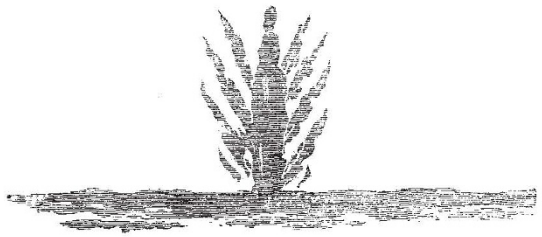
If the eggs of a wild duck are placed with those of a tame one under a hen [1] to be hatched, the ducklings from the former, on the very day they leave the egg, will immediately endeavour to hide themselves, or take to the water if there is any near, should any person approach, whilst the young from the tame duck's eggs will show little or no alarm, indicating in both cases a clear instance of instinct or "inherited memory."

4, Addison Gardens, July 16 JOHN RAE

Clouds

THE following notes of a cloud action, which, so far as I am aware, is not common, may be considered worthy of record.

The occurrence took place at Chatham at about 1 p.m. on Sunday the 1st inst., and attracted attention more particularly from its following a week of strong electrical disturbance in the neighbourhood, accompanied by two fatal results.



At the hour named above, and apparently at a considerable height, certain semi-transparent clouds arranged themselves in thin columns at right angles to each other, some of the columns giving off shoots throughout their length, in shape somewhat resembling blades of grass. Whenever fleecy clouds passed between the foregoing formation and the earth, they were quickly

broken up into small, attenuated components which gradually reunited on getting out of the influence; but on one occasion a very small cloud thus acted upon set itself in the form of a right angle also and remained so. R. Y. ARMSTRONG

July 7

Extraordinary Flight of Dragon-Flies

AN English gentleman writing from Malmö, in Sweden, on July 3, says:—

"On Sunday, June 24, we had an extraordinary flight of the *Trollslända* (*Libellula quadrimaculata*, Linn.), . . . a brown dragon-fly an inch and five-eighths long and three inches from tip to tip of the wings. . . . They passed over or through the town and neighbourhood for about half an hour in the afternoon. The next day about 1 o'clock they reappeