematic position of these genera of fungi, which he places in the first of Costantin's four great groups of Mucedineæ, in which the spores are inserted on a special apparatus in the form of a rounded or spherical vesicle.

Fungus parasitic on Mushroom.†—Dr. O. Stapf describes the attacks of a parasitic fungus which are extremely destructive to mushroom-beds in Vienna. The diseased mushrooms are infested by a *Saccharomyces*, probably *S. glutinis*, but this is always preceded by the appearance of a mould, *Verticillium agaricinum*, covering the beds with a dense weft of delicate hyphæ, and producing abundance of conids. The *Verticillium* is undoubtedly the conidial form of an ascomycetous fungus belonging to the family Sphæriaceæ, and the genus *Hypomyces* or some other nearly allied to it; but the exact species the author was unable to determine, though it is probably *Mycogone Linkii.*

Slime-disease of Horse-chestnut.‡—Herr F. Ludwig finds on horse-chestnuts in the avenues in Thüringia a mucilaginous fungus-disease resembling that previously described in the case of apple-trees. It occurs also on oaks and birches, in the latter case in connection with *Polyporus betulinus.* The attacks of the parasite are accompanied by a fermentative process. When the mucilage is of a brown colour, *Torula monilioides* was found; in the black patches on the beech, an alga, *Scytonema Hoffmanni*, lives in symbiosis with the bacteria. A process of fermentation was also abundantly observed on the bark and exuded gum of cherry-trees, due to the action of *Coryneum Beyerinkii.*

Micro-organisms of Fermentation.§—A. Jörgensen's work on the microbes of industrial fermentation has recently reappeared in a second edition. The number of pages has been increased from 138 to 188, and the figures from 36 to 41. The book is divided into six chapters which deal with the methods of fermentation, microscopical preparation, pure cultivations, analysis of air and water, bacteria, moulds, alcoholic ferments, the progress made in the art of fermentation, and the improvements for which the trade is indebted to it.

New Puccinia.‖—Herr F. Ludwig describes a new species of *Puccinia*, *P. Saccardoi*, belonging to the section *Pucciniopsis*, parasitic on the leaves of *Goodenia geniculata* in South Australia. Among the normal teleutospores occur others, unicellular or tricellular, sometimes of enormous size, and, occasionally, singular hornlike branched spores, resembling those of *Phragmidium obtusum.*

Autobasidiomycetes.¶—Following up his account of the first family, the Dacryomycetes, Herr O. Brefeld now proceeds to a description of the other families of this group of Fungi.

* CR. Soc. Roy. Bot. Belgique, 1889, pp. 128–33.

† Verhandl. K.K. Zool.-Bot. Gesell. Wien, xxxix. (1889) pp. 617–22.

‡ Deutsch. Bot. Monatensch., 1889, 2 pp. See Bot. Centralbl., xli. (1890) p. 299. Cf. this Journal, 1889, p. 795.

§ 'Die Micro-organismen der Gährungsindustrie,' 2nd edition, Berlin. See Annales de Micrographie, ii. (1890) pp. 252–3.

‖ Hedwigia, xxviii. (1889) pp. 362–3.

¶ 'Unters. a. d. Gesammtgebiete d. Mykologie,' Heft 8, Leipzig, 1889, 307 pp. and 12 pls. See Bot. Centralbl., xli. (1890) pp. 51 and 87. Cf. this Journal, 1888, p. 778.

The second family or Clavarieæ includes the genera *Typhula*, *Pterula*, *Clavaria*, *Pistillaria*, and *Sparassis*, and doubtfully *Microcera*.

The Tomentelleæ are separated from the Thelephoreæ, and include those genera with no well-developed hymenium or receptacle, the basids springing directly from the mycele, viz.:—*Pachysterigma* g. n., *Hypochnus*, *Tomentella*, *Exobasidium*, and *Corticium*. *Pachysterigma* consists of four species of minute fungi, composed of thick, loosely interwoven mycelial threads with but few clamp-connections on the septa. The basids spring directly from these filaments as lateral pear-shaped or spherical swellings, and produce from four to eight sterigmas. These latter swell into a globular form, and put out long protrusions, on which arise the large round or elongated spores; on germination these form secondary spores, but no other kind of fructification. *Exobasidium* differs from the other Tomentelleæ in its parasitic mode of life; *Corticium* includes the most highly developed forms of the order.

To the Thelephoreæ in the more limited sense of the term belong the genera *Stereum*, *Cyphella*, *Thelephora*, and *Craterellus*.

In the Hydneæ the hymenium is more fully developed than in the previous families, but not so much so as in the Agaricineæ and Polyporeæ; but many of the genera bear an external resemblance to genera in those families; thus *Odontia* and *Grandinia* to *Corticium*, *Phlebia* to *Merulius*, *Irpex* to *Dædalea* and *Lenzites*, the pileoid forms to corresponding genera of Polyporeæ. The genera are described in detail.

The numerous genera of Agaricineæ are then described, including the oidium-form in several genera, and the formation of chlamydospores in *Nyctalis*.

Among Polyporeæ, in addition to *Porothelium*, *Solenia* (intermediate between Polyporeæ and Thelephoreæ), *Merulius*, *Favolus*, *Dædalea*, *Hexagona*, *Trametes*, *Polyporus*, *Fistulina*, and *Boletus*, two new genera are described, viz. *Oligosporus* and *Heterobasidion*, both separated from *Polyporus*. Besides basids, there occur also in the family oidia, chlamydospores, and conids. *Oligosporus* embraces those species hitherto included under *Polyporus* in which the formation of hymenium with basidiospores is almost entirely suppressed, the ordinary mode of propagation being by abundant chlamydospores; it includes three species. *Heterobasidion* is founded on *Polyporus annosus* Fr. (*Trametes radiciperda* Hart.).

The Autobasidiomycetes are distinguished from the Protobasidiomycetes by their unseptated basids; the latter include the angiocarpous Pilacreæ, the gymnocarpous Auricularieæ, and the Tremellineæ; the former the Dacryomycetes, Tomentelleæ, Thelephoreæ, Gasteromycetes, and Hymenomycetes. In the Protobasidiomycetes, conids are almost the only form of secondary reproductive bodies; among the Autobasidiomycetes, we find frequent formation of chlamydospores, of which oidia are the simplest form. The Thelephoreæ and Tomentelleæ, being entirely gymnocarpous, are the simplest orders of the family. The conids are an independent form of fructification, and do not vary in character throughout the Basidiomycetes. Basids are formed by progressive development from the conidiophores, and show considerable diversity in the different groups:—In *Pilacre* and the Auricularieæ they are elongated and filiform, septated horizontally, and with lateral spores; in the Tremellineæ septated transversely; in the Autobasidiomycetes they are not septated. The relationship of the various groups to one another, as shown by the structure of the basids, is closely worked out. The chlamydospores which, in their simplest form, are simply short fragments of hyphæ, attain a great variety of development in the Uredineæ and Ustilagineæ,* where the true reproductive organs are so greatly suppressed that the fungi become conspicuous only through the germination of the chlamydospores. The unseptated sporophores of *Entyloma* and *Tilletia* with apical spores closely resemble perfect basids, and the Ustilagineæ are therefore nearly related to the Basidiomycetes. In the Uredineæ, besides three different kinds of chlamydospores, there are also spermogones with "spermatia" and promyceles with sterigmas, or two different forms of conids. The Uredineæ are, therefore, a family of Protobasidiomycetes with gymnocarpous rudiments of basids. The relationship is further traced between these families of Fungi and the Oomycetes, Zygomycetes, and Ascomycetes.

Schröter's Cryptogamic Flora of Silesia.†—The first half of the third volume of this important work contains all the orders of Fungi except the Ascomycetes and the Imperfectæ. The author separates the Chytridiaceæ and the Zygomycetes from the Oomycetes, erecting them into an independent and a parallel series; the Zygomycetes being either derived from the Protococcaceæ through the Chytridiaceæ, or the latter from the Zygomycetes by retrogression. In the Uredineæ he regards the teleutospore-layer rather than the æcidia as the analogue of the ascocarp of the Ascomycetes. The Basidiomycetes with transversely septated basids are separated as a special group under the name Auricularieæ; the Basidiomycetes themselves are divided into Tremellineæ, Dacryomycetes, and Eubasidiomycetes, the latter including the Hymenomycetes, Gasteromycetes, and Phalloideæ. *Protomyces* and the Ustilagineæ occupy a place intermediate between the Oomycetes and the Uredineæ.

Mycetozoa.

Classification of Myxomycetes.‡—Herr J. Schröter divides the Myxomycetes into the three following groups:—

A. Ripe fructification consisting of a mass of free spores.
  - *a.* Saprophytes; the amœboid bodies unite into compound plasmodes without completely coalescing, ACRASIEÆ.
  - *b.* Parasites in the interior of living cells, forming, as far as is known, true plasmodes, PHYTOMYXINEÆ.

B. Spores formed in the interior of sporanges or on the outside of disc-shaped or columnar fructifications; true plasmodes, MYXOGASTRES.

* Cf. this Journal, 1889, p. 787.

† Dritter Band, 1te Hälfte, Breslau, 1889, 8vo, 814 pp. See Bot. Ztg., xlviii. (1890) p. 76.

‡ Engler u. Prantl's Natürl. Pflanzenfam., 36 Lief., von J. Schröter, Leipzig, 1889. See Hedwigia, xxviii. (1889) p. 375.

The Acrasieæ comprise the genera *Copromyxa*, *Guttulina*, *Dictyostelium*, *Acrasis*, and *Polysphondylium;* the Phytomyxineæ, *Plasmodiophora*, *Phytomyxa*, *Tetramyxa*, and *Sorosphæra.* The numerous genera of Myxogastres or true Myxomycetes are divided into 11 families.

Pseudospora.*—Prof. C. Gobi describes the structure and development of this parasite on living *Vaucheriæ.* The motile naked masses of protoplasm develope a single cilium at the posterior end, and must then be regarded as zoogonids, and their mother-cells as zoocarps or zoosporanges. The zoogonids consume the protoplasm and the chlorophyll of the host; when mature, they multiply by repeated bipartition. Finally they become encysted into zoocarps, which may either reproduce zoogonids directly, or plasmamœbæ in the first place, of the form which the author calls actinophryds, globes with radially arranged pseudopods; these are reproduced in several ways. Both the zoogonids and the actinophryds can pierce the wall of the *Vaucheria*-sac, and, after they have moved about it for a time, transfer themselves to another one. The author traces a resemblance between the development of *Pseudospora* and that of *Plasmodium Malariæ.*

Protophyta.

α. Schizophyceæ.

Auxospores of Chætoceros.†—Herr F. Schütt describes the mode of formation of the auxospores in this marine genus of diatoms. In a cell in the chain which has attained its maximum length, the valve is perforated at a spot on its girdle-band, and the protoplasm protrudes as a small vesicle, and becomes invested by a fine shell, the entire protoplasm of the mother-cell finally passing into it. The nearly globular auxospore attains double or three times the diameter of the mother-cell, and then somewhat increases in length in the diameter at right angles to the axis of the mother-cell. The protoplasm then contracts, and becomes invested in a new siliceous coat, which gradually assumes the form characteristic of the genus, while the horns are at the same time gradually formed out of the surface of the valve, and break through the siliceous coat; the new cell, which is placed at right angles to the original chain, and is much larger than its component cells, now divides transversely.

Fossil Diatoms of Gianicolo.‡—Dr. M. Lanzi describes the diatomiferous deposit found near the summit of Monte Gianicolo, within the Roman basin, with a list of the species.

Cells of the Cyanophyceæ.§—Herr E. Zacharias has carefully examined the structure of the cell in the following genera of Cyanophyceæ, viz.:—*Oscillaria*, *Nostoc*, *Cylindrospermum*, *Tolypothrix*, and *Scytonema.* He finds in all cases, in the living cell, a central colourless portion, surrounded by a peripheral layer of protoplasm, in which alone the

* Ber. Gesell. öff. Gesundheitspflege, Petersburg, 1887 (Russian). See Bot. Centralbl., xxxix. (1889) p. 346.

† Ber. Deutsch. Bot. Gesell., vii. (1889) pp. 361–3 (1 pl.).

‡ Atti Accad. Pontif. Nuov. Lincei, xlii. (1889) 9 pp.

§ Ber. Deutsch. Bot. Gesell., vii. (1889) Gen.-Versamml.-Heft, pp. 31–4, and Bot. Ztg., xlviii. (1890) pp. 1–10, 17–26, 33–43, 49–60, 65–70 (1 pl.).

pigment or cyanophycin resides, and which alone contains granular inclosures of various sizes. No vacuoles could be detected. The peripheral coloured protoplasm consists mainly of plastin; the inclosed granules are colourless and unstratified, and are insoluble in alcohol or ether, and do not give the ordinary albumen reactions. In the central portion are often found one or two bodies agreeing in their appearance and their chemical reactions with nucleoles. The mode of cell-division appears uniform in the genera named. The new division-wall makes its first appearance on the wall of the mother-cell as a circular ridge, which then gradually projects into the cell, and finally divides it completely in two. This is accompanied by a constriction of the central portion of the cell. This central portion cannot, however, in the opinion of the author, be correctly described as a nucleus, since it differs materially in its properties from ordinary cell-nuclei, although it presents the microchemical reactions of nuclein.

β. Schizomycetes.

New Type of Endosporous Bacteria.*—Prof. L. Klein describes a previously unobserved mode of endosporous formation of spores in a number of bacteria found in marshes, chiefly inhabiting partially decayed algæ, generally *Volvox* and *Hydrodictyon.* The spore is either terminal or median, the first indication of its formation being a swelling of the rod, and the protoplasm of this swelling, which always remains in communication with that of the rest of the rod, assumes a light green tint. The entire contents of the swollen part then contracts, separates itself from the cell-wall, increases in refrangibility, and gradually assumes the form of an endospore, which retains permanently its strong refrangibility and its blue-green tint. This peculiarity was observed in five species, all of them new, to which Dr. Klein gives the names *Bacillus de Baryanus*, *B. Solmsii*, *B. Peroniella*, *B. macrosporus*, and *B. limosus*. In all, except *B. Peroniella* and *limosus*, the ripe spore is somewhat bean-shaped; when the spores are terminal the end where they are placed is usually somewhat swollen; when motility was observed the sporiferous end was generally anterior.

The author traces a homology between the mode of formation of these spores and that of the cysts of the Flagellatæ; and suggests that the Schizomycetes consist of two groups not very closely related to one another phylogenetically, one forming endospores and nearer to the Flagellatæ, while the other may be regarded as Cyanophyceæ which have become saprophytic in their mode of life and colourless.

Symbiotic Organism of the Tubercles of Leguminosæ.†—Herr B. Frank points out that the symbiosis in the tubercles of Leguminosæ is of an entirely different character from that which occurs in the roots of any other plants, except the alder and *Elæagnus.* The infection always takes place from the soil, but in two different ways, either by means of hyphæ or without them; the latter is always the case in *Lupinus* and *Phaseolus.* The infecting hyphæ and the hypha-like bodies in the meristem of the host which are derived from them, do not differ

* Ber. Deutsch. Bot. Gesell., vii. (1889) Gen.-Versamml.-Heft, pp. 57–72 (1 pl.).
† T. c., pp. 332–46. Cf. this Journal, *ante*, p. 59.

essentially from the rest of the protoplasmic contents of the infected meristem-cells. The hyphæ have no true cell-wall; and the substance of which they and the rest of the contents of the meristem-cells is composed may conveniently be termed *mycoplasm*. The author suggests that the so-called hyphæ are in reality a formation from the protoplasm of the host designed for the reception of the symbiotic micrococcus or bacterium swarm-cells. For the infecting microbe he proposes the name *Rhizobium Leguminosarum*, and considers it rather a Schizomycete than a Myxomycete, though possibly allied to *Plasmodiophora Brassicæ*. The so-called "bacteroids" are not fungi, but formations from the protoplasm of the host in which the micrococcus of the microbe is contained. In *Phaseolus vulgaris* we have the simplest relation between the two symbionts; the microbe is a parasite performing no service to the host. In the lupin and pea the same is the case when the soil is rich in humus; but when the supply of humus is deficient the microbe-symbiont is of the greatest service to the host in promoting the various vital processes of assimilation, formation of chlorophyll, &c.

Morphological Constancy of Micrococci.*—Dr. G. Mirto concludes from his experiments made with various micro-organisms that there exists a large class of micro-organisms in the coccus form which preserve their morphological characters unchanged, however the external conditions of their existence may be varied; such micro-organisms never give rise to the formation of spores.

The micro-organisms made use of by the author in his investigation were *Micrococcus cinnabareus*, *M. roseus*, *M. cereus albus*, *M. radiatus*, *M. flavus liquefaciens*, *M. ureæ liquefaciens*, and an unclassified micrococcus. The media employed were gelatin, agar, potato, broth, and solid flesh. On these media, with the above-named microbes, the author made frequent observations, in all of which the morphological constancy of the organisms was maintained; the cocci always producing cocci at all periods of their growth and in the different cultivation media. Spore-formation was never observed.

Decomposition of Albumen by Anaerobic Schizomycetes.†—In his experiment M. von Nencki used *Bacillus liquefaciens magnus*, *B. spinosus*, and *Bacillus* of symptomatic anthrax. Flasks holding 4–10 litres were filled with sterilized serum albumen, and the air in the flasks replaced with CO_2, H, or N. In a few days fermentation began, with the development of gas. The decomposition-products of the three bacilli were the same. Among these the author found fatty acids, aromatic acids, and a new product of albumen decomposition, skatol acetic acid. This, with nitrite of potash and acetic acid, forms a yellow crystalline nitrous compound.

Bacteria found in Influenza ‡—Secretions from the respiratory passages and juices from various organs from cases of influenza were used by Dr. V. Babès as intravenous and subcutaneous injections in guinea-pigs and rabbits. The animals were also infected by rubbing

* Bollettino Soc. Ital. Microscopisti, i. (1889) pp. 6–25.

† SB. K. Akad. Wiss. Wien, May 1889. Cf. Centralbl. f. Bakteriol. u. Parasitenk., vii. (1890) pp. 129–30.

‡ Centralbl. f. Bakteriol. u. Parasitenk., vii. (1890) pp. 233–41.

their nasal mucosa with the tainted discharge. Many of the animals succumbed to the poison, but on the other hand, many survived, an inflammatory swelling only being developed at the place of inoculation. From the organs of the animals which died cultivations were made on agar, gelatin, and potato, and several forms of bacteria developed. Among these were *Staphylococcus pyogenes aureus* and *albus*, and also a *Staphylococcus* from 0·8–1 μ broad, which did not liquefy gelatin, and was not pathogenic. Of the bacilli, two forms distinguished as B i. and B ii. are specially noted. The colonies of bacillus i. are distinguished by being perfectly transparent and colourless. The individual elements, which are extremely small, from 0·2–0·4 μ thick, form small chains or threads. They are only faintly stained by anilin pigments, and not at all by Gram's method. They are quite motionless. Bacterium ii. was found to stain well. The primitive elements, usually in pairs, are about 0·5 μ broad, with pointed ends. Transverse striations could be detected. These bacilli did not grow on gelatin, but throve on potato. They were found to be pathogenic to mice and guinea-pigs, their chief effect being exerted in the lungs.

Besides the foregoing colonies of oval bacteria, slender bacilli and thick bacilli were also observed.

These observations were made from cases occurring during the height of the epidemic, and another set is given from cases of pneumonia, which started as influenza. Among the micro-organisms isolated from the latter cases were *Streptococcus pyogenes*, a lancet-shaped diplo-bacterium, and a bacterium the colonies of which formed mucous-looking masses below agar layers or upon gelatin. They were pathogenic to mice and rabbits.

Dr. Bouchard,* after narrating instances of the contagiousness of influenza, proceeds to say that he found three pathogenic microbes of influenza, "two of which are too many if we go for a specific virus of influenza." All these three microbes are the constant companions of the various cavities of the human body. Hence, in order to have any causal relation to influenza, they must have exceeded the ordinary conditions of their existence. The author's view that *Streptococcus pyogenes aureus* is the only microbe capable of producing pneumonia wants further corroboration. This microbe was isolated from the vesicles of *Herpes labialis*, and was found also in the pneumonias complicating influenza. *Streptococcus Pneumoniæ* was found by the author in the bronchial secretion, but not in the blood. This microbe is con-considered by the author to be identical with the Streptococcus of erysipelas, of suppuration, and of puerperal fever.

Dr. T. M. Prudden † has examined seven cases of unmistakeable influenza. Cultivations were made on agar and agar-glycerin plates at the temperature of the body. The pathogenic forms discovered were *Staphylococcus pyogenes aureus*, *Streptococcus pyogenes*, and *Diplococcus pneumoniæ.* The author concludes that bacteriology has "brought to light no living germ which there is reason to believe has anything to do with causing the disease." When compared with Ribbert's investigation

* La Semaine Méd., 1890, No. 5. See Centralbl. f. Bakteriol. u. Parasitenk., vii. (1890) pp. 375–6.

† Medical Record, Feb. 15, 1890.

of a quite similar set of cases, i. e. influenza with and without pneumonia, it is found that the author discovers *Diplococcus pneumoniæ* in tolerable frequency, while Ribbert does not mention this microbe at all.

Dr. Ribbert* examined seven cases dead of influenza for bacteria. Cultivations were made from lungs, trachea, spleen, and kidney, on agar. Having found in five cases *Streptococcus pyogenes* vel *erysipelatis*, the author asks if this microbe can be the excitant of influenza. If this be the case it is obvious that this Streptococcus must have acquired, temporarily at least, pathogenic properties, differing a good deal from those usually attributed to it, but it may be acknowledged that, when once the disease has been set up, this micro-organism plays at least an important though secondary part.

Chicken-Cholera Microbes.†—Dr. O. Katz, who was entrusted with the investigation of the fowl-cholera question in Australia, finds that when material of undoubted virulence (blood pure cultivations) is subcutaneously injected, rabbits invariably succumb, and usually in a short time, some dying in 7–8 hours. When fed with food contaminated with these bacteria, the rabbits were nearly always found to die, the average duration of the disease being 18–25 hours.

The liquid medium used by the author for cultivation of the microbes was rabbit flesh infusion or broth. This was made by mixing finely chopped up rabbit flesh with twice its weight of distilled water, and allowing the mixture to stand for 24 hours in a cool place, stirring from time to time, filtering and pressing through cheese-cloth, steaming, filtering again, neutralizing with 20 per cent. aqueous solution of anhydrous carbonate of soda, steaming and filtering again, and ultimately filling into different sized cotton-wool-plugged sterilized test-tubes, which with their contents were thereupon discontinuously sterilized. Other cultivations were made with the foregoing fluid to which 1 per cent. peptone and 0·5 per cent. NaCl were added. Of the solid media the most used was a 6 per cent. rabbit broth peptone gelatin.

The author's experiments on the "immunization" conferred by sterilized broth cultivations against a subsequent infection by active cultures lead him to admit the great possibility of the protective power of this "vaccination"; but his experiments are too few for a certain conclusion.

With regard to the question, Is chicken cholera a contagious disease among rabbits? the author's experiments were considerably in favour of a positive answer; although, from the conditions under which the animals were placed, these experiments were marred in consequence of the great mortality due to causes other than chicken-cholera.

The question whether the virus of chicken-cholera is affected by its transmission through rabbits in successive generations, is answered in the negative. For this purpose twenty generations were used, and on summing up the results the author found that there was neither an increase nor a decrease in the virulence.

Further experiments were made to ascertain how far certain indi-

* Deutsche Med. Wochenschrift, 1890, No. 4. See Centralbl. f. Bakteriol. u. Parasitenk., vii. (1890) pp. 273–5.

† Proc. Soc. Linn. N.S.W., iv. (1889) pp. 513–97.

genous and other birds were affected by the chicken-cholera microbe. The results appear to have been doubtful.

Pathogenic Micro-organisms of the Mouth.*—Dr. R. Kreibohm's investigation of the micro-organisms found in the mouth extended to *Leptothrix buccalis* and some pathogenic bacteria. From microscopical examination, and from cultivation, the author came to the conclusion that Leptothrix merely represents a peculiar phase of growth of different Schizomycetes. Four forms were observed to develope Leptothrix, two of which were bacilli, and two short bacteria.

Of the pathogenic microbes, the author was able to demonstrate four different species, of which three were not cultivable on the usual nutritive media. All four kinds were fatal to animals, producing a septicæmia, and they were afterwards found in the blood in large quantities.

Positive results were obtained only from the tongue-fur of sick persons, and best from those in condition of high fever. To only one of these micro-organisms is a name given, *Bacillus sputigenus crassus*, a short fat bacillus found in the sputum and tongue-fur of chronic bronchitis. These grew well on potato, agar and gelatin, and were easily stained by the customary methods. They were found to be very fatal to animals, producing gastroenteritis, pulmonary hæmorrhage, and death in a few hours. Sterilized cultures had the same effect.

Passage of Pathogenic Micro-organisms from Mother to Fœtus.†—Dr. M. Simon has endeavoured to solve the problem of the passage of pathogenic microbes from mother to fœtus by the microscopical observation of anthrax in rabbits. Cultivation experiments for determining the presence of the anthrax bacilli in the fœtus were not made.

According to the author, the placenta does not form a physiological filter for anthrax bacilli, which were found not only on the surface of the fœtus, but as deep down as the peritoneum.

Coarse pathological changes such as hæmorrhages were not observed in the placenta. Bacilli were detected in the fœtal placenta, in the amniotic fluid, and in the fœtus, but they were found to vary in quantity and in situation with the length of the disease.

Bacteria of the Normal Respiratory Tract.‡—Dr. L. von Besser has examined the secretion from the nasal cavities in 57 men of 20 to 60 years of age: 28 of these were convalescents, the rest being healthy individuals employed in the laboratory. The experiments were microscopical, cultural, and vaccinal. Of pathogenic microbes, *Diplococcus pneumoniæ*, *Staphylococcus pyogenes aureus*, *Streptococcus pyogenes*, and *Bacillus pneumoniæ* were discovered, and less frequently in the invalids than in the healthy persons. Of non-pathogenic bacteria, the author found *M. liquefaciens albus*, *M. albus*, *M. cumulatus tenuis*, *M. flavus liquefaciens*, and several others. The laryngeal and bronchial secretions were also made the subject of examination, and with analogous results.

* Inaugural-Dissertation Göttingen, 1889. See Centralbl. f. Bakteriol. u. Parasitenk., vii. (1890) pp. 312–3.

† Zeitschr. f. Gebürtshülfe u. Gynækologie, xvii. (1889) pt. 1. See Centralbl. f. Bakteriol. u. Parasitenk., vii. (1890) p. 219.

‡ Beitr. z. Pathol. Anat. u. z. Allgem. Pathol., vi., No. 4. See Centralbl. f. Bakteriol. u. Parasitenk., vii. (1890) pp. 151–2.

Behaviour of the Virus of Cholera, Enteric Fever, and of Tuberculosis in Milk, Butter, Whey, and Cheese.*—Milk having been shown to be a vehicle for the transmission of certain diseases, e.g. scarlet fever, enteric fever, cholera and tuberculosis, Dr. L. Heim made experiments to ascertain the duration of viability of certain disease germs when cultivated in milk or the food-stuffs prepared from it, butter, whey and cheese. The author's results show that the germs were still capable of development in

	Cholera.	Enteric Fever.	Tuberculosis.
Milk after	6	35	10 days.
Butter „	32	21	30 „
Curds „	0	1	2 „
Whey „	2	1	14 „
Cheese „	1	3	14 „

Behaviour of Pathogenic Micro-organisms in Sea Water.†—Prof. de Giaxa, in examining the action of sea water on pathogenic micro-organisms, used the bacteria of cholera, anthrax or typhoid, and the *Staphylococcus pyogenes aureus*, while the sea water was obtained from different localities. In the result it was found that there was little difference between sea water and fresh water towards pathogenic microbes; for in the latter, when it has been sterilized, pathogenic microbes may live for a long time; but, when not sterilized, the competition between the common bacteria and the pathogenic microbes causes the latter to disappear with greater or less rapidity; the practical result of the author's experiments is that pathogenic microbes can resist the competition of the common bacteria for a certain time, and hence, if the conditions be favourable, they may become the source of direct or indirect infection.

Baumgarten's Annual Report on Pathogenic Micro-organisms.‡—The first half of this report for 1888 has just appeared. It notices, often at length, 514 monographs or books. This half is devoted to:—(1) Works on Microbiology, (2) Pathogenic Micrococci, (3) Bacilli.

ARLOING.—**Immunité naturelle.** (Natural immunity.) (Soc. des Sciences Méd. de Lyon.) *Lyon Méd.*, 1889, No. 51, p. 605.

BRAEM, G.—**Untersuchungen über die Degenerations-Erscheinungen pathogener Bakterien im destillirten Wasser.** (Researches on the degeneration of pathogenic bacteria in distilled water.) Königsberg, 1889, 62 pp.

BURRILL, THOMAS J.—**A Bacterioid Disease of Corn.** *University of Illinois, Agricultural Experiment Station*, 1889, Bulletin No. 6, p. 165.

CHENZINSKI, C. J.—**Micro-organismen der Malaria.** (Micro-organisms of malaria.) Odessa (A. Schultz), 8vo, 1889, 66 pp., 1 pl. (Russian).

DAVIES, A. M.—**Report on Bacterial Cultivations from Drinking Water.** *Army Med. Departm. Rep.*, 1887, London, 1889, No. 29, pp. 307–20.

ERNST, H. C.—**How far may a cow be tuberculous before her milk becomes dangerous as an article of food?** *Amer. Journ. of the Med. Sciences*, Nov. 1889, pp. 439–50.

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* Arbeiten aus d. Kaiserl. Gesundheitsamte, 1889. See Centralbl. f. Bakteriol. u. Parasitenk., vii. (1890) pp. 152–5.

† Zeitschr. f. Hygiene, vi. p. 162. Cf. Annales de Micrographie, ii. (1889) pp. 86–9.

‡ See Annales de Micrographie, ii. (1890) pp. 253–4.

FOKKER, A. P.—**Die Grundlagen der Bakteriologie.** (Elements of Bacteriology.)
Leipzig, 8vo, 1889.

FONTIN, W. M.—**Bakteriologische Untersuchungen des Hagels.** (Bacteriological investigation of hail.)
Wratsch, 1889, Nos. 49, 50, pp. 1081–3, 1105–7 (Russian).

GÜNTHER, G.—**Die wichtigsten Vorkommnisse des Jahres 1888 auf dem Gebiete der Bacteriologie.** (Record of Bacteriology for 1888.)
Deutsche Med. Wochenschrift, Nos. 30–3 and 35.

HUEPPE, F., AND WOOD, G. E. C.—**Investigations on the Relation of Putrefactive to Parasitic Bacteria.** *Lancet*, 1889, II., No. 23, pp. 1162 4.

LAVERAN, A.—**Les hématozoaires du paludisme.** (Hæmatozoa of malaria.)
Arch. de Méd. Expér. et d'Anat. Pathol., 1889, No. 6, pp. 798–833.

LUBARSCH.—**Ueber die Behandlung der Metschnikoffschen Phagocyten für die Vernichtung der Milzbrandbacillen im Froschkörper.** (On the treatment of Metschnikoff's phagocytes for the destruction of anthrax-bacilli in the body of the frog.)
Tagebl. d. 64. *Versammlg. Deutsch. Naturforscher u. Aerzte in Köln*, 1889, p. 84.

MAGGIORA, A.—**Contributo allo studio dei microfiti della pelle umana normale et specialmente del piede.** (Contribution to the study of the microphytes of the human skin and specially of the feet.)
Giornale della R. Società Ital. d'Igiene, 1889, No. 5, p. 335.

MATTEI, E. DI.—**Sulla presenza del bacillo tubercolare sulla superficie del corpo dei tisichi.** (On the presence of the bacillus of tuberculosis on the surface of the body of phthisical persons.)
Annali dell' Istituto d' Igiene Sperimentale, I. p. 2.

MINGES, G.—**Bacteriological Examination of nineteen American Mineral Waters in the bottle state.**
Journ. of the Amer. Med. Assoc., II., 1889, No. 20, pp. 691–5.

MILLER, W. D.—**Die Micro-organismen der Mundhöhle.** (The micro-organisms of the buccal cavity.) Leipzig, 1889, 305 pp., 112 figs.

PODWYSSOZKI, W., JUN.—**Zur Terminologie in der Phagocytenlehre nebst einigen Bemerkungen über die Riesenzellenbildung.** (On the terminology to be used in speaking of phagocytes, with some observations on the formation of giant-cells.)
Fortschritte der Medicin, VII., p. 487.

SCHMIDT-MÜLHEIM.—**Ueber das Pasteurisiren und Sterilisiren der Kuhmilch.** (On the Pasteurization and sterilization of cow's milk.)
Arch. f. Animal. Nahrungsmittelkunde, Bd. IV. No. 10; Bd. V. No. 1.

SCHUBERT, P.—**Fadenpilze in der Nase.** (Mycelium in the nasal fossa.)
Berliner Klinische Wochenschrift, 1889, p. 39.

THOIN ET MASSELIN.—**Précis de microbie médicale et vétérinaire.** (Handbook of medical and veterinary Bacteriology.) Paris (G. Masson), 8vo, 408 pp.

TUCKER, G. R.—**The number and distribution of Micro-organisms in the air of the Boston City Hospital, with some carbonic acid determinations.**
Report of the Board of Health of the State of Massachusetts, 1887–88.
Boston, 1889, p. 161–230.

VALLIN, E.—**Les hématozoaires du paludisme.** (Hæmatozoa of malaria.)
Rev. d'Hygiène, 1890, No. 2, pp. 97–105.

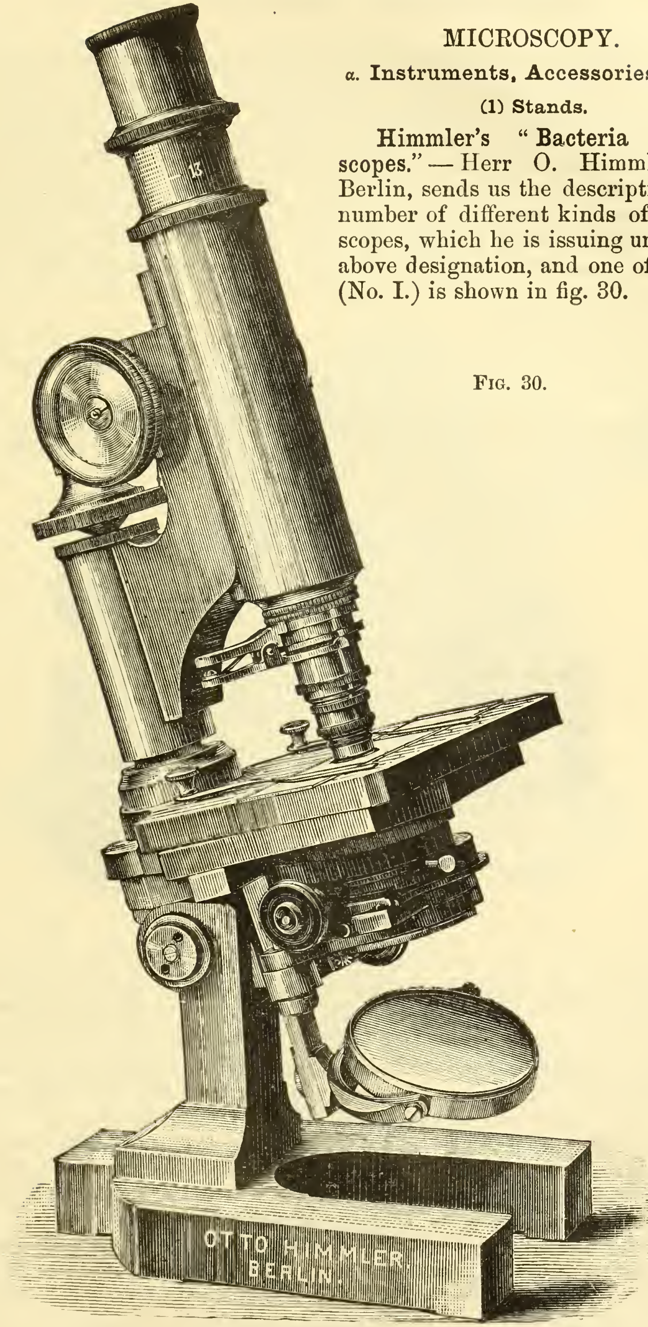
MICROSCOPY.

α. Instruments, Accessories, &c.*

(1) Stands.

Himmler's "Bacteria Microscopes." — Herr O. Himmler, of Berlin, sends us the description of a number of different kinds of Microscopes, which he is issuing under the above designation, and one of which (No. I.) is shown in fig. 30.

Fig. 30.



* This subdivision contains (1) Stands; (2) Eye-pieces and Objectives; (3) Illuminating and other Apparatus; (4) Photomicrography; (5) Microscopical Optics and Manipulation; (6) Miscellaneous.

Generally, the instrument, as will be seen, is on the Hartnack model, but with an Abbe condenser. The condenser is on an arm with rack and pinion, so that it can be instantaneously moved in and out of the axis, by racking it down and turning it to the left. The maker claims that "this is a great advantage as against the instruments of other makers which have not such a contrivance." The claim as made is too wide, as we have seen German instruments which have had a similar arrangement in principle, though it might be more generally applied, as it is often very inconvenient to be obliged to alter the position of the Microscope, and slide out the illuminating apparatus when it is desired to work without the condenser.

For rapidly changing objectives, the instrument, as shown in fig. 30, is supplied with a Fuess clamp, the objective being released by pressing the end of the "tongs" together against the spring.

Blackhall's Simple Microscope with Multiple Illuminator. — In this little instrument (figs. 31 and 32) sent us by Mr. W. Blackhall, an

Fig. 31.

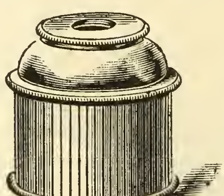
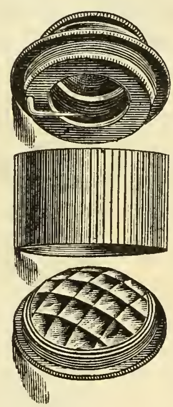


Fig. 32.



ingenious device has been made use of for illuminating the object, which is fixed on a pin in front of the simple lens. The bottom of the tube, in place of being closed by a convex lens, has a "multiplying glass," as shown in fig. 32, by the facets of which the light is thrown on the object.

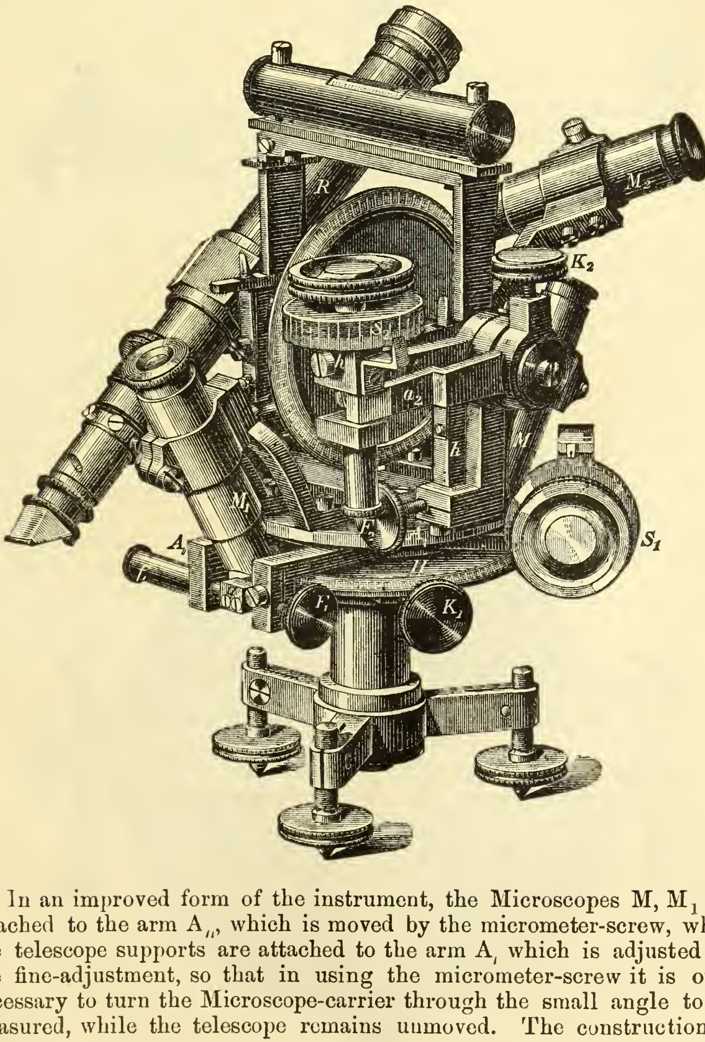
Heyde's Microscopes for Theodolites.*—Herr G. Heyde has designed an instrument intended to unite the advantages of the screw Microscope with the convenience of the small Hensoldt scale Microscope. It has not generally been found possible to apply the screw Microscope to small theodolites, on account of the inconvenience for transport, &c., and yet their accurately divided scales deserve a better method of reading than either the Vernier or Hensoldt Microscope.

In the new theodolite M, M_1 (fig. 33) are Microscopes with parallel wires for reading the horizontal scale H; they are attached to the arm $A_{\prime}$, which carries the supports of the telescope-axis. Below $A_{\prime}$ is a second

* Zeitschr. f. Instrumentenk., viii. (1888) pp. 171–6 (3 figs.).

arm $A_{\prime\prime}$, provided with two fine-adjustments; one at F_1 with a spring f_1 and clamping-screw K_1 serves for the azimuthal adjustment of the telescope R_1; the other S_1 serves to turn $A_{\prime}$ with respect to $A_{\prime\prime}$, and plays the part of the micrometer-screw in the screw Microscope. The Microscope M_2, which is used for reading the vertical scale, is connected in the same way with a micrometer screw S_2, which, after the telescope is adjusted to the right elevation, serves to measure the interval between the cross-wire and the image of the nearest division.

Fig. 33.



In an improved form of the instrument, the Microscopes M, M_1 are attached to the arm $A_{\prime\prime}$, which is moved by the micrometer-screw, while the telescope supports are attached to the arm $A_{\prime}$ which is adjusted by the fine-adjustment, so that in using the micrometer-screw it is only necessary to turn the Microscope-carrier through the small angle to be measured, while the telescope remains unmoved. The construction is

Fig. 34.

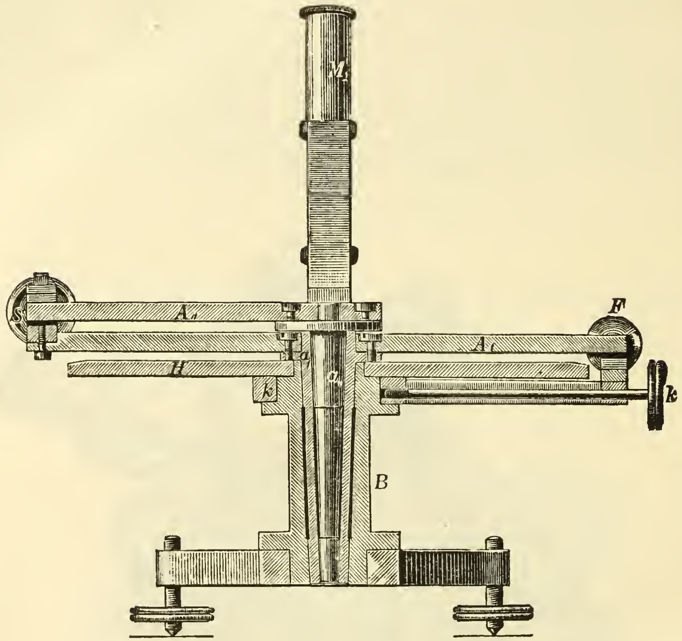
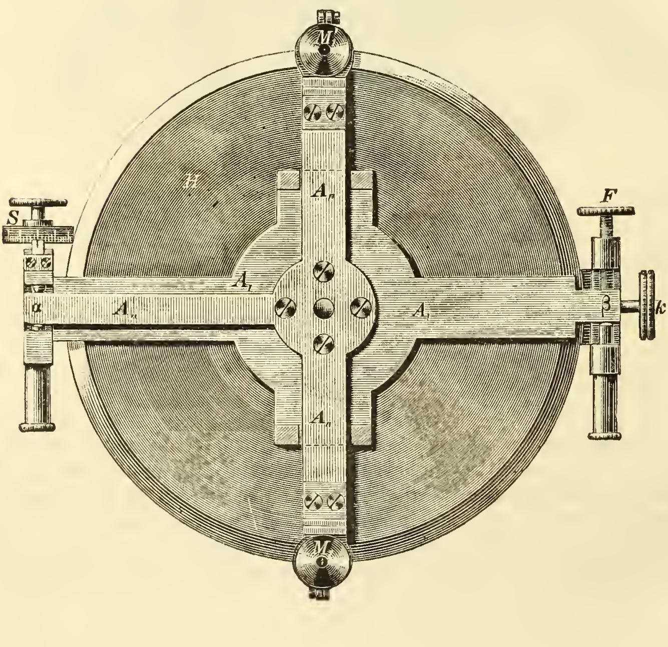


Fig. 35.



shown in figs. 34 and 35. B is the supporting column, and $A_{\prime}$ the principal axis, which contains a second axis $A_{\prime\prime}$ carrying the second arm $A_{\prime\prime\prime}$, to which the two Microscopes M_1 and $M_1{}^1$ are screwed. The principal arm $A_{\prime}$, connected with the axis a and carrying the telescope, has two prolongations, α and β, which extend beyond the divided circle. β is connected with the fine-adjustment screw F on the clamp k; and α carries the micrometer screw S. S serves to turn the Microscope arm $A_{\prime\prime}$ alone; while F moves the principal arm with the upper part of the instrument, and at the same time the Microscope arm. A second arm is not necessary on the vertical circle, where it is replaced by the telescope carrier. The circles being divided into one-third of a degree, a complete turn of the drum is made to correspond to 20 minutes, and it is divided into 200 parts, so as to read to tenths of a minute.

(2) Eye-pieces and Objectives.

Binocular Eye-pieces.—The late Mr. R. B. Tolles's binocular eye-piece has not yet been described in this country, and as inquiries are constantly made on the subject, the following description is reproduced with slight modifications from his original paper.*

"To apply the binocular principle to the eye-piece of a Microscope or telescope, it is only necessary to make use of the erecting form of eye-piece, and to place the dividing prism at the point where the pencils composing the whole bundle of rays proceeding from the object cross the eye-piece, which is the point where, in any erecting eye-piece, the diaphragm proper is correctly placed.

If the theory of the erecting eye-piece of common form were generally understood, no demonstration that binocularity can be given to such an eye-piece would be necessary. Suffice it to say that, since any one pencil of light proceeding from any point of the object through the *whole area* of the object-glass *does* at this point equally fill the whole area of the diaphragm (that being of proper aperture) substantially in the same manner, therefore the division for binocular vision, if made here by the appropriate prism, must be a very nearly equal division of every particular pencil, and give a similar and satisfactory image of the entire field in each eye-tube. This is a sufficient expression of the whole theory of the binocular eye-piece.

It is, however, important in order to avoid pseudoscopic effects, to adopt the proper form of dividing prism; and this form is precisely that best suited to that kind of binocular Microscope in which the dividing prism is placed immediately above the objective. The natural presumption has been—contrary to this—that prisms of rectangular form would give the proper effects in the eye-piece, because of the pseudoscopic effects produced by their use in the Microscope of binocular body. But this is an error, inasmuch as the pencils proceeding to form the second image in the erecting eye-piece reach the small dividing prism under conditions suitable for correct vision of the object *were the eye placed there*, and, accordingly, the same false appearances obtain with the eye-piece of rectangular prisms, *having oculars above*, as if such division were made immediately above the objective; the effect being,

* Silliman's American Journal of Science, xxxix. (1865) pp. 212–5 (1 fig.).

that the order in which the rays proceeding from the sides of the object or image viewed reach the eyes, as to right and left, is reversed from that which exists in natural vision; the left eye receiving a preponderating portion from the right side, and the right from the left side of the object.

It is to be noted, however, that the eye-piece with rectangular prisms, arranged after the first method of Prof. Riddell, does not uniformly produce conversion of relief, or that inversion of perspective which obtained in that first experimental arrangement for a binocular Microscope. Such a *binocular eye-piece* used in the Microscope upon transparent objects only occasionally gives the view in depth thus inverted. With low powers, and considerable thickness of the transparent object, the view is usually pseudoscopic. With medium and high powers, it is otherwise; and the effect is much controlled in this respect by the direction of the light upon the object.

When the binocular eye-piece with rectangular prisms is used in the telescope to view a landscape, the perspective is not *throughout* inverted, but portions of the field appear interposed between the eye and nearer objects in a singular and somewhat startling manner.

By arranging the compound rectangular prism so that the optical pencil is divided in the *plane of vision*, instead of vertically, the pseudoscopic effect is almost entirely obviated.

In constructing the binocular eye-piece, the prisms and arrangement of Nachet have been found to answer every condition and requisite of binocular vision. The dividing prism being placed, as before stated, at the point of crossing of the pencils in the erecting eye-piece, each pencil of light will enter the small dividing prism and impinge upon its reflecting surfaces in a manner similar to that illustrated in the Nachet binocular Microscope. The binocular eye-piece has greatly the advantage over the other arrangement. For when the prisms are placed *in the binocular body immediately above the objective*, their position, in order to secure a *proper division* of each transmitted pencil, should change with every change of objective used—which can be easily provided for in the case of low powers, but is rather impracticable with the higher numbers, it being very difficult to bring the prisms sufficiently near to the posterior combination of the objective. On the contrary, when the binocular arrangement is embodied *in the eye-piece*, the prism being once fixed in proper position, as before described, is correctly placed for every power of objective, and the eye-piece, thus binocular in form, is as applicable through the whole range of powers as if it were monocular. Applied to high powers, only one condition would be distinguishingly critical in the case of the eye-piece—that of the centricity of the central prism. The form of erecting *eye-piece* found most advantageous in this binocular adaptation is a duplication of the ordinary Huyghenian negative eye-piece, wherein the small dividing prism is very nearly at the eye-hole point of such a negative eye-piece as is ordinarily applied in the monocular Microscope. At a proper distance above this is placed another negative eye-piece, in which is formed a second image of the object viewed.

This form of erecting eye-piece gives less extension above the body of the Microscope than the positive form, and for that reason is preferred.

The annexed diagram (fig. 36) illustrates the division of pencils proceeding from the first image formed in the apparatus, and their general course to emergence at the two eye-surfaces. When the eye-piece is constructed of the form as here shown, the field is produced very satisfactorily, and of tolerable expansion; and does not necessitate more than 4·5 inches extension beyond the Microscope-body. The draw-tube can be as well withdrawn, and the eye-piece occupy its place, thus diminishing somewhat the total extent of the instrument. With proper modifications of the system of lenses placed before the prisms in the eye-piece, the whole binocular arrangement can be brought still nearer the objective, and retain also all the characteristics of the binocular eye-piece as contradistinguished from the binocular Microscope known and in use.

Fig. 36.

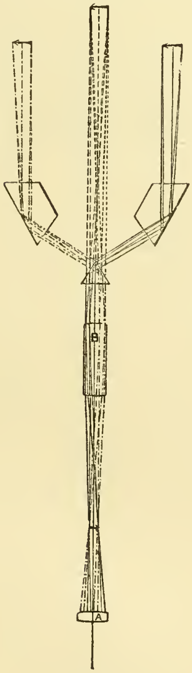
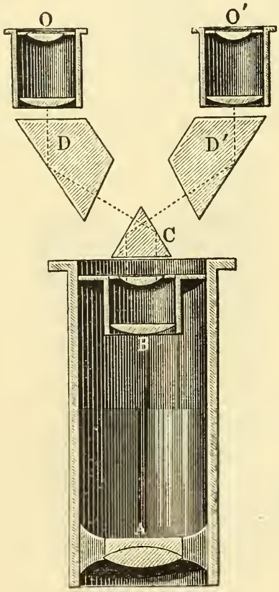


Fig. 37.



The objection that loss of light must occur on account of the additional front system of lenses pertaining to an erecting eye-piece (the lower system in the diagram), of course militates against the arrangement; but there are, on the other hand, incidental advantages in the use of the erecting form. . . . . As the object is for the sake of efficiency with a high-power objective, to give as large an area to the transmitted pencil as possible at the point where it undergoes division in the small prism, therefore the power of the front system should be kept down, and amplification, as far as necessary in the eye-piece, be produced after the division has taken place. . . . .

Having obtained by this means a pencil (or beam) transmitted through the eye-piece of the greatest possible dimension or area, at the point of binocular division, greater amplification in the eye-piece, as to its total power, might be advantageously effected by means of lenticular immergent and emergent surfaces of the upper prisms; the lower face of each prism to be *convex*, the upper emergent surfaces concave, giving achromatized refraction in each case. By this means a larger field, together with a minimum length of tubes above the prisms, would be secured.

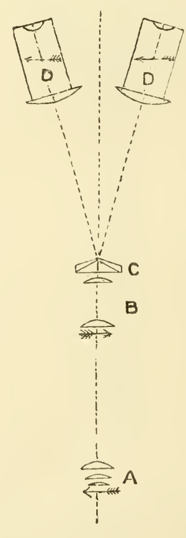
By thus appropriating every surface of all the prisms not a reflecting surface, for the purpose of lenticular refraction, the greatest aggregate advantage appears to be secured."

We should mention that fig. 36 is not the diagram given with Mr. Tolles' original paper, but is one supplied by him shortly before his death, and drawn to scale, showing the path of the rays. In sending it, he remarked that without A the arrangement is a Nachet Binocular Microscope.

Fig. 37 shows one of the earlier forms of the instrument as combined with the eye-pieces, and is reproduced from Dr. Dippel's 'Handbuch der Allgemeinen Mikroskopie,' vol. ii. p. 598. Dr. Dippel points out that the eye-piece "either entails a very considerable lengthening of the body-tube or, if this inconvenience be avoided, considerably disturbs

Fig. 38.

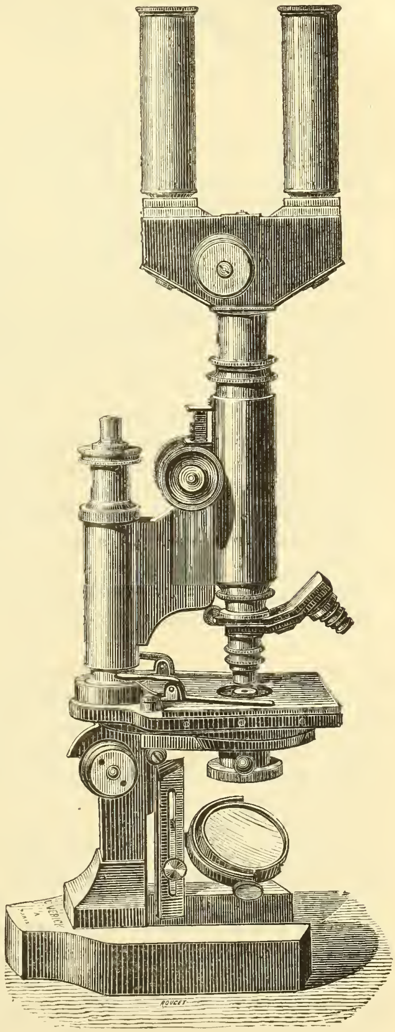
Fig. 39.



the optical effect of most objectives, because in this case they are used for a far shorter imaged distance, and consequently with an essentially different course of rays than in ordinary use."

Prazmowski's (figs. 38 and 39) is made entirely of brass, and being of considerable size is inordinately heavy. A is the objective which forms an image near B, which is composed of two lenses, of which one is achromatic. This arrangement is essentially like a terrestrial or erecting eye-piece for a telescope, except that in the terrestrial eye-piece, the crossing-point (Ramsden circle) is *between* the component lenses, whilst in this binocular the crossing-point is situated higher up, in fact, just at the angle-edge of the achromatic prism C, where the pencil is divided. This arrangement gives a good field in each eye-piece. After division, the pencils pass on to the two eye-pieces D D, where they form images which are slightly unsymmetrical, by which the stereoscopic effect is obtained.

Fig. 40.



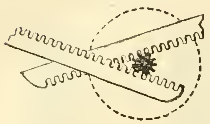
The diagram fig. 39 is from a drawing made for this Journal by the late A. Prazmowski.

Vérick's (fig. 40) is, so far as its essential optical arrangement is concerned, identical with that of Tolles, *having a central equilateral prism and two truncated ones at the sides.* The erector is, however, an achromatic combination formed of a lower plano-convex lens and an upper biconvex one. The central equilateral prism is also mounted with its lower face in a brass ring, having a circular diaphragm about 1/4 in. in diameter immediately above the upper lens of the erector. To secure its exact orientation in relation to the truncated lateral prisms, the brass ring is made to rotate partially in the horizontal plane; a portion of the cylindrical edge of the ring being provided with a "worm" on which acts an endless screw that can be turned by a small key whilst the observer views the image.

Fig. 41 shows the mechanism by which the lateral prisms (with the eye-pieces) can be separated to suit the width of the observer's eyes. The sliding ebonite box-fittings in which they are mounted are attached respectively to the diagonal racked bars; the revolution of the toothed pinion (acted upon externally by the milled head shown by a dotted line in fig. 41 and seen also in fig. 40), causing them to move exactly together outwards, or in the reverse direction.

A great advantage of the apparatus is that instead of being made of brass, and therefore very heavy, the eye-piece tubes are of aluminium, and the prism-box of ebonite; an admirably light eye-piece is thus obtained, which in that respect leaves nothing to be desired.

Fig. 41.



Hartnack also made some binocular eye-pieces, but we have not been able to obtain the materials for their description. Dr. Dippel gives * the following description of two of them, but his woodcut of the first, which he describes as having four Riddell prisms, is obviously not correct, as it figures an eye-piece like that of Vérick, which will not take the Riddell prisms.

"In the older Hartnack binocular, which is inserted into the Microscope-tube by means of an adapter, the duplication of the image and halving of the pencil of rays takes place in the course of the pencil between the objective and the position of the real objective image. Riddell's arrangement of four prisms serves for this purpose, the two eye-pieces being rigidly connected with the two prisms, which direct upward the twice totally reflected rays parallel to the axis of the Microscope. The adjustment of the eye-pieces to suit the eyes of the observer is effected by mechanism put in motion by a screw-head. More recently, Dr. Hartnack has constructed a somewhat more complex binocular eye-piece, which gives splendid images with a small field of view, and, as far as I could ascertain, agrees in principle with the Tolles apparatus, inasmuch as a prism, over a lens-system in the lower tube acting as eye-piece, divides the image into two erect images, which are observed through two ordinary eye-pieces converging below and movable by rack and pinion in the direction of their long axes."

(3) Illuminating and other Apparatus.

Screw Eye-piece Micrometers.—Much discussion has taken place in recent years on the subject of the relative accuracy of the different eye-piece micrometers, that is, between the fixed glass-plate micrometers on the one side, and the movable screw or spider's-web (filar) micrometers on the other.

In all these discussions the only screw-micrometer that has been referred to is the ordinary English form, with two spider lines, in which the optical part of the eye-piece is fixed immovably in the optic axis, while one of the spider lines traverses the field of view by the action of the screw. There are, however, some refinements of this apparatus to which attention may be called.

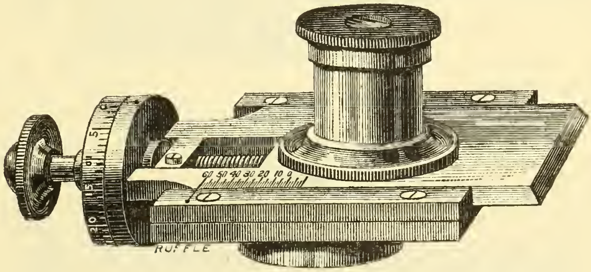
An important defect of the ordinary form of screw-micrometer arises from the fact that the measurements are not effected with the centre of the eye-piece alone, but use is made of the excentric parts of the lenses. The result of this is that the image of the object is subjected to more or less distortion, as its various parts are magnified differently, according

* L. c., pp. 598–9.

to their lateral distance from the optic axis. Harting found that the image of ten divisions of a glass micrometer gave a result 1/33 less when it was measured as a whole than when the single divisions were measured and added together. The difference in magnifying power of the different parts of the field of view can of course be determined, but the process would be very tedious, and is not practically available.

Dr. H. v. Mohl * therefore adopted the plan of moving the optical part of the eye-piece (with crossed threads) across the field. The image

Fig. 42.



is thus always observed only through the axis of the lenses, and the distortion found in the case of the ordinary micrometer is avoided. As will be seen in fig. 42, the tube containing the eye-lens and field-lens is attached to a slide which is moved by the screw so that the axis of the lenses may be displaced laterally in relation to the optic axis of the Microscope, or in other words, the eye and field lenses can be made to traverse the field of view. †

This micrometer, though it obviated the distortion caused by observation through the excentric parts of the eye-piece, gave rise to a some-

* Arch. f. Mikr. Anat., i. (1865) pp. 79–100.

† Fig. 42 does not represent Mohl's micrometer as described by him (of which, indeed, we believe no figure is extant), but is taken from one sent us by Messrs. Merz, the makers of his original form. One important difference is that in the latter the eye-piece is not attached directly to the slide moved by the screw, but to a second upper slide which can be moved on the first by hand. The object of this is to adjust the lenses in the optic axis at the commencement of an observation without having to use the screw for that purpose. (We should be glad to be referred to a drawing or photograph of Mohl's original form if it exists.)

The following is a condensed abstract of Dr. Mohl's original description :—

" As regards the mechanical details of the instrument constructed for Mohl by Steinheil, the Microscope-tube is screwed into a horizontal plate fixed on a solid standard, and carries a Fraunhofer screw-micrometer which works in agate bearings; above the micrometer is an orthoscopic Kellner eye-piece with a short tube. The eye-piece tube is not fixed directly to the micrometer-slide which is moved by the screw, but to a second slide which moves between swallow-tail guides upon the upper surface of the first in a direction parallel to the length of the micrometer-screw; this slide itself is moved by a second screw of deep pitch. The stage and condenser are separated from the body of the Microscope, being carried by a bar which can be fixed to the stand of the instrument by means of two short arms. The eye-piece therefore is movable not only by the micrometer-screw together with the slide which is used for measuring purposes, but also when desired by the second slide (or " eye-piece slide ") which moves horizontally upon the first, so that what similar error of optical excentricity, the image observed by the eye-piece when not in the optic axis, being formed not by the central rays from the objective, but by the marginal rays. To obviate this

Fig. 43.

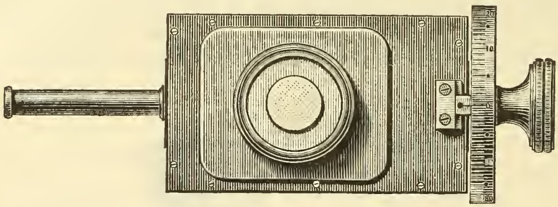
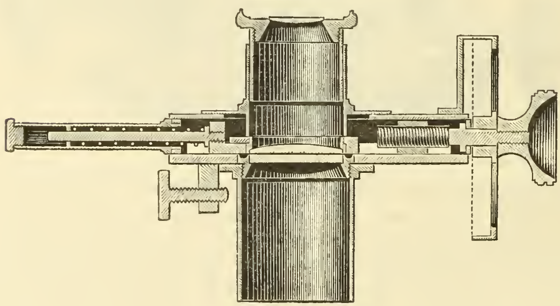


Fig. 44.



Prof. Abbe (see figs. 43 and 44) while making use of Mohl's device for moving the eye-piece across the field of view, added a second lens close

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it can be made to traverse the whole of the fixed microscopic image. It is important to have some means of readily bringing the eye-piece back to the axis of the Microscope, and of noting the positions of the micrometer and eye-piece slides which correspond to this adjustment. For this purpose three diaphragms were employed, each perforated with a minute hole; one is placed over the objective, one in the middle of the body-tube, and the third immediately under the eye-piece, so that they only transmit rays along the axis of the tube; by this contrivance the eye-piece can be adjusted in the axis by bringing it into the position in which the cross-wires exactly divide the small circular openings of the diaphragm into four equal quadrants; the position is then noted by marking an index line upon the eye-piece slide and one of its guides, and reading the micrometer-screw, so that it may at any time be at once recovered without a fresh adjustment. If it is required to use another part of the screw for measuring purposes it is only necessary to adjust the eye-piece to the axis, note the position of the cross-wires upon an object, and then after moving the screw to the desired point, to bring back the cross-wires to the same position by means of the eye-piece slide. In attempting to make a preliminary series of measurements Mohl found that in spite of the solid stand employed in his instrument and the massive plate to which the tube and micrometer were fixed, the pressure of the hand upon the micrometer-screw produced such considerable deflections in the instrument that it was impossible to make accurate adjustments, and it was only by fixing the tube to the stand by means of a rectangular framework of brass plates that it could be made sufficiently rigid."

beneath the field lens which remains immovable in the axis, while the field and eye-lens move over it. The lower plane surface of the field lens has diagonal cross lines, as well as a double index-mark engraved on it, and the plane upper surface of the additional lens has a scale. The lens has a focal length of about 17 mm., so that its lower focal point lies approximately in the opening of the objective, and the principal rays are made parallel in front of the eye-piece as if their centre of divergence was at infinite distance. In consequence of this, in every position of the eye-piece, the point of the field under observation behaves as the centre of the field of view in the ordinary arrangement, that is, *all* the pencils are identical with the axial pencil, and the shifting of the eye-piece produces no optical excentricity.*

Winkel's Combination of Screw-micrometer and Glass-micrometer Eye-piece.†—Dr. A. Koch writes as follows:—For fine microscopic measurements, in particular for the determination of the thickness of Bacteria, it appeared to me to be of advantage to possess an apparatus with which exact determinations could be made more easily than with the ordinary eye-piece micrometer. I found useful for this purpose an eye-piece with a thread such as has been in use for a long time in physical and astronomical instruments, and occasionally employed in Microscopes. In these eye-pieces a stretched thread or a mark on a glass plate can be moved parallel to itself by means of a micrometer-screw with divided head; for measuring, the thread is brought successively to both edges of the object, and its breadth is given by the number of turns of the micrometer-screw necessary to move the thread from one margin of the object to the other. The value of the divisions of the drum of the micrometer-screw is determined by an object-micrometer.

It is, however, inconvenient, especially with very strong magnifications and very small objects lying in great numbers in the field of view (such as Bacteria) to have to replace such a screw eye-piece by an ordinary micrometer eye-piece when it is desired to measure with less exactness the larger divisions of the object which we had previously been measuring with the screw eye-piece, e. g. the length of a *Bacterium*. Herr R. Winkel, of Göttingen, has, however, constructed a micrometer eye-piece in which the thread is replaced by a division on a glass-micrometer. This apparatus can therefore be used, as I have already mentioned in my work, 'Ueber Morphologie und Entwicklungsgeschichte einiger endosporer Bacterienformen,'‡ either as an ordinary micrometer eye-piece with fixed micrometer for less fine measurements, or for more exact determinations by using the micrometer-screw and successively adjusting one edge of a division on the margins of the object.

The mechanical details of the apparatus are shown in figs. 45 and 46, the latter fig. showing the internal arrangement after the upper part at A (fig. 45) has been unscrewed. In fig. 46 is seen the frame DE, which is moved by the micrometer-screw EF, which has a pitch of exactly 1/5 mm., and on which lies a glass micrometer divided in $\frac{10 \text{ mm.}}{100}$; the

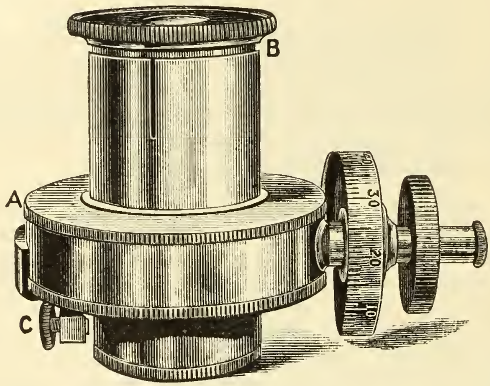
* Cf. Dippel's 'Handbuch der Allgemeinen Mikroskopie,' 2nd ed., 1882, pp. 639–40 (2 figs.).

† Zeitschr. f. Wiss. Mikr., vi. (1889) pp. 33–5 (2 figs.).

‡ Bot. Ztg., 1888.

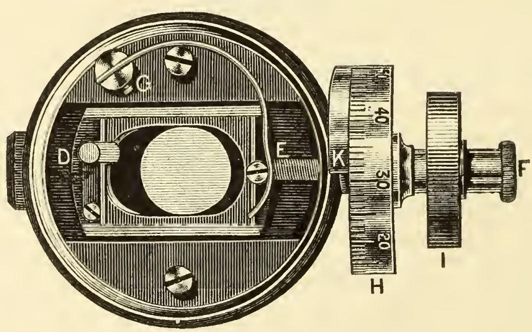
latter is held firm by the clamp at D, and on removing the upper part can be taken out for cleaning. Backlash of the micrometer-screw is completely avoided by the spring fastened at G, which extends to E.

Fig. 45.



On the micrometer-screw is the drum H divided into 100 parts, and the head I for clamping; the sharp end of the piece K screwed to the socket of the eye-piece serves as index. The upper lens of the eye-piece can be drawn out (B, fig. 45) for the exact focussing of the micrometer-

Fig. 46.



divisions. The whole is fixed to the body-tube by the screw C, though a slight shaking of the body-tube, owing to the movement of the micrometer-screw, does not injuriously affect the exactness of the measurements.

(5) Microscopical Optics and Manipulation.

On the use of Fluorite for Optical Purposes.*—Prof. E. Abbe has an article on this subject. Of the minerals which occur in nature, quartz and calc-spar are the only two which have been regularly used in

* Zeitschr. f. Instrumentenk., x. (1890) pp. 1–6.

practical optics. The great transparency of these minerals for violet and ultra-violet light has recommended them for spectroscopic purposes, but their chief use depends on the specific property of non-tesseral crystals of double refraction, by which results are effected which are not to be attained with an amorphous substance, such as glass. Tesseral crystalline minerals which, so far as their optical properties are concerned, are like glass, have already been made use of for optical purposes. Brewster and Pritchard, within the last forty years, recommended and employed the diamond and other precious stones of unusually high refractive power in Microscope lenses. Attempts in this direction, however, have brought no lasting gain to optics, and must at present be considered as wholly given up, the simple Microscope formed of uncorrected lenses being relegated to a subordinate use. Quite different points of view are now kept under consideration in judging of optical resources for the continued improvement of the compound Microscope. For, in face of the refinements which, in recent times, practical optics has kept in view, the estimation of the materials used in lens-combinations has altered in direction; it no longer looks at the greater or less perfection of its fundamental effect, which depends of course on the refractive power, but it has turned to the consideration of the degree in which the properties of these materials facilitate and advance the neutralization of the unavoidable subsidiary effects—spherical and chromatic aberration.

From this point of view a material which, from the standpoint of the efforts of Brewster and Pritchard, would appear very unprofitable, viz. fluor-spar, becomes of special interest at the present time for practical optics. This is because it offers unusual advantages in respect to the neutralization of those subsidiary effects. Fluorite possesses an abnormally low refractive power; the index for sodium light is only 1·4338, and is thus considerably lower than that of crown glass; its use as a constituent of a lens-system is therefore, in respect to the fundamental effect, relatively disadvantageous. However, with many lens-combinations, such as those used for the Microscope, there must be a difference of refractive indices between media in contact and with equal curvature of the bounding surfaces in contact to remove the spherical aberration; it is on the amount of this difference that the compensating effect in respect to the spherical aberration depends. The lower the index for the first medium, the greater the amount of this difference, and the more perfect the compensating effect which is to be attained by the addition of a second medium of given refractive power. So, also, the lower the index for the first medium, the lower that of the second, when a certain given difference is to be maintained. If, for example, in a cemented double lens—as used in the Microscope—an ordinary crown glass of index $n_D = 1·52$ serves as the one member, and the removal of spherical aberration requires a difference of refractive powers of 0·20 on both sides of the cemented faces, then the above consideration shows that there must be connected with that crown glass a second lens with index 1·72, and consequently one made of a very heavy, strongly dispersive, flint glass. Supposing, on the other hand, the first member to be a lens of fluorite, then the required excess of refractive power of the second member would be given by an ordinary flint glass of 1·63, which for many reasons would be much more advantageous. That mineral therefore affords greater convenience in the choice of the kinds of glass to be used in obtaining perfect compensating effects for the removal of the spherical aberration in lens-systems.

Besides this advantage, which gains special importance in the construction of Microscope objectives of large aperture, fluorite possesses the further useful optical properties of an abnormally low colour-dispersion, and a relation to the partial dispersions for the different parts of the spectrum which is very serviceable for the removal of the secondary spectrum. For the three hydrogen lines H_α, H_β, H_γ the differences of the refractive index are—

Material.	$N_\beta - N_\alpha$	$N_\gamma - N_\beta$	N_D.	$\frac{\Delta n}{n-1}$	$\frac{N_\gamma - N_\beta}{N_\beta - N_\alpha}$
Fluorite	0·00455	0·00255	1·4338	$\frac{1}{95 \cdot 4}$	0·561
Ordinary calc-silicate crown glass	0·00860	0·00487	1·5179	$\frac{1}{60 \cdot 2}$	0·566
Aluminium-phosphate crown glass	0·00737	0·00407	1·5159	$\frac{1}{70 \cdot 0}$	0·552
Borate flint glass	0·01026	0·00582	1·5521	$\frac{1}{53 \cdot 8}$	0·567

If the interval from H_α to H_β (C to F) be taken as a measure of the mean dispersion (Δn), the above table shows that the fluorite, not only taken absolutely, but also relatively to the value of $(n - 1)$, possesses a considerably lower colour-dispersion than the most advantageous glass hitherto produced; for while with the latter the so-called relative dispersion does not sink below 1/70, with fluor-spar it is diminished to 1/95. But the curvature which a compound lens of this medium must have in order to give an achromatic system of determined focal length when combined with a lens of greater relative dispersion, depends essentially on the amount of the relative dispersion of a medium. The smaller the $\Delta n / (n - 1)$ the less curvature suffices for achromatism under otherwise similar circumstances for a given focal length.

While thus a simple non-achromatic lens of fluor-spar, on account of its low refractive power, necessitates a much greater curvature for a determined focal length than one of crown glass, on the other hand, an achromatic lens with this material requires less curvature than one made of crown glass, supposing that the same flint glass is used for the compensation of the colour-dispersion.

Finally, the numbers in the last column of the above table show that the ratio of the partial dispersions in the two parts of the spectrum H_α to H_β and H_β to H_γ has for fluorite, in spite of its very low dispersion, almost the same value as for an ordinary silicate crown glass with dispersion 1/60. On the other hand, for the aluminium phosphate-crown, the most advantageous glass so far as the relative dispersion is concerned, the blue end of the spectrum is seen to be relatively shortened, although the value of the $\Delta n / (n - 1)$ is only diminished to 1/70. Consequently fluorite may be said to offer special advantages for the simultaneous union of three rays of the spectrum, i. e. for the removal of the secondary colour-dispersion.

The above-mentioned phosphate crown glass, it is true, in combination with the above or a similar borate flint glass, also allows a direct achromatism for three different colours (not the three rays $H\alpha$, $H\beta$, $H\gamma$, yet three rays within the less refrangible part of the spectrum). It therefore serves for the construction of a double lens with only tertiary colours remaining; but in this combination the curvatures are somewhat disadvantageous. This is due to the fact that the numbers for the relative dispersion $\Delta n / (n - 1)$ in these two media—1/70 and 1/54—show only a slight difference. If, however, fluorite be substituted for the above crown glass, then a combination is obtained which satisfies the condition of the union of three different colours, and at the same time gives a very considerable difference of the relative dispersions of the two constituents (1/95 and 1/54). This difference still remains sufficiently large if the calc-silicate crown be substituted for the borate flint. The dispersion of this glass is, moreover, almost rigidly proportional to that of the fluorite through the whole visible dispersion. Accordingly, with these two media, a double achromatic lens of almost absolutely complete colour-union could be made; for there would be no tertiary spectrum remaining over. Having regard then to all the conditions which regulate the construction of a perfect lens-combination—the spherical aberration in systems of large aperture, as well as the chromatic aberration of first and second orders—fluor-spar affords more profitable relations than any material at present at our disposal in optics. The data on which the present conclusions are based, were made known long ago by the spectroscopic measurements on fluor-spar which Stefan published in the year 1871. The numbers given above are from the measurements of Dr. Riedel, of Jena, made in the year 1880 and later at the author's instigation, with the use of hydrogen lines, on different varieties of the mineral. They agree with the values found by Stefan within the limits of errors of measurement, so far as they concern the same parts of the spectrum. The characteristic optical properties of fluor-spar shown by these spectroscopic measurements are doubtless due to the specific effect of the fluorine which makes up fifty-six per cent. of the calcium fluoride. It might therefore be reasonably expected that if it were possible to introduce this element in considerable quantity into artificial fusions, kinds of glass would be obtained which, partially at least, would exhibit the valuable peculiarities of fluor-spar.

Experiments made in this direction by Dr. Schott in 1881 and the following year in the course of his work on the improvement of optical glass have to a certain extent realized that idea. By the use of fluorides in small quantity glasses were produced which, with lower refractive index, exhibited also a very diminished dispersion. These experiments, however, showed clearly at the same time (as Dr. Schott has already indicated) the extraordinary technical difficulties which stand in the way of the production of sufficiently homogeneous glass of such a composition. These difficulties at first appeared to be so great that it seemed to be impossible to prepare practically useful kinds of glass with similar properties to those of fluor-spar.

This result has served to fix the author's attention on the use of the natural mineral for purposes of practical optics, and more especially for Microscope objectives; for previous experiments in the year 1881 had already shown that fluorite, in spite of its less hardness, is susceptible of being shaped like glass, although with some difficulty.

By using clear crystals and cleavage fragments, such as were then easily obtainable from mineral dealers, in the year 1884 the optical factory of Carl Zeiss in Jena first constructed, under the author's direction, Microscope objectives of different kinds, in which perfect correction of the spherical and chromatic aberration was effected by the use of lenses—one to three in each system—of fluorite instead of crown glass. With the introduction of the new Microscope objective, the "Apochromatic," the mineral has come into regular use in Jena, and has been further extended by other opticians in their imitation of the Zeiss construction. The calculations and technical details of these constructions have been rendered much easier by the introduction of fluor-spar in partial replacement of crown glass. Without its aid those lens-systems, for the same requirements in the construction, would have been still more complicated in composition, and more difficult in manufacture than they are at present.

In view of this use of fluorite for the Microscope now generally admitted, and considering the advantages which it offers for many other purposes of practical optics, it will be of interest to discuss the determining condition of its use, viz. the possibility of procuring this material in sufficient quantity and quality.

The inquiries which the author set on foot many years ago have hitherto led to no satisfactory result. Fluor-spar belongs, it is true, to the widely distributed minerals, and is found in very many places in transparent crystals. Most varieties, however, apart from the rarity of large clear pieces, are quite worthless for optical purposes. This is due to the fact that they show double refraction in a marked degree and owing to disturbances of the regular crystal growth. Until some years ago, tolerably large pieces, which were water-clear and in parts quite pure, could be obtained from mineral dealers. These were attributed to different, though principally Swiss, localities, and it seemed reasonable to suppose that this serviceable variety, free from double refraction, would be of quite general occurrence and consequently not difficult to procure. More exact inquiries, however, soon proved that all such specimens of fluorite, met with amongst dealers or in collections, are referable to one and the same locality in the Schwarzhornstock in the Bernese Oberland, and in fact, to a single find accidentally made there almost sixty years ago.

According to the communications of Herr E. v. Fellenberg, of Bern, and to information which the author obtained later at the place itself, a hole, out of which was obtained considerably more than 100 cwt. of large water-clear crystals and cleavage pieces of fluor-spar, was discovered above the Alp Oltscheren by Alpine shepherds from Brienzwyler, near Brienz, in the year 1832. This material was distributed amongst dealers in minerals in all directions, and after dealers, collectors, and museums had been supplied, was sold by the owners to chemists for the preparation of hydrofluoric acid, or thrown away as worthless. A part is said to have come to Paris fifty years ago, and to have been used by opticians in lenses and prisms for experiments on heat radiation. The remnants presumably of this remarkable find, which included some water-clear crystals (cubes) as large as one's head, hidden away in cellars, &c., were purchased by the author in the preceding year from the grandchildren of the original finders, and were thus saved for optical purposes.

The precise locality of that old find had been forgotten. By means of the labels, however, found in the Bern Museum, Herr v. Fellenberg, who has assisted the author in these inquiries in the most friendly way, was enabled to fix it as the south-west slope of the Oltschihorn, the offshoot of the Schwarzhornstock towards the Lake of Brienz.

Chance investigations made with the help of some Oberland crystal-seekers proved the frequent occurrence of fluor-spar in the neighbourhood, but the old locality was not discovered, nor was further material with the characteristics of the earlier find obtained. The firm of Carl Zeiss therefore took up the quest, and during the summer of this and the preceding year caused regular excavations to be made by a large number of practised workmen under the direction of an agent. By this means, in July 1888, on a steep, almost inaccessible rock about 1900 metres above sea-level, the hole was discovered out of which came the find of 1832. It was found, however, to be practically exhausted. Further investigation of the mountain which—belonging to the upper Jura—is distinguished by massive schist formations with numerous precipices, fissures, and cavities, was then made. In this way semi-transparent calc-spar and fluor-spar, crystallized in large cubes, but so far as purity was concerned in no way comparable with that found in the old locality, were discovered in several places near that spot. Of several hundredweight collected, only some pounds were clear and suitable for optical purposes. In August of the present year the work was therefore discontinued, after all traces found by blasting had been followed up as far as they gave any indications of better results. It therefore appears beyond all doubt that the single locality which formerly afforded fluor-spar in large clear masses is now completely exhausted.

The employment of the mineral for Microscope lenses is hardly affected by this; for the comparatively small quantity required for this purpose is assured by the general occurrence of less perfect material, from which, with some difficulty, it can be picked out. On the other hand, the further extension of its use in optics will be dependent in every way on the discovery of new localities which afford large crystals or cleavage-masses of similar purity to that which was formerly found at Oltschihorn.

Perhaps this communication may help to make this mineral, so valuable to optics, an object of greater attention, and possibly to bring to light localities of it which have hitherto remained unnoticed.

J. M. M. writes,* in reply to a correspondent "Prismatique," "'Fluorite' is simply the Continental name for common fluor-spar, and,

* Engl. Mech., li. (1890) pp. 205-6.

doubtless, if he will visit any of the Derbyshire spar or lead mines—for the mineral is a constant companion of lead veins—he will find crystals of it quite fit for optical work in overwhelming quantities. Perfectly colourless crystals are certainly not very common, neither are they very rare; but, at the same time, are they necessary? The most common colour the mineral assumes is a pale green, evident enough in large crystals; but in laminæ thin as the lenses of an objective, scarcely, if at all, perceptible.

'Prismatique's' experience of the deterioration of the new glasses from atmospheric influences is valuable. It is, at the same time, just what a chemist would expect from the composition of some of them, that is, if they are honestly named. It must not be forgotten that more than half a century ago our own Faraday in England, and Amici, in Italy, produced new glasses for optical work which possessed valuable properties, and offered great advantages, optically, over those in common use. Ross, in London, and Chevalier, in Paris, worked Microscope objectives from the new glass, and their performance was said to be a great advance upon that of lenses made from the ordinary material. It was, however, found that they deteriorated so rapidly that their manufacture was given up.

I have now in my possession a 1/10 in. made by Chevalier. The outer lenses of the combination, viewed by reflected light, are a bright steel-blue in colour, much like the screw-heads in a watch movement. The performance must have been phenomenal at the date of its production, for it will even now "dot" *angulatum;* but the field is filled with fog produced by the action of the decomposed surfaces upon the light, analogous in effect, but less in degree, to that produced by a very finely ground but unpolished lens. With this experience behind us, precisely equivalent to that of 'Prismatique' with the new glasses, it behoves one to pause before rushing to the conclusion that the optical millennium is here."

Mr. Lewis Wright writes * on the same subject in reply to some strictures by 'Prismatique' on the Jena glass and German opticians. "Apart from fluorite altogether, great improvement has been made by English and other opticians with the new glass alone; and German micro-objectives are now reaching this country superior to any made here at double the price. I speak from personal trials, of which I may perhaps say a few words another time. Zeiss undoubtedly used at first glass which would not bear exposure to the air; but these things were gradually discovered and remedied, though it is too soon yet to say if even present lenses will stand permanently. I believe I was, myself, the very first to utter a word of caution in these columns on that very point, though a glass may be useful in the middle of a triplet which will not stand atmospheric exposure."

Jena Glass.†—Mr. A. Caplatzi thinks it will be of interest to give the list published in 1888, which brings the variety of glasses up to 63.

The first column contains the number, the second the factory number, the third the description, the fourth the refractive index for D, the fifth the medium dispersion C to F, and the sixth the specific gravity. At a

* Engl. Mech., li. (1890) p. 222. † T. c., p. 117.

little enhanced price pressed discs of the same glass having the approximate form of the desired lens can be obtained.

No.	Fabric No.	Description.	Refractive Index D.	Medium Dispersion, C-F.	Specific Gravity.
45	0·599	Boron silicate crown	1·5069	0·00813	2·48
46	0·337	Silicate crown	1·5144	0·00847	2·60
47	0·374	" "	1·5109	0·00844	2·48
48	0·546	Flint crown	1·5170	0·00859	2·59
49	0·567	Silicate crown	1·5134	0·00859	2·51
50	0·610	Crown of low dispersion ..	1·5063	0·00858	2·51
51	0·598	Silicate crown	1·5152	0·00879	2·59
52	0·512	" "	1·5195	0·00886	2·64
53	0·463	Baryta light flint	1·5646	0·01020	3·11
54	0·608	Crown of high dispersion ..	1·5149	0·00942	2·60
55	0·602	Baryta light flint	1·5676	0·01072	3·12
56	0·381	Crown of high dispersion ..	1·5262	0·01026	2·70
57	0·583	Baryta light flint	1·5688	0·01110	3·16
58	0·543	" "	1·5637	0·01115	3·11
59	0·527	" "	1·5718	0·01133	3·19
60	0·575	" "	1·5682	0·01151	3·15
61	0·522	" "	1·5554	0·01153	3·03
62	0·578	" "	1·5825	0·01255	3·29
63	0·376	Ordinary light flint	1·5660	0·01319	3·12
64	0·340	" "	1·5774	0·01396	3·21
65	0·569	" "	1·5738	0·01383	3·22
66	0·318	" "	1·6031	0·01575	3·48
67	0·266	" "	1·6287	0·01775	3·72
68	0·335	Dense silicate flint	1·6372	0·01831	3·77

Lehmann's Molecular Physics.*—The following review of Dr. Lehmann's treatise is taken from a recent number of 'Nature,'† where it appeared under the title of "The Application of the Microscope to Physical and Chemical Investigations":—

Very soon after the first invention of the Microscope, attempts were made to apply the new instrument to solve some of the remarkable problems of crystallogenesis. The early volumes of the Royal Society Transactions contain in the papers of Boyle, Hooke, and Leeuwenhoek, published between the years 1663 and 1709, many records of attempts of this kind; and the works of Henry Baker, which appeared between 1744 and 1764, are also largely concerned with the study of the process of crystallization under the Microscope.

In Germany, Ledermuller in 1764, and Gerhardt in 1780, showed the value of the Microscope in studying the internal structure of crystals; while in France a long succession of enthusiastic investigators, Daubenton, Dolomieu, Fleurian de Bellevue, Cordier, and others, were busily engaged in laying the foundations of the science of microscopical petrography.

Early in the present century, we find the English investigators once

* 'Molekularphysik, mit besonderer Berücksichtigung mikroskopischer Untersuchungen und Anleitung zu Solchen, sowie einem Anhang über mikrochemische Analyse.' Von Dr. O. Lehmann, Professor der Electrotechnik am kgl. Polytechnikum zu Dresden. Leipzig (W. Engelmann), 1888–9, 2 vols., pp. 852 and 697 (624 figs. and 10 pls.).

† Nature, xlii. (1890) pp. 1–2.

more taking a leading part in applying the Microscope to the study of crystallized bodies. Between the years 1806 and 1862, Brewster published a long series of memoirs, dealing with the microscopical characters of natural and artificial crystals, and the inclusions which they contain. About the year 1850, too, Mr. Sorby commenced his important investigations on the subject, availing himself of the method of preparing transparent sections of rocks and minerals which had been, shortly before this time, devised by William Nicol. Mr. Sorby's epoch-making memoir, "On the Microscopical Structure of Crystals, indicating the Structure of Minerals and Rocks," made its appearance in 1858.

While one group of investigators, following the lines of the early work of Brewster and Sorby, have sought to make the Microscope an efficient instrument for the determination of minerals, even when present in rocks as the minutest crystals or fragments; others have no less diligently pursued the methods which the same pioneers in this branch of research have initiated for solving physical and chemical problems connected with the formation of crystallized bodies.

In the hands of Des Cloizeaux, Tschermak, Zirkel, Von Lasaulx, Fouqué and Michel-Lévy, Rosenbusch, and other workers, the Microscope has gradually been developed into a splendid instrument of mineralogical research; and the determination of the minutest particles of a mineral is now becoming no less easy and certain than that of the largest hand-specimens.

But, at the same time, Brewster and Sorby's early attempts to solve physical and chemical problems by the aid of the Microscope have not failed to exercise an important influence on subsequent workers in these branches of science. Link, Frankenheim, Klocke, Harting, and especially Vogelsang (whose early death was a severe loss to this branch of science), have done much towards establishing the science of crystallogenesis upon a firm basis of accurate observation; and their labours have been continued in more recent times by H. Behrens and Dr. Otto Lehmann, the author of the work before us.

As the well-known treatises of Rosenbusch, and of Fouqué, Michel-Lévy, and Lacroix give us an admirable *résumé* of the present state of determinative mineralogy, as improved by the application of the Microscope, so does the work before us contain a perfect summary of the contributions of the microscopist to the sciences of physics and chemistry.

It will only be possible, within the limits of an article like the present, to indicate briefly the plan of the very comprehensive and, indeed, almost exhaustive work, in which Dr. Lehmann has embodied the observations of himself and his predecessors in this field of inquiry.

The first division of the book deals with the construction and use of the Microscope; especial attention being given to forms of the instrument, like those devised by Nachet and by the author of this work, for the special purpose of studying crystallization and other physical and chemical processes.

The second division of the book treats of those physical properties of matter which are presented by all bodies, whether in the solid, liquid, or gaseous state. Such questions as the polarization and absorption of light, the conduction of heat, and the electric and magnetic relations of various substances are here dealt with by the author.

The next division relates to the peculiar properties presented by solids. Elasticity and plasticity are considered, and, under the latter head, the remarkable phenomenon of the production of twinned structures in crystals by mechanical means is fully discussed. Under the head of cleavage we find a treatment of such phenomena as the production of mathematical figures in certain crystals by pressure, percussion, &c.; while under the heads of "Enantiotropie" and "Monotropie" are classified the consequences which follow from heteromorphism among crystalline substances, and the tendency of the heteromorphous forms to pass one into the other.

The division dealing with liquids and their peculiar properties contains discussions on fluidity, surface-tension, diffusion, capillarity, and crystal-growth, with the origin of structural anomalies. The problems of solution and precipitation, with those of solidification and fusion, are also treated of in this part of the treatise.

The second volume of the work commences with the discussion of the properties of gases and their relations to solids and liquids. This division of the subject, which is very exhaustively treated, extends to 335 pages.

The work concludes with critical remarks upon different molecular theories. The chapters dealing with the theories of crystal structure, of allotropy, of heteromorphism, and of isomerism, with several others, in the same division of the book, are full of interest and suggestiveness.

A supplement of about 150 pages is devoted to what the author calls "crystal-analysis," or what is generally known to geologists and mineralogists as "microchemical analysis." Very minute particles of an unknown substance may often be determined by being treated with appropriate reagents and studied under the Microscope; in this way they are made to yield crystals of various compounds which can be recognized by their characteristic forms and habit. An admirable summary is given by the author of the work of Bôricky, Streng, Behrens, Haushofer, and others, who have gradually perfected this branch of research, and made the method one which is of the very greatest service to the students of microscopical mineralogy and petrography.

While the physicist and chemist will find in this work a perfect mine of interesting and ingenious experiments (many of which are suited to class-demonstrations by projection methods), the mineralogist and geologist will hail the appearance of the book as one that completes and supplements the well-known treatise of Vogelsang—a work that has exercised the most important influence on the development of petrological theory.

In conclusion, it may be pointed out that, not only are the numerous observations of the author on crystallogenesis that are described in memoirs in 'Groth's Zeitschrift' included in the work before us, but many others that have never before been published find a place in these volumes. The work is very fully illustrated both with woodcuts and coloured plates, and constitutes a complete synopsis of all that is known on a number of questions of great importance and interest to workers in many different branches of science.

β. Technique.*

(1) Collecting Objects, including Culture Processes.

Foureur, A.—**Étude sur la culture des Microorganismes anaérobies.** (Study on the culture of anaerobic micro-organisms.)
Paris (Doin), 1889, 8vo, 73 pp. and 25 figs.

Jeffries, J. A.—**A new method of making Anaerobic Cultures.**
Med. News, 1889, p. 274.

(2) Preparing Objects.

Study of the Embryology of the Earthworm.†—Mr. E. B. Wilson says:—"After testing many different hardening fluids, I have found none to compare with Perenyi's fluid, which gives uniformly the best results, both for sections and for surface-views of all stages, and is far superior to picro-sulphuric acid or corrosive sublimate. Flemming's mixture of osmic, chromic, and acetic acids gives very clear differentiation of the middle stratum of the germ-bands after staining with hæmatoxylin, but in most respects it is far inferior to Perenyi's fluid. The embryos were left in the fluid from 15 to 60 minutes, placed in 70 per cent. alcohol for a day, and kept permanently in 90 per cent. alcohol.

For permanent staining no method has proved so satisfactory as borax-carmine followed by hæmatoxylin. After being deeply stained in the carmine (12 hours), and extracted in acid alcohol in the usual manner, the embryos were treated with extremely dilute ammoniacal alcohol for a few minutes, to neutralize the free acid, and were then stained in very dilute Kleinenberg's hæmatoxylin (12 hours or more). In case of overstaining with hæmatoxylin, the colour may be again extracted with acid alcohol, after which the specimens are again treated with ammoniacal alcohol. This process, following treatment with Perenyi's fluid, gives beautifully clear preparations, which are specially favourable on account of the clearness with which the cell-outlines are shown. It has been found desirable to imbed the specimens for sectioning as soon as possible after hardening, and to reduce the time of immersion in melted paraffin to a minimum (i. e. not more than 10 or 15 minutes).

For surface-views of the germ-bands the borax-carmine stain should be very deep, and the hæmatoxylin very slight, so as to give the specimen only a purplish colour, not a dark-blue. The germ-bands are dissected off on the slide, in strong glycerin. This method has, in my experience, given far better results than that of osmic acid followed by Merkel's fluid, so successfully used by Whitman in the study of *Clepsine*.

For the study of entire specimens of the young stages I have found Perenyi's fluid, followed by alcohol, water, very dilute iodine solution, and glycerin, to give results superior beyond comparison to those attained by any other method. The iodine colours the protoplasm pale yellowish-brown, the cell-outlines are clearly marked, and the nuclei are stained deep brown. In time, most of the iodine is precipitated in the form of deep-brown spheres, which mar the clearness of the preparations, but

* This subdivision contains (1) Collecting Objects, including Culture Processes; (2) Preparing Objects; (3) Cutting, including Imbedding and Microtomes; (4) Staining and Injecting; (5) Mounting, including slides, preservative fluids, &c.; (6) Miscellaneous.

† Journal of Morphology, iii. (1889) pp. 445–6.

such specimens may be afterwards stained with carmine, &c., sectioned, and mounted in balsam in the usual manner, and give perfect satisfaction, even after a stay of two years or more in the glycerin."

Experimental Imitation of Protoplasm.*—Prof. O. Bütschli has communicated to Prof. Ray Lankester a full account of the methods by which he attempts to imitate protoplasm.† A medium-sized watch-glass or flat dish must be filled with a thin layer of common olive oil and be placed on a water-bath or small cupboard at a temperature of about 50° C. The great point is to select the right moment at which the oil attains the proper degree of thickness and viscosity; this moment can, however, only be found by systematic trials. After three or four days a trial may be made. Should the drop not have become finely vesiculate and exhibit little or no streaming, the heating process must be continued and a trial made on the succeeding day. If the oil becomes too thick it will form frothy drops, and in such cases a small quantity of ordinary olive oil must be mixed with it.

The vesiculate drops are prepared thus:—In a small agate mortar a small quantity of dry carbonate of potash is ground to a fine powder. This must be breathed on till the salt becomes slightly moist, and then a drop of oil must be added; the two constituents should be mixed till they form a thickish paste. A few drops of it, about the size of a pin's head or smaller, are placed on a cover-glass, the corners of which are supported by small pegs of soft paraffin. Prof. Bütschli then places on a slide a drop of water, and puts the cover-glass over it in such a manner that the drops of paste are immersed in the water, but are not much compressed. The preparation is then placed in a damp chamber, and remains there about twenty-four hours, when the drops have a milk-white and opaque appearance. The preparation is then well washed out with water, which is supplied at one edge by a capillary tube and drawn out by blotting-paper at another.

If the drops have turned out well they will begin almost at once to move about rapidly and change their shape continuously. The water under the cover-glass must now be displaced by glycerin diluted with an equal bulk of water, when a vigorous streaming movement will be exhibited. The amœboid movements are generally more distinct if the drops are somewhat compressed. If the drops do not stream they can generally be made to do so by tapping the cover-glass slightly, by applying gentle pressure, or sometimes by breaking up the drops. It is especially interesting to see how fast and beautifully the drops creep to and fro in the water or in half-diluted glycerin, even when they are not compressed. The streaming movement, on the other hand, is better seen if the drops are somewhat compressed; this may be done by inserting under the cover-glass a piece of broken cover-glass of medium thickness, and then removing the paraffin pegs. This streaming movement is best demonstrated twenty-four hours after the addition of the glycerin, as the drops will then be thoroughly cleared and transparent. The movement and streaming are much more marked and distinct if the drops are examined on a stage warmed to 50° C.

* Quart. Journ., Micr. Sci., xxxi. (1890) pp. 99-103.
† See this Journal, 1889, p. 731.

Prof. Bütschli adds:—"You must not doubt the correctness of the phenomena which I have described if the first trials do not give the desired results."

The student may also be referred to the account given by M. Yves Delage * of his experiences in Prof. Bütschli's laboratory at Heidelberg.

Method of Examining Network of Muscle-fibres.†—Mr. C. F. Marshall adopted a modification of Mays' method of demonstrating nerve-endings in muscle. Mays used a mixture of 20 parts arsenic acid (1/2 per cent.), 4 parts gold chloride (4 per cent.), and 1 part osmic acid (2 per cent.), but this, while preserving the nerve-endings, disintegrates the muscle-fibre by the action of the arsenic acid. Mr. Marshall, after several experiments, used 20 parts acetic acid (1 per cent.), 4 parts gold chloride (1 per cent), and 1 part osmic acid (1 per cent.). The muscle-fibre was placed in this solution for fifteen minutes after previous immersion in acetic acid (1 per cent.) for a few seconds; then in acetic acid (1 per cent.) again in a warm chamber for one or two hours.

Mounting Spermatozoa of Salmonidæ.—Mr. F. M. Walford, at the meeting on April 16th, said:—"Having occasion lately to examine the spermatozoa of the English brook trout (*Salmo fario*) and the American trout (*S. fontinalis*), I found it would be advantageous to have permanent mounts at my disposal. Mr. E. M. Nelson has suggested that the communication to the Royal Microscopical Society of a brief note descriptive of the method adopted might be of assistance to students of this branch of science.

The collection of the milt containing the spermatozoa flowing from a spawning fish presents no difficulties when a medium is used which will preserve the spermatozoa without coagulating them. Alcohol or acetic acid, even when dilute, coagulate the milt, and should be avoided. One part glycerin to five of water is a fairly good medium, but the aqueous solutions of phenol or corrosive sublimate of about 2½ per cent. are preferable.

The majority of text-books recommend glycerin and water for mounting spermatozoa, and hence this was one of the first media tried, but the resolution, even with 1/12 oil-immersion, was most unsatisfactory. The result of a number of experiments in staining may be summed up in the statement that the effect of staining is to make the heads more prominent and the filaments less visible. Specimens collected in 2½ per cent. and mounted in 1¼ per cent. solution of corrosive sublimate looked fairly well for a time, but after a few months the heads of the spermatozoa gradually dilated and showed signs of disintegration.

A suggestion was made that, as probably a medium of low refractive index was desirable, it might be practicable to mount the spermatozoa dry on the cover-glass. So far I have not succeeded in doing so, but future experiments in this direction may be productive of better results. I was told by a friend that at one of the hospitals Farrant's medium was used for human spermatozoa, and the idea occurred to me that, as working in Farrant often produced where not desired a plentiful crop of air-bubbles, it might be possible to take advantage of this peculiarity and show the

* Arch. Zool. Expér. et Gén., v. (1889) pp. xliii.–xlviii.
† Quart. Journ. Micr. Sci., xxxi. (1890) pp. 73–4.

spermatozoa in the air-bubbles on the surface of the Farrant. The *modus operandi* is as follows:—A drop of Farrant is placed on the slip. A small quantity of the spermatozoa in $1\frac{1}{4}$ per cent. corrosive sublimate is dropped from a pipette on the Farrant. The cover-glass is lowered horizontally on to the spermatozoa, and if there are no air-bubbles visible to the naked eye, the cover-glass is lifted and again allowed to fall flat on the spermatozoa. The superfluous fluid is drawn from the edge of the cover-glass with a piece of blotting-paper. The mount is placed in a drying cabinet for some hours until the Farrant is set quite hard, and is then secured by two coats of Hollis."

Methods for making Permanent Preparations of Blood.*—Dr. U. Rossi communicates two methods by means of which he obtains permanent preparations of blood. (1) In a glass vessel is prepared a strongish and recently filtered solution of methyl-green. Another vessel is filled with one-third distilled water, one-third osmic acid (1 per cent.), and one-third of the foregoing solution. The mixture should be quite clear, and of an emerald-green colour. One drop of this mixture, which is at the same time fixative and staining, is placed on a slide. Then a glass rod just smeared with the staining solution is dipped in the heart's blood of a recently killed animal, and this drop of blood mixed with the drop of the methyl-green solution on the slide. The preparation, protected from dust, is left in a moist atmosphere for about half an hour. At the end of this time the preparation is treated with a minute drop of acetic acid, all the various ingredients being carefully mixed together with the quill-point which has carried the acetic acid. The preparation is then covered over, and glycerin in very small drops placed along the edge of the cover-glass, under which it slowly runs.

(2) Blood obtained directly from the heart of some small mammal is allowed to fall into a watch-glass containing osmic acid of $1-1\frac{1}{2}$ per cent. The mixture having been well shaken up, is poured into a little tube and left for 24 hours. At the expiration of this time the blood is deposited at the bottom, and the osmic acid is then siphoned off or removed by means of a piece of cotton thread, one end of which dips into the fluid, but so as not to touch the blood, and the other into an empty tube. When the acid has been removed the blood is washed two or three times with distilled water, this being removed in the same way as the acid. The blood is then stained with alum-carmine to which has been added acetic acid in the proportion of 1 per cent. by volume of the carmine solution. The blood is then washed again, and next treated first with rectified spirit and afterwards with absolute alcohol. A drop of this blood is removed with a pipette to a slide, and when the spirit has evaporated is treated with carbol-xylol and then mounted in dammar.

Effect of Galvanic Current and other Irritants on Protista.†—Dr. M. Verworn, in studying the effect of galvanism upon certain

* Zeitschr. f. Wiss. Mikr., vi. (1889) pp. 475-7.

† Pflüger's Archiv f. d. Ges. Physiol., xlv. (1889) pp. 1-36 (2 pls. and 6 figs.); xlvi. (1889) pp. 267-383 (3 pls. and 5 figs.). 'Psycho-physiologische Protisten-Studien,' Jena, 1889, 8vo, 220 pp. and 6 pls. Cf. Zeitschr. f. Wiss. Mikr., vi. (1889) pp. 496-50 (3 figs.).

Protista, employed the following apparatus. The fluid containing the organisms was placed in a rectangular cell, the long sides of which, composed of porous clay, were from 1–5 mm. thick and 20 mm. long, the shorter ends being composed of a cement made of a mixture of wax and resin. To the clay sides or electrodes were applied the brush electrodes. These were short glass tubes, closed at one end with clay and filled with a saturated solution of zinc sulphate. From the plug projects outward the brush, while at the other end projects inwards a zinc rod connected with the wires. Sometimes the extremities of the electrodes were made of porous clay and cemented down to the slide, so that their points were immersed in the fluid. The current was produced from a chromic acid battery of twelve elements, the cells of which were 17 cm. high and 11 cm. broad.

In this way the author found that various species responded differently to the two kinds of stimulus, some being affected by the positive current and others by the negative.

By the use of the porous points instead of brushes it was found that the galvanotropic effect was not confined to a small area near the electrodes, but was actively efficient even in vessels of 10 ccm. contents over the whole mass of water. Hence the action tended to collect the organisms into aggregations. For example, in the same water Flagellata would accumulate about the anode, the Ciliata about the kathode.

When the movements of Protista are to be studied to ascertain the influence of light, it is important to remove all sources of disturbance. If a large drop of water should be used, the Microscope must be quite horizontal, oblique light must be cut off by surrounding the slide with black paper, and the warming power of the transmitted light obviated by the interposition of a layer of ice between the mirror and the slide. The Protista may then be examined either by placing them under the Microscope with all the just-mentioned precautions, and with the addition of first covering the mirror with black paper. The paper is then suddenly withdrawn, and the movements observed. Or a drop of water containing the organisms is placed on a cover-glass coated on the other side with black paper, in which a window 3 mm. square has been cut. The effect of coloured light can be observed by interposing solutions such as ammonia, copper, and bichromate of potash.

The effect of warmth can be studied in a similar way, that is, by means of first covering the mirror and observing the movements through the window of the cover-glass. It is of course necessary to first ascertain the degree of heat by previously focussing the light on a thermometer.

The effect of mechanical irritation was ascertained by shaking the slide either once or frequently. The continued vibration was attained by fixing one end of the slide and moving the other end up, and then allowing it to drop by means of a toothed wheel of four cm. diameter, and with the teeth 1 cm. apart.

In addition to the foregoing, the effects of local, acoustic and chemical irritants were also examined.

The behaviour of small pieces as compared with uninjured organisms was also observed. The pieces were obtained by crushing or cutting with a knife made by sharpening a needle into a blade.

Effect of Hardening Reagents on Nerve-cells.*—Dr. E. Sehrwald calculates that the large cells of the central nervous system become shrivelled to the extent of 21–26 per cent., owing to the effect of the hardening fluids necessary for producing Golgi's staining. The shrivelling is accompanied by warping, a result induced by the fibres and processes from the cells being incrusted with metallic salts. From the warpings and curves produced in the fibres, the author makes his calculation as to the diminution in size of the cells.

Staining and permanent Preservation of Histological Elements, isolated by means of caustic potash or nitric acid.†—Mr. S. H. Gage and Mrs. S. P. Gage point out the methods of checking completely the action of KHO and HNO^3 at will, so that the isolated elements may be permanently preserved in alcohol or glycerin, and also stained in the usual way.

30 to 50 per cent. solutions of caustic potash act with great rapidity on intercellular substance, and quite slowly on cellular elements, while weak solutions rapidly dissolve all the elements. The action of the strong solution may be checked at any time by means of a 60 per cent. solution of potassium acetate, or by the addition of sufficient glacial acetic acid to neutralize the caustic potash and form acetate of potash. Either fresh or hardened tissue may be used. The pieces should not exceed half a cubic centimetre in size, and fifteen to twenty times as much potash solution should be used as tissue. As soon as the elements separate readily the caustic potash solution should be poured off and replaced by a copious supply of a 60 per cent. solution of acetate of potash, to which one per cent. glacial acetic acid has been added. The isolated elements may be mounted in acetate of potash, in glycerin, or in glycerin-jelly. If the elements are to be stained, they must be soaked for twenty-four hours or more in a saturated aqueous solution of alum. They are then stained with hæmatoxylin, or alum-carmine.

Nitric acid is used in 20 per cent. solution, and the time required varies with the temperature. At the ordinary temperature, one to three days are required. If heat be used, the action may be completed in a few minutes. The action of the acid is suspended by immersion in water until the acid is quite removed. The fibres are teased out in water or in glycerin tinged with picric acid, and then mounted in glycerin-jelly. If the nuclei are to be stained, the Koch tubercle stain diluted 4–5 times answers well. The preparations are then mounted in balsam.

Disintegration of Woody Tissues.‡—Prof. G. L. Goodale recommends the following method of disintegrating woody tissues for microscopic observation. The tissue is soaked for a sufficient length of time in a ten per cent. solution of potassium bichromate, then quickly freed from the excess of the salt, by once rinsing in pure water, and immediately acted on by concentrated sulphuric acid. After the acid has acted for a short time, the tissue is to be placed in a large quantity of water, when it will be found to have undergone more or less complete disinte-

* Zeitschr. f. Wiss. Mikr., vi. (1889) pp. 461–70.
† Proc. Amer. Soc. Micr., 1889, pp. 34–45.
‡ Amer. Journ. Sci., xxxix. (1890) p. 79.

gration, each structural element being separated from its neighbours, with little or no corrosion of the wall.

Cleaning Diatoms.*—Mr. Edward S. Nott recommends that—

(1) The material be completely disintegrated by continued boiling in a solution of sal soda.

(2) The disintegrated material should be sifted in a sieve made of bolt-cloth, removing all the fine earths and broken forms.

(3) The remainder may have the greater part of the sand removed from it by revolving it in an evaporating dish with water.

(4) The material, now mostly diatoms, should be boiled in acids: first, in muriatic, then wash; second, in nitric, then wash, and sometimes boil also in sulphuric acid.

(5) After washing all traces of acid away, boil once more in a solution of sal soda, wash, and sift in a fine sieve of bolt-cloth.

The object is to remove all the debris and waste material before using the acids, as the result will be better and the expenditure of time and labour less. The stock should be kept in alcohol, and in mounting, the best distilled water should be used.

(4) Staining and Injecting.

Methylen-blue Staining for Nerve-endings.†—The examination of nerve-endings by staining with methylen-blue, a method invented by Ehrlich, has received, since its introduction, considerable attention at the hands of physiologists, owing to the comparative simplicity of the procedure, and the satisfactoriness of the results—results quite equal to those obtained by the silver nitrate and gold methods. The method as recommended by Prof. S. Mayer, consists of two distinct parts, the first of these being the treatment with the blue pigment, the second that of its fixation by means of picrate of ammonia. The methylen-blue solution is made by dissolving 1 gram of the pigment in 300–400 ccm. of a half per cent. salt solution. The picro-glycerin solution is composed of a cold saturated solution of picrate of ammonia, diluted with an equal volume of pure glycerin.

The animals are injected through a blood-vessel with the blue solution, or pieces of fresh tissue are soaked in the solution, or the animal may be immersed alive in the fluid without danger to life.

Small pieces of the object are then immersed in the picro-glycerin and are at once ready for examination. If found suitable for a permanent preparation the cover-glass can be fixed down with a mass composed of equal parts of wax and resin.

If found desirable the injected or impregnated preparations may be kept for some time in the picro-glycerin.

The effect of the second reagent is to alter the colour of the stained parts, all shades of red, brown, black being seen in the axis-cylinders and the non-medullated terminal nerve-expansions. This disadvantage is compensated by the stain being fixed and the preparation cleared up at the same time, advantages not counteracted by any considerable changes in the tissues.

* Proc. Amer. Soc. Microscopists, xi. p. 149. Amer. Mon. Micr. Journ., xi. (1890) p. 31.

† Zeitschr. f. Wiss. Mikr., vi. (1889) pp. 422–38.

The simplicity and rapidity of the method is seen when pieces of tissue are to be examined. Small pieces as fresh as possible are placed for about ten minutes in the methylen-blue solution, they are then well washed in a half per cent. salt solution and then examined at once in the picro-glycerin, the time required for all the manipulation being about 30 minutes. The results as to the positive and negative pictures attained by this procedure are equivalent to those produced by the action of silver nitrate on fresh tissues. Hence this method has all the advantages without any of the disadvantages of the silver method.

Technique of Golgi's Staining Method.*—The many recent modifications of Golgi's method of staining nervous tissue have tended, says Dr. E. Sehrwald, either towards improving the excellence of the picture or towards rendering the preparation permanent. But in effect these modifications practically destroy the picture, the finer details, visible enough in the silver solution, being lost during the manipulations required by the various modifications.

The author proposes a method which leaves intact all the details of the original silver chromate deposit and allows the preparation to be soaked in warm paraffin, so that sections of any required thinness may be prepared. This method simply consists in saturating all the reagents employed in Golgi's method with bichromate of silver. The only precaution required is that the reagents should be saturated with the salt at a high temperature.

In this discursive disquisition no details are given, the author, after minutely describing a long series of failures, contenting himself with a piece of general advice and stating that if this method be adopted preparations will be obtained which, if they have any fault, are too full of detail.

Method for Restaining old Preparations.†—Mr. J. W. Gatehouse gives the following method by which it is possible to stain objects that after mounting in balsam have become so transparent as to be scarcely visible. Take filtered oil of turpentine and saturate it with picric acid, adding the acid gradually till a fine yellow colour has been obtained, and scales of the acid remain undissolved. To this solution add carefully crystals of resublimed iodine, taking care to add only a few at a time, as otherwise the chemical action set up may possibly produce sufficient heat to ignite the turpentine and cause even a slight explosion. With all due care even, a series of small decrepitations may be noticed as the iodine dissolves. Sufficient iodine should be added to change the colour of the solution from a light yellow to a distinct brown tint. Then place the slide in a dish containing turpentine, to which some of the stain has been added, and allow it to remain there until the balsam is softened and the stain has penetrated and done its work, when the turpentine can be replaced by more balsam. In this way the author has restained slides of embryonic tissues which had been mounted several years and which had become almost invisible except in special lights. After two days' soaking the whole of the structures were brought out splendidly, every detail being perfectly clear.

* Zeitschr. f. Wiss. Mikr., vi. (1889) pp. 443–56.
† Journ. Microscopy and Nat. Sci., iii. (1890) pp. 113–4.

Staining Elastic Fibres and the Corneous Layer of Skin.*—Herr A. Köppen recommends the following method for staining elastic fibres and the corneous layer. The sections, freed from all foreign constituents, are to remain for 24 hours or longer in absolute alcohol; they are then placed in the following staining fluid:—Saturated alcoholic solution of crystal violet, 5; acid. carbol., 5; aq. destil., 100. In this solution, freshly made, the sections remain for 15–24 hours. They are then placed in iodine solution for two minutes (I, 1; KI, 2; H_2O, 300), after this for five minutes in a 10 per cent. aqueous solution of common salt. They are then waved about for 15 seconds in 1 per cent. hydrochloric acid. Next they are decolorized in absolute alcohol. When sufficiently decolorized they are immersed first in turpentine and then in xylol, after which the sections are mounted in xylol balsam.

Prevention of Surface Deposits in Golgi's Chrom-silver Method.†—Pieces of nervous tissues which are treated by Golgi's method are frequently rendered useless, owing to the thick deposit which altogether prevents the details of the preparation from being examined. This inconvenience, says Dr. E. Sehrwald, may be avoided by enveloping the pieces in a substance which, while it penetrates into the cavities and adheres closely to the surface, yet allows the silver salt to permeate without hindrance. Such a substance is gelatin in 10 per cent. aqueous solution. This, when cold, forms a firm but plastic mass, and melts at a temperature below that of the body.

It is best manipulated by pouring it over the object placed in a box made by winding a strip of paper round a piece of cork. When cold the box may be immersed in the silver solution. A piece about a centimetre square is quite saturated in 24 hours in the cold.

Although fresh pieces may be imbedded in the gelatin before being fixed in Müller's fluid, it is much better to envelope with gelatin after the Müller.

When the silver reaction is complete the gelatin must be removed, at any rate if the object is to be imbedded in paraffin. This is done with warm water to which chrom-silver salt, as explained above (see technique of Golgi's method, p. 409), has been added to excess. The solubility of the gelatin is but little affected by the action of the silver salt or by light.

Staining Paraffin Sections.‡—Those who have used the paraffin imbedding method for serial sections have, doubtless, wished for some simplification of the process of staining. This may be done, according to Dr. Kükenthal, by dissolving the colouring matter in absolute alcohol and dropping the solution into turpentine until the desired depth of colour is secured. Sections fixed to the slide with the collodion are kept in the oven until the clove oil has completely evaporated, the paraffin dissolved in turpentine as usual, and the slide brought into the dye. The staining is quickly effected. Over-staining may be corrected by placing the slide for a short time in a mixture of acid-free absolute alcohol and turpentine (equal parts). Turbidity of the colouring fluid may be corrected by adding a drop or two of alcohol; Meyer's carmine,

* Zeitschr. f. Wiss. Mikr., vi. (1889) pp. 473–5.

† T. c., pp. 457–61.

‡ Amer. Mon. Micr. Journ., xi. (1890) p. 11.

methyl-green, methyl-blue, gentian-violet, safranin, Bismarck-brown, eosin, fuchsin, tropeolin, and malachite-green may be used in the above ways.

MAGALHAES, P. S. DE.—**Estudo geral das colorações em histologia.** (Use of staining-methods in histology.) Rio de Janeiro, 1889, 8vo, 89 pp.

FEIST, B.—**Ueber die vitale Methylenblaufärbung markhaltiger Nervenstämme.** (On methylen-blue staining of living medullated nerve-fibres.) Strassburg, 1889, 8vo.

KRYSINSKY, S.—**Beiträge zur histologischen Technik.** 5. Kupfercarmin. 6. Lithiumcarmin und Lithiumpikrincarmin. (Contributions to histological technique. 5. Copper-carmine. 6. Lithium-carmine and lithium-picrocarmine.) *Virchow's Arch.*, CXVII. (1889) pp. 204–6.

MARTINOTTI, G.—**Alcuni miglioramenti nella tecnica della reazione al nitrato d'argento nei centri nervosi.** (Some improvements in the technique of the silver nitrate reaction on the nervous centres.) *Atti del* 12. *Congr. della Assoc. Med. Ital.*, I., p. 179.

MONTI, —.—**Una nuova reazione degli elementi del sistema nervoso centrale.** (A new reaction of the elements of the central nervous system.) *Atti della R. Accad. dei Lincei—Rendic.*, V. (1889) p. 705.

WEIGERT, C.—**Neue Neurogliafärbung.** (New neuroglia-staining.) *Münchener Med. Wochenschr.*, XXXVI. (1889) No. 29.

(5) Mounting, including Slides, Preservative Fluids, &c.

Mounting in Glycerin Jelly.*—Glycerin jelly, says Mr. J. D. King, answers more purposes as a mounting medium than any other, but it is dreaded by many on account of the difficulty of getting rid of air-bubbles, a difficulty which may be avoided by the following method. Heat the jelly in a water-bath till the water boils, then, always working in a warm room, mount with it as you would with glycerin except dipping the cover in fluid, being careful to remove any stray air-bubbles under the dissecting glass before putting on the cover, for even very small ones cannot be depended on to disappear of their own accord.

Small or delicate objects can be arranged and kept in place by first covering the bottom of the cell with glycerin jelly and placing the objects in it, being careful to cover them well, and leaving them to harden. When hardened, apply additional jelly and put on the cover. After standing overnight in a cool place, if the jelly be of good quality it may be cleaned off under water with a small paint-brush and finished off with cement. It is the better way to use cells for glycerin jelly mounts, though it is not necessary to fill the surface or apply the cement before putting on the cover-glass, or even in all cases to have them as deep as the object is thick. A cell prevents the cover-glass from touching the slide at any point, and thus creating a liability of forming a vacuum by shrinkage, and it makes better work every way.

New Mounting Medium.†—Mr. H. Shimer has devised the following mounting medium, the use of which gives every satisfaction. It is a mixture of equal parts of glycerin jelly, Farrant's solution, and glycerin. The glycerin jelly is made as follows:—Gelatin, 30 parts; water, 70 parts; glycerin, 100 parts; carbolic acid, 2 parts.

Of this glycerin jelly, liquefied by the heat of a water-bath, pour 1 fluid oz. into a 4-oz. glass-stoppered bottle, add an equal volume of the Farrant's medium and of glycerin. A little gentle agitating in

* Microscope, ix. (1889) p. 138. † T. c., pp. 143–5.

the water-bath will soon insure a complete mixing. Into this bottle drop a small lump of camphor.

This medium needs a little warming (about 110° Fahr.) to make it fluid for use.

Preserving Animals.*—Dr. C. J. Cori, after trying various fixatives as reagents for rapidly narcotizing small invertebrate animals, such as hot sublimate, chloral hydrate, ethyl-alcohol, certain alkaloids, such as strychnia and cocain, found that ordinary wood-spirit or methyl-alcohol, since it has little action on albumen and possesses sufficiently satisfactory narcotic properties, gave the best results. The formula for the solution is:—Methyl-alcohol 96 per cent, 10 ccm.; water, 90 ccm.; sodium chloride, 0·6 grm. The addition of the salt prevents the too great maceration of the tissues.

For preserving and hardening the author found that chrom-osmium-acetic acid in the following proportions gave excellent results:—chromic acid 1 per cent., 25 vols.; acetic acid 2 per cent., 5 vols.; osmic acid 1 per cent., 1 vol.; water, 69 vols. The specimens are said not to become blackened, and stain quite well.

If objects contain lime salts, these neutralize the acids, an inconvenience which can be obviated by using large quantities of the solution and frequent renewals of the fluid. In the fluid the animals remain, according to size, from 2-48 hours; they are then washed in running water for 6–72 hours, then placed in 50 per cent. spirit, and finally in 70 per cent.

The osmic acid is dissolved in distilled water to which so much permanganate of potash has been added as gives it a faint rose colour. A little of the salt should be added to the solution from time to time, or when the colour is beginning to fade.

The osmic solution is best kept in yellow or black glass bottles with two grooves in the stopper, a device which allows large drops to be obtained without removal of the stopper.

Agar as a Fixative for Microscopical Sections.†—M. A. Gravis recommends agar as a medium for fixing sections to the slide. According to the author it possesses several conspicuous advantages. It is quite liquid at the ordinary temperature; the sections can be arranged on the slide with great ease. Air-bubbles never appear beneath the section. Vegetable cells, which often become distorted when imbedded in paraffin, resume their shape and original dimensions. When well dried this fixative is insoluble in all reagents, except in distilled water. The specimens may be mounted in either balsam or glycerin.

The fixative is prepared by soaking half a gram of agar in distilled water for some hours. It is then heated gently until it boils. It is then boiled for about 15 minutes so that the agar may be completely dissolved. When cold it is filtered through a fine cloth and preserved in stoppered bottles.

In order to make the fixative stick properly, the slides must be perfectly clean. It is best to boil the slides in water acidulated with hydrochloric acid, and then, having rinsed them in distilled water, dry them on a clean cloth. The fixative is put on the slide with a brush.

* Zeitschr. f. Wiss. Mikr., vi. (1889) pp. 437–42.

† Journ. de Microgr., xiv. (1890) pp. 83–5.

Upon this layer the sections are arranged. Directly this is done the slide is gently heated over a Bunsen's burner in order to soften, but not to melt, the paraffin imbedding. Any excess of fixative may now be removed by merely draining it off. The fixative is now to be thoroughly dried, and as this requires several hours, the slides should be covered over with a bell-jar and left till next day. The paraffin is then dissolved out either with warm turpentine or with chloroform, and then the solvent extracted by running some strong spirit over the slide. If the preparations have been stained *en masse* the slide is then dehydrated in alcohol, cleared up with oil of cloves, and mounted in balsam. If the sections require to be stained, the slide is merely placed in the staining solution, and when withdrawn, rinsed with spirit, after which it is mounted in balsam. As indicated above, almost any reagent may be used, provided it be not purely aqueous.

Use of Cajeput Oil for dissolving Canada Balsam.* — Prof. O. Beccari recommends the use of cajeput oil, obtained from *Melaleuca Leucodendron*, instead of oil of cloves, for dissolving Canada balsam. It has the advantage of being soluble in dilute alcohol, and the object can therefore be transferred directly from the dilute alcohol to the oil, which is not the case with oil of cloves. In addition, objects placed in cajeput oil and alcohol take up methyl-green and retain it in Canada balsam.

New Method of finishing Balsam Mounts.†—Mr. F. N. Pease remarks:—" It is only a question of time, when balsam mounts thoroughly hardened and unprotected from atmospheric influence will be ruined, on account of the cover-glass becoming detached, especially during rough handling. Discoloration of the mounting medium often occurs previous to the more serious result above mentioned, proceeding from the margin inward. On the other hand, preparations in which the balsam, storax, or other resinous media are used, are often injured by the running in of the cement used for finishing the slide, when sufficient care is not taken.

A method has been adopted, which effectively obviates these objections, and at the same time renders it possible to mount and finish a slide at once, without the delay due to allowing successive coats of cement to dry before others are applied. The mounts need not be thoroughly hardened before finishing, provided the nature of the preparation does not require it.

The method used is as follows:—The object is mounted on the slide, applying the cover-glass in the ordinary manner, using either balsam, hardened balsam, balsam and benzol, storax, or dammar. The slide is then heated to drive off the solvent, or more volatile constituents, either gently in the water-bath or at a higher heat, even boiling carefully over a spirit-lamp when the nature of the object will permit.

When cold, the superfluous mounting medium, when present, is carefully removed, then a narrow ring of paraffin wax is applied in the following manner:—hard white paraffin wax (such as is used for imbedding) is heated in a suitable capsule until it is melted and quite limpid. With the aid of a very small camel's hair pencil, the melted paraffin is applied at the edge of the cover-glass, covering the exposed mounting medium and instantly solidifying. With round cover-glasses and a turntable, very neat narrow rings of paraffin wax can be readily and

* Malpighia, iii. (1890) p. 410.
† Micr. Bulletin and Sci. News, vii. (1890) pp. 1–2.

rapidly applied. Whenever they are not satisfactorily symmetrical, a penknife may be used to bring them to the desired shape.

It is now necessary to apply a finishing cement. For this purpose Bell's cement has been found excellent, when modified as described below. The cement ring is finished at one application, enough being applied to produce a well-rounded ring. In a few hours the slide is ready for the cabinet. Bell's cement has been found at times to work unsatisfactorily, not flowing freely from the brush, and forming large bubbles in the ring, particularly in a warm room. The addition of a very little chloroform to the cement, and thorough mixing, produces a material that works smoothly, and dries with a satisfactory finish."

How to mount Objects in Motion for Examination by Polarized Light.*—Mr. George H. Curtis remarks:—" None of the manuals I have consulted give directions for preparing slides of objects in motion for polariscope. Rubber cells are best and they should be about 1/16 in. deep and preferably for a 3/4 cover. The medium I use is Canada balsam thinned with a not quite equal bulk of spirits turpentine. Stir well together, and when dissolved filter through cotton. Cement the cells to slide with something not acted on by turpentine, say shellac, or sealing-wax in alcohol. Le Page's liquid glue I think would answer, but I have not tried it. The fragments may be quartz, agate, sand, or anything not soluble in turpentine which polarizes well. One of the best is transparent gypsum or sulphate of lime. It is unnecessary to cement the cover on; set aside for a couple of days and the balsam will get dry enough to hold it. Should you wish to ring them with Brunswick black, size first with a coat or two of liquid glue made thin enough to flow, or the black will probably run in and spoil the slide."

Glycero-gum as a Mounting Medium.—Mr. C. C. Faris † finds a solution of gum arabic in glycerin preferable to Canada balsam or glycerin alone, as it is more transparent than balsam, with none of the objectionable features of glycerin. An object can be as well mounted in it without a cell as it can be mounted in balsam with a cell. The solution is made as follows:—Selected gum arabic, 2 oz.; glycerin and distilled water, of each $1\frac{1}{2}$ oz.; thymol, 1 gr. Mix the glycerin and water, and dissolve the gum arabic in it by heating on a water-bath. After the solution has been effected add the thymol, and filter through absorbent cotton by the aid of a hot-water funnel. To have the solution perfectly clear the most transparent pieces of selected gum should be chosen. The solution will then be transparent and brilliant, and be found a successful medium for starches and pollen. It has shown no signs of deterioration after four months.

Cleaning the Hands after working with Dammar Cements.‡—A writer in the 'National Druggist' says:—" As everybody knows who has worked at mounting, it is no easy matter to get the gummy and resinous material off the hands. Ordinary soap is of no avail, benzin is but little if any better, and aside from its costliness, benzol burns and dries the skin. I have used with a good deal of satisfaction a liquid soap made as follows:—Castile soap, shaved fine, 15 parts; alcohol 95 per cent.,

* Micr. Bulletin and Sci. News, vii. (1890).
† Western Druggist; Microscope, x. (1890) pp. 59-60.
‡ The Microscope, x. (1890) pp. 25-6.

10 parts; benzol, ordinary, 10 parts; ammonia water, 5 parts; glycerin, 5 parts. Dissolve the soap in the alcohol, add the ammonia water and benzol, and, after thorough agitation, the glycerin. After wetting the hands in plain water, the soap is smeared on with a bit of sponge over the patches of gum or cement, and well rubbed in. After washing and rinsing the hands, partly dry them on the towel, and finish by rubbing them over with a few drops of glycerin. The hands will not crack or chap in the coldest weather if the last precaution be taken. The soap will remain liquid during the summer, but solidifies in cold weather. It is, however, easily liquefied at all times."

(6) Miscellaneous.

'The Microtomist's Vade-Mecum.' *—Mr. A. B. Lee's work, the first edition of which appeared in 1885, has been so fundamentally revised and rewritten to such an extent that it almost seems like a new work. While a great number of processes have been omitted or only briefly mentioned, other subjects, such as fixation and fixing agents, have received more attention. The methods of killing now occupy a whole chapter, and other chapters, such as those devoted to staining with coal-tar colours, on imbedding processes, the methods of cytology, and on the central nervous system, have been re-written and brought up to date.

The present edition is more suited to the wants of the zoologist than to those of the pathologist.

Demonstration of Bacteria in Tissues.†—Dr. V. D. Harris has translated and edited Prof. Kühne's small work, which deals with the question of how to stain bacteria in animal tissues, and the answer thereto is somewhat affected by the author's peculiar but not unpractical views.

In addition to running through the technique of preparing, staining, and mounting specimens, it gives a few very useful formulæ and some useful pieces of advice.

The translation, which is decidedly Germanesque in style, also bears evidence of want of revision. For example, Mastzellen are usually translated plasma-cells, not fat-cells (p. 10). The 50 per cent. carbolic acid solution (p. 38, No. 1) does not agree with the 5 per cent. mentioned on p. 14. On the whole, we think that if the work were rewritten it might possibly be useful to some student unacquainted with the German tongue.

RAWITZ, B.—**Leitfaden für histologische Untersuchungen.** (Introduction to Histology.) Jena, 1889, 8vo.

REMY, CH.—**Manuel des travaux pratiques d'histologie, des éléments des tissues, des systèmes des organes.** (Manual of Practical Histology.) Paris, 1889, 8vo, 399 pp.

TYAS, W. A.—**Methods of Hardening, Imbedding, Cutting, and Staining animal sections,** and methods of mounting the same. *Trans. Manchester Micr. Soc.*, 1888, p. 83.

ZUNE, A.—**Traité de microscopie médicale et pharmaceutique.** (Treatise on Medical and Pharmaceutical Microscopy.) Bruxelles (H. Lamertin), Paris (J. B. Baillière et fils), 1889, 1 vol. sm. 8vo, 130 pp. and 41 figs.

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* 2nd ed., London (Churchill), 1890.

† 'Guide to the Demonstration of Bacteria' (Kühne), translated by V. D. Harris, M.D., London, 1890, 52 pp. and 7 figs.

PROCEEDINGS OF THE SOCIETY.

Meeting of 16th April, 1890, at 20, Hanover Square, W., the President (Dr. C. T. Hudson, F.R.S.), in the Chair.

The Minutes of the meeting of 19th March last were read and confirmed, and were signed by the President.

The List of Donations (exclusive of exchanges and reprints) received since the last meeting was submitted, and the thanks of the Society given to the donors.

	From
Lee, A. B., The Microtomist's Vade-mecum. 2nd edition. ix. and 413 pp. (8vo, London, 1890)	*The Author.*
Spiral ruling on glass	*Mr. P. Braham.*
Photomicrographs of *Eupodiscus Rogersii*, *Isthmia nervosa*, *Navicula aspera*, and *N. Durrandii*	*Mr. Thomas Comber.*

Mr. J. Mayall, jun., called attention (1) to the new edition of the 'Microtomist's Vade-mecum,' by Mr. A. B. Lee; (2) to a spiral ruling on glass, sent by Mr. Philip Braham, of Bath, which was curious as having been produced in an ordinary lathe, the diamond point being adjusted on the slide-rest; (3) to a series of four photomicrographs of diatoms, sent by Mr. Thomas Comber, which would be found on examination to be of special excellence. The magnifying power was about 1000 diameters, and Mr. Comber evidently possessed first-rate appliances, and used them with much skill. Mr. Mayall thought these photomicrographs of particular interest from the fact that they were produced with sunlight, by which the maximum resolving power of the objective was obtained. He understood also that Mr. Comber employed monochromatic illumination. It was matter of regret that so few English microscopists used sunlight in their photomicrographic work. The climate was somewhat unfavourable; but yet there were occasional hours of sunshine that ought to be usefully employed in that direction. Artificial light was probably more easily manipulated; but still there remained the fact, long ago demonstrated by the late Dr. J. J. Woodward, of Washington, that sunlight gave the most perfect results.

Mr. E. M. Nelson said Mr. Comber had communicated with him on several occasions with regard to his apparatus and the methods employed by him in producing these photographs. His solar apparatus was of the most perfect description, at the same time it was simple, and his results showed a high advance upon anything of the kind previously done.

Mr. Mayall referred to an improved form of fine-adjustment constructed and exhibited by Messrs. Powell and Lealand, for the production of which he was himself chiefly responsible.

Dr. Dallinger said he had not yet had an opportunity of examining this new fine-adjustment; but he was quite satisfied that the more delicate the workmanship that could be expended upon this portion of the instrument, the greater would be the advantage gained. He was satisfied that the adoption of these agate bearings would give a continuity and precision of movement which under such circumstances would be of immense advantage.

Mr. Goodwin exhibited a form of eye-piece for the Microscope, which, though not entirely new, he thought might be of interest to some of the Fellows of the Society. It had been designed by himself, acting upon the exigencies of the moment, by arranging the lenses so as to give a large field with considerable magnifying power. It would be seen from the drawing (made on the board) that it was the Huyghenian eye-piece modified by the introduction of a second plano-convex eye-lens, the convex surfaces of the two eye-lenses facing: the result was a field which was both large and flat, similar to that of a Kellner eye-piece but somewhat flatter. Some persons may find it troublesome to use on account of the angle of vision being too large to suit their eyes; this was a matter of personal equation, and was capable of being met by a slight modification in the construction. Since he had first exhibited this eye-piece he had found that Steinheil made one identical with it about twenty years ago; this fact was, however, unknown to him at the time his was designed. He had found it necessary to modify it somewhat since it was originally made, for although it worked well with his own objectives, it gave too much colour with those of other makers. To meet this difficulty the two eye-lenses had been fitted to slide in the tube, so that the distance between them and the field-lens could be altered as required, and this not only answered the purpose, but was of advantage in providing a means of adjustment which greatly assisted in the collar-correction. An alteration in the distance of 1/20 in. made a remarkable difference in the collar-correction.

Mr. A. W. Bennett said that a paper of great interest had been placed in his hands to bring before the meeting, "On the Freshwater Algæ of North Wales." It was, however, hardly a paper to be read on that occasion, because of its technical character and the long lists of species of which it largely consisted. He merely indicated the nature of its contents, as the paper itself would be printed in the Journal.

The President said that the thanks of the Society would no doubt be cordially given to Mr. West for his valuable paper, and to Mr. Bennett for the account which he had given them of its contents.

The President drew the attention of the meeting to Mr. Rousselet's tank, which was exhibited in the room (as described and figured in this Journal, p. 90). The trouble of catching a quick and lively rotifer in a tank, especially if nothing better were used than a watchmaker's eye-glass, was to him a matter of painful experience. In order to have both hands free, he had made for the purpose a pair of spectacles having one eye blank, and the other fitted with a high-power lens. For his purpose he should prefer to have a smaller tank, in order that he could use a higher power which would focus through, and then, if put against a window, there would be no difficulty in following any desired rotifer. He should, perhaps, want one not more than a quarter of the size of that upon the table, though no doubt for the purpose originally intended it was all that could be desired.

Dr. Dallinger said he had one made for his own use of a size suitable for the × 10 magnifying power. He also found it to be an advantage to fit it upon a wooden mount provided with a winch, by means of which it could be raised or lowered as convenience required.

The President said that Mr. Rousselet had used with advantage a piece of black cloth or board on the other side of the tank, so as to obtain a black background, on which the rotifers were seen bright.

Prof. M. Hartog's paper "On the State in which Water exists in Live Protoplasm," was read by Prof. Bell, who explained that it was brought before the British Association at their last meeting, but had not been printed.

The thanks of the Society were given to the author.

Mr. E. M. Nelson said that Mr. Halford had been experimenting in the matter of mounting the spermatozoa of the Salmonidæ, obtained from the milts of spawning fish; but the results were not satisfactory. This year, however, he had mounted them in another way, and the result had been that details which had formerly been invisible with the highest powers, could now be seen with a 1 in. A paper descriptive of the method adopted was then read to the meeting, and specimens in illustration were exhibited by the lantern upon the screen. (See *ante*, p. 404.)

Mr. Mayall thought it would be well to mention that the gathering which was to have taken place this year at Antwerp in celebration of the 300th anniversary of the invention of the Microscope, had been unavoidably postponed until next year, in consequence of some difficulties which had been met with in getting ready the premises in which the meetings were to be held within the time at disposal.

Mr. E. M. Nelson then exhibited on the screen several slides showing under high powers (× 1350) the bordered pits of *Pinus sylvestris*, also radial structure in *Pinus* and *Tilia*. He also exhibited a small series of slides to show the qualities of a new apochromatic 1/4 in. objective, with fluorite lenses, and of ·95 N.A., one of a series of new apochromatic objectives recently produced by Messrs. Powell and Lealand. (Objects shown:—"Secondary" structure of *Isthmia enervis; P. angulatum*, with dry 1/4 in.; same diatom on dark ground, with 1 in.; same, with apochromatic oil-immersion 1/8 in.; fracture through "secondary" marking of *Triceratium favus;* "postage-stamp" fracture on *P. angulatum;* black dot on *P. angulatum*, with 1/4 in., × 600; same, with 1/2 in., showing white dot only.)

Mr. Bennett inquired, with regard to the bordered pits of the pine, whether Mr. Nelson was quite satisfied as to the existence of the membrane in the mature as well as the young structure, because it seemed to him to be rather an important point, as affecting the generally received idea of the mode of nourishment in plants.

Mr. Nelson was unable to say what was the age of the specimens examined, as he did not prepare them himself. His impression was that there was an exceedingly delicate membrane covering a thicker membrane, which had a sieve-like perforation. The appearance struck him as being very much like that of a diatom just on the point of resolution.

The President reminded the Fellows of the Society that their next Conversazione would take place on Wednesday the 30th inst.

The following Instruments, Objects, &c., were exhibited:—

Mr. P. Braham:—Spiral ruling on glass.

Mr. T. Comber:—Photomicrographs of *Eupodiscus Rogersii*, *Isthmia nervosa*, *Navicula aspera*, and *N. Durrandii.*

Mr. Goodwin:—Eye-piece with large field.

Mr. Halford:—Spermatozoa of Salmonidæ.

Mr. E. M. Nelson:—*Asteromphalus Arachne*, viewed with Powell and Lealand's new apochromatic objective, 1/4 dry. Slides of bordered pits of *Pinus sylvestris* and radial structure of *Pinus* and *Tilia*.

Messrs. Powell and Lealand:—Mayall's Jewelled Fine-adjustment.

Mr. Rousselet:—Rotifers.

Mr. W. West:—Slides of Desmids from Capel Curig, North Wales, in illustration of his paper.

New Fellows:—The following were elected *Ordinary* Fellows:—Messrs. James M. Allen, James B. Bessell, Frederick Justen, F.L.S., Herbert S. Martin, Henry W. Parritt, Helenus R. Robertson, Theodore Stanley, M.D., W. Le Conte Stevens, and Miss C. C. Crisp. Prof. F. Leydig, of Würzburg, was elected an Honorary Fellow.

Meeting of 21st May, 1890, at 20, Hanover Square, W., James Glaisher, Esq., F.R.S., Vice-President, in the Chair.

The Minutes of the meeting of 16th April last were read and confirmed, and were signed by the Chairman.

The List of Donations (exclusive of exchanges and reprints) received since the last meeting was submitted, and the thanks of the Society given to the donors.

	From
Pringle, A., Practical Photomicrography by the latest methods. 183 and ix. pp., 6 pls. and 42 figs. (8vo, New York, 1890) ..	*Mr. A. Pringle.*
Marzoli's Achromatic Lens (1808)	*Messrs. Trainini Bros., of Brescia.*

Mr. J. Mayall, junr., referred to the donation by Mr. Andrew Pringle of a copy of his recently published work on 'Photomicrography.' He said the volume embodied much practical information on the technical processes of photography; whilst the chapters devoted to the description of the various methods of adjusting the Microscope and accessory apparatus required in the production of photomicrographs bore everywhere traces of Mr. Nelson's co-operation, as frankly acknowledged by the author. It had struck him as somewhat strange that a work of this kind, addressed primarily to an American audience (for it was published by the Scovill and Adams Company, of New York) should contain so little reference to the employment of sunlight, the most powerful illumination at the disposal of the microscopist for photomicrographic work, and so generally available in America. The use of the electric light was also dealt with very cursorily, though he was under the impression that great facilities were offered in America for its employment. The oxy-hydrogen light was explained in considerable detail, and some excellent examples of photomicrographs produced with it were given.

Mr. Mayall also referred to the donation, by Messrs. Trainini Bros., opticians, of Brescia, of an early form of achromatic Microscope objective, constructed by the late Bernardino Marzoli, curator of the Physical Laboratory of the Lyceum of Brescia. He said the donation promised to be of historical interest; he would therefore explain the circumstances of its arrival, and the data which gave it special interest. In collecting notes on the early history of the application of achromatism to the Microscope, he had found a reference to Marzoli's achromatic objectives in Giovanni Santini's 'Teorica degli Stromenti Ottici,' published in Padua, 1828 (2 vols. 8vo). In vol. ii. p. 187, Santini mentioned Selligue's then recent achromatic objectives as described in the French journals, and stated that Marzoli, of Brescia, had long preceded Selligue in the production of such objectives. Such a statement by Santini seemed to him to merit special attention, and he determined to make inquiries at Brescia for any traces of Marzoli's objectives. By the courtesy of Mr. Frederick Justen, a newly-elected Fellow of the Society, a communication of the particulars was made to the President of the Athenæum of Brescia, who most kindly saw the Brothers Trainini, the grand-nephews of Marzoli, on the subject. These gentlemen replied, stating that Marzoli was an amateur optician; that he had taken much interest in the application of achromatism to Microscopes; that a paper of his on the subject had been summarized by the secretary of the Accademia di Scienze, of Brescia, and published in the *Commentarj* for the year 1808; that he had exhibited his achromatic objectives at Milan in 1811, for which he had been awarded a silver medal under the authority of the *Istituto Reale delle Scienze*, of Milan; that they possessed one of these objectives, which had been "religiously preserved," and they would send it to the Royal Microscopical Society if it were thought acceptable. He (Mr. Mayall) replied to Messrs. Trainini, assuring them that such a donation would be much appreciated by the Society. and requesting them to furnish the fullest information regarding Marzoli's actual work, and if possible send a copy of any official document that might exist to confirm the fact that he received a public recognition of his labours in connection with the production of achromatic objectives so early as 1811. Messrs. Trainini forwarded (1) the *Processo*

Verbale, or official record of the awards, containing the notification of Marzoli's exhibits, and of the silver medal decreed for them; (2) they sent the actual Diploma, dated August 20, 1811, signed by the Italian Minister of the Interior, in which the exhibits and award were duly set forth, and the congratulations of the Minister conveyed to Marzoli personally. Since then he had had access to the vol. of the *Commentarj della Accademia di Scienze*, of Brescia, for the year 1808, and was thus able to place before the Society what he thought must be regarded as satisfactory evidence establishing the fact of Marzoli's early connection with the application of achromatism to Microscope objectives. The volume he had just mentioned contained a plate drawn by Marzoli, in which his achromatic objectives were figured, and also the special apparatus he had devised for their construction. It was a point of interest to find that the objective received appeared to correspond almost exactly with the figures, and hence the probability of their being contemporaneous demanded no great stretch of imagination; at any rate, the figures spoke for themselves, and fixed the date 1808, whilst the Diploma anent the award of the Silver Medal fixed the date of 1811, so that Santini's claim on behalf of Marzoli's having preceded Selligue in the production of achromatic objectives, was abundantly confirmed. The date of Selligue's objective was fixed (1) by Charles Chevalier's "Notes Justificatives," published in Paris in 1835, in which he stated that he and his father made an achromatic Microscope for Selligue in 1823, which was exhibited at the Académie des Sciences on April 5, 1824; and (2) there was Fresnel's special report on that exhibit communicated to the Académie on August 30, 1824. It would be manifestly unfair to Selligue to ignore the fact that his capital improvement over every suggestion of his predecessors was the idea of so constructing the achromatic doublets that they could be used in combinations of three or four in superposition. Marzoli's objective was a cemented combination, and in the figure published in 1808, the plane side of the flint was downwards, as if presented to the object; but whether this was a mere accident in the drawing, or whether it was intended to be used, must be matter of conjecture. His (Mr. Mayall's) own conjecture was that it was intended to be employed as figured, for the drawing being made by Marzoli himself, it was hardly probable that he would have inverted the objective; still it was not certain that Marzoli preceded the Chevaliers' practical discovery of the improvement due to the presentation of the plane surface of the combination to the object to be viewed.

There were still many obscure points in the early history of the achromatic Microscope which could not be satisfactorily explained unless access were obtained to the achromatic objectives made by B. Martin (1759), N. Fuss (1774), Van Deyl (1807), Charles (1800–1810), Amici (1815), Fraunhofer (1816). The late Prof. Harting had met with an objective by Beeldsnyder, to which he assigned the date 1791, and, by the courtesy of Prof. Hubrecht, of the University of Utrecht, he (Mr. Mayall) had examined it with much interest; but the workmanship was not such as to give much promise for the future development of the achromatic system. Marzoli's objective, just received from Brescia, was of excellent workmanship, and might fairly be said to have demonstrated the importance of achromatism in those early days. The authorities at Milan had shown conspicuous judgment in their recognition of Marzoli's skill by the award of a silver medal. He trusted the Society would give the lens most careful guardianship in their cabinet of apparatus, and that he should be empowered to express officially to Messrs. Trainini their high appreciation of the donation.

The Chairman said the Society were much indebted to their Secretary, Mr. Mayall, for his very interesting communication, and he had much pleasure in proposing, first, that the best thanks of the Society be given to their Secretary for his energy, tact, and perseverance in following up the subject, and for bringing it before them in the way he had done; and, secondly, that their best thanks be also given to the donors of the lens, and that the Secretary be requested to assure them of the high value in which it was held, and always would be held, by them as a Society.

Mr. Charters White inquired if it was known what was used for the purpose of cementing the lenses together, Canada balsam being at that time unknown?

Mr. Mayall thought it was not quite certain that Canada balsam was unknown then; but it was a fact that Clairaut, the eminent French mathematician of the last century, had proposed that lenses might be cemented together, believing that he had thus suggested an important improvement upon Dollond's uncemented achromatic telescope object-glasses.

Mr. Powell said that gum mastic was frequently used for the purpose; his firm many years ago used it constantly.

Mr. Mayall said it would be remembered that at the last meeting Mr. Goodwin brought forward an eye-piece for which some advantages were claimed. Almost immediately after that meeting he received a note from Mr. Philip Vallance, who, having seen a report of Mr. Goodwin's communication, wrote to say that he had in his possession two eye-pieces which were made for him on the same plan nearly forty years ago by Mr. Murrell. Mr. Mayall said, as a matter of fact, this form was very old indeed, dating from about 1667. Mention was made of one like it in the 'Philosophical Transactions,' constructed by Eustachio Divini shortly after the publication of Hooke's 'Micrographia,' 1665. In Birch's 'History of the Royal Society,' an extract from the Society's minutes showed that Christopher Cock, the optician who worked for Hooke, was requested to exhibit at the Society a large Microscope having such an eye-piece. Later on Grindl, of Aix-la-Chapelle, mentioned the same thing, and it had been also employed by others, with more or less modification, throughout the last century, and later. Then with regard to the other point of novelty claimed by Mr. Goodwin—the possibility of adjustment—it seemed that in those which Mr. Philip Vallance had made for him there was a screw provided which enabled the compound eye-lens to be adjusted, with reference to the field-lens, through a space of nearly 1/2 in.

Mr. E. M. Nelson read a paper on "Micrometers," in the course of which he described a new micrometer made for him by Messrs. Powell and Lealand. The subject was illustrated by a drawing upon the board, and the micrometer, attached to a Microscope and lamp, was also handed round for inspection.

The Chairman thought that papers like the one just read were of great practical value, and that all would be grateful for the observations which had been made.

Mr. Thomas Comber's paper "On a Simple Form of Heliostat and its application to Photomicrography," was read by Mr. Mayall, who explained that having been much struck by the excellence of the results of Mr. Comber's work, shown at the last meeting, he had requested him to forward a description explaining the construction and application of his heliostat. Mr. Comber had not only given these explanations, but had sent the heliostat for inspection, together with photographs showing the installation of his photomicrographic apparatus. Apart from the question of the extreme simplicity of the heliostat, which was mainly due to limiting the reflection of the mirror to the polar direction, and deflecting the pencil in the horizontal direction in the axis of the Microscope by means of a fixed mirror, placed at half the angle of the latitude, above the heliostat mirror, Mr. Comber had rendered important service to photomicrography, by showing how the heliostat might be placed close to the Microscope, so that the error due to slight inaccuracy of the adjustment of the heliostat might escape the optical leverage which took place when the reflected beam was made to travel through a considerable space—which obtained with heliostats, as usually placed with reference to the Microscope. Mr. Comber's observations on the fallacy of employing monochromatic illumination for photomicrography would have to be most carefully considered by microscopists, for if they stood the test of experience—and Mr. Comber was evidently a careful observer—the process would be permanently simplified. Mr. Comber had certainly devised a very practical method of using sunlight; he wished he could give them any equally practical means of obtaining more of it.

Mr. E. M. Nelson said that with regard to Mr. Comber's paper, which he had listened to with great interest, there were one or two points upon which he would remark. He thought great credit must be given to Mr. Comber for the admirable way in which he had simplified the heliostat. However necessary a universal heliostat might be for other scientific purposes, the instrument exhibited furnished a practical demonstration that for photomicrography not only was it unnecessary, but the other and far simpler and less expensive non-universal was really the more efficient of the two. The universal heliostat gave a steady beam over a considerable range of directions, but the non-universal only in one. On that account the non-universal needed two mirrors; the slight loss of light thus occasioned was no real detriment, because, generally speaking, there was more light than was required. Then, with reference to monochromatic illumination, he would direct special attention to that passage where Mr. Comber stated that the plate itself made a time selection of the actinic ray. The importance of that sentence could not be over-estimated. Speaking for himself, he could only look back with regret at the amount of time wasted with prisms and absorption media, merely from the want of knowledge of that fact. His was no isolated experience. With reference to the correction of achromatic lenses for photomicrography, he went some time ago through an exhaustive series of trials with an achromatic homogeneous-immersion objective, whose actinic focus was displaced from its visual, but which, nevertheless, yielded a very fine image at that visual focus. A number of biconvex correcting lenses, placed immediately behind the objective, were tried, and it was found that a suitable lens would bring back the actinic focus to the plane of the visual. When, however, the focus was brought back, the actinic image was quite unlike the visual, inasmuch as it had lost all sharpness. The image resembled that yielded by an objective quite out of adjustment. He had next tried monochromatic illumination, with no better results. One thing only remained to complete the experiments, and that was monochromatic sunlight. Not being in a position to carry out these experiments himself, Mr. Comber very kindly undertook them for him. The results he obtained with a very fine duplex-fronted water-immersion 1/12 of 1·22 N.A. entirely agreed with those formerly obtained. In his opinion, no ordinary *achromatic* lens could be corrected for photomicrography. He did not for a moment doubt that its actinic focus could be brought into coincidence with its visual; but if the lens yielded a crisp visual image its actinic image would be out of correction. He believed that no lens could be said to be corrected for photomicrography which was not *apochromatic* in the strict meaning of the word.

The Chairman said that this heliostat seemed to be rigidly for use in one latitude only. The subject was one of much interest and utility to those who were working at photomicrography, and their thanks were justly due to Mr. Comber for his communication.

The following Instruments, Objects, &c., were exhibited:—

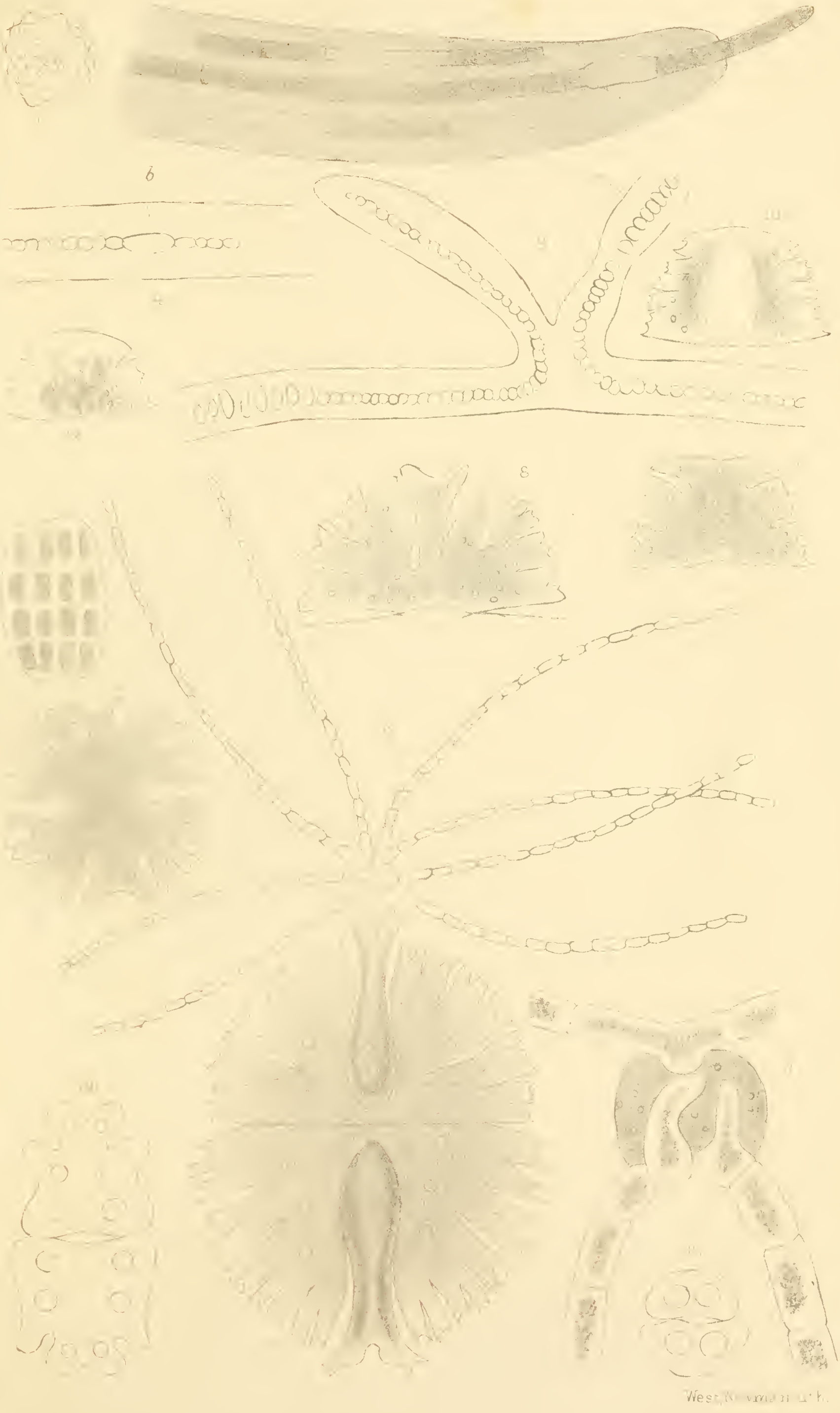
Mr. T. Comber:—Heliostat in illustration of his paper.

Mr. J. Mayall, Jun.:—Marzoli's Achromatic Lens (1808).

Mr. E. M. Nelson:—New form of Micrometer Eye-piece.

Mr. Vallance:—Eye-piece with Compound Eye-lens giving extra large field.

New Fellows:—The following were elected *Ordinary* Fellows:—Messrs Philip Braham, F.C.S., William Forgan, Thomas H. Hall, and W. Scott Lang, M.D.



West, Newman lith.

Pl. II.

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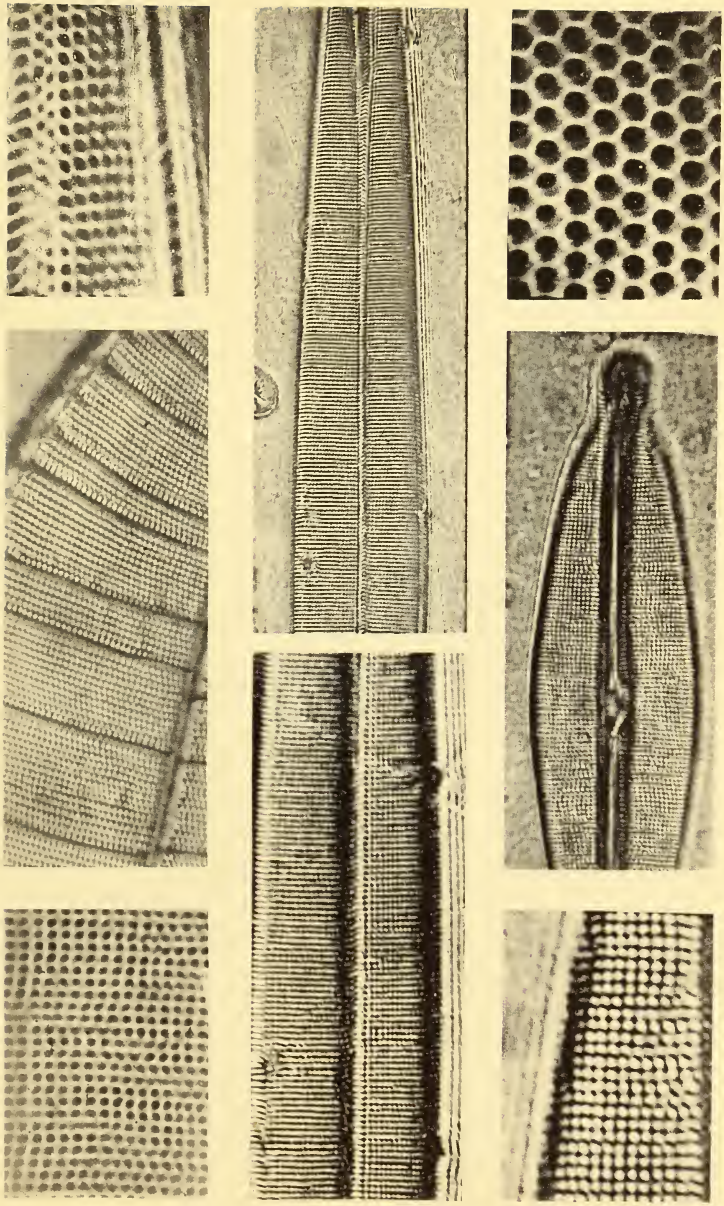

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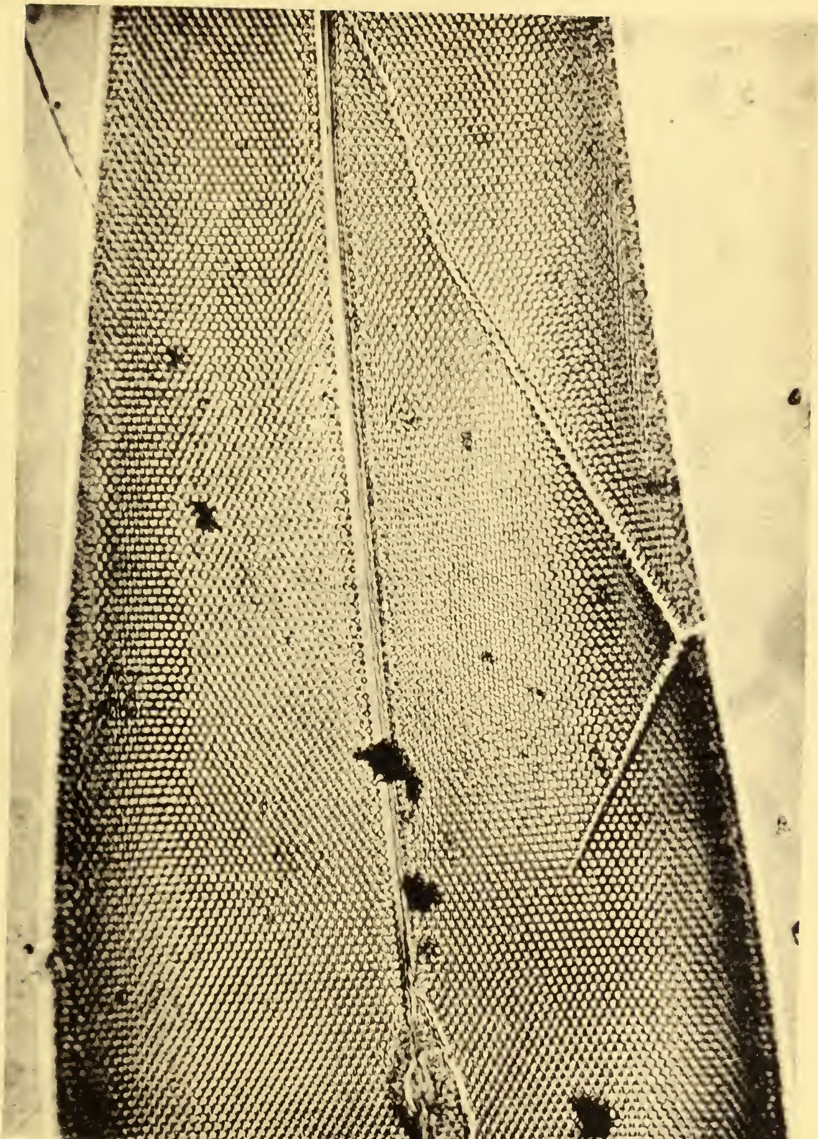
Dr. H. Van Heurck, phot. 2 J. Maes, phototyp.

1-3. Amphipleura pellucida Kütz. — 4. A. Lindheimeri Grun.
5. Surirella Gemma Ehr. — 6. Pleurosigma angulatum W. Sm.
7-8. Van Heurckia crassinervis Breb.

C. Zeiss. Object. 2,5 N.A. 1,63 — Ocul. 12 — Cond. N.A. 1,60.
Lumière solaire monochromatique.
Oct.-Nov.-Déc. 1889.



Dr H. Van Heurck, phot.

J. Maes, phototyp.

Pleurosigma angulatum W. Sm.

C. Zeiss. Object. 2,5 N.A. 1,63 — Ocul. 12 — Cond. N.A. 1,60.
Lumière solaire monochromatique.
Novembre 1889.

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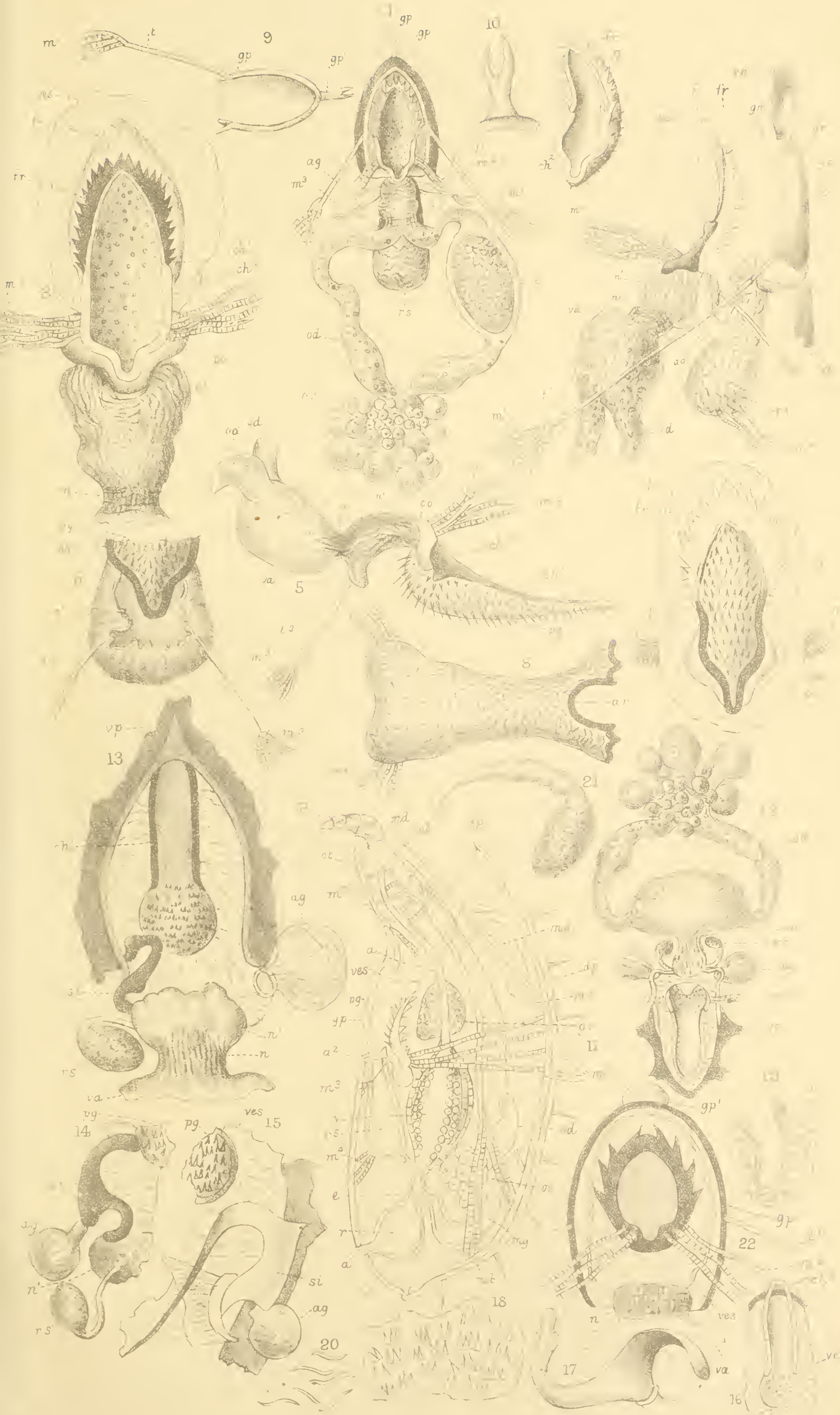
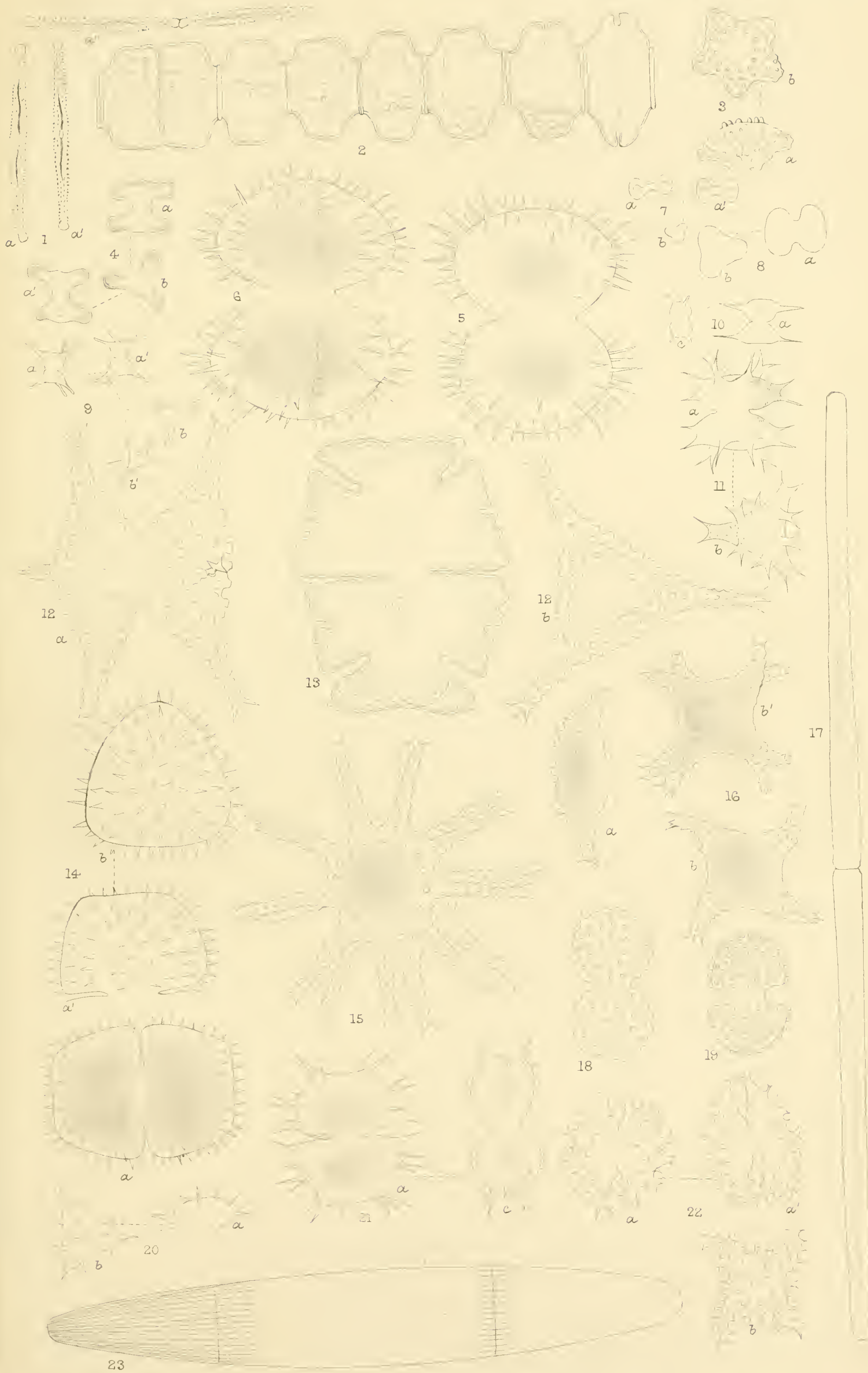


A. D. Michael ad nat del.

West, Newman

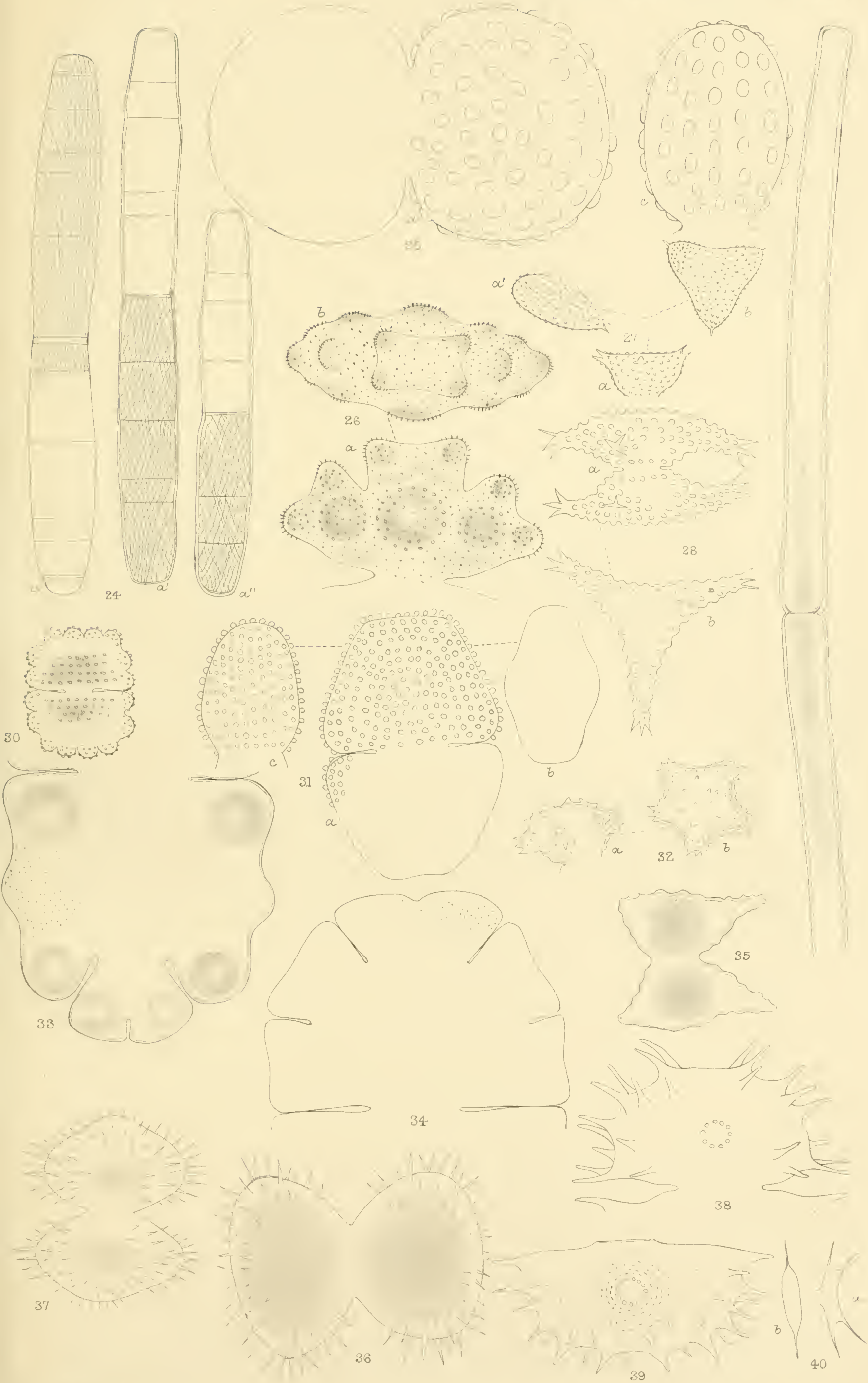
Anatomy of Uropoda



G.S. & W. West del a lith.

West Newman imp.

Desmids of North Wales



G. S. & W. West del. ad nat.

West Newman lith.

Desmids of North Wales.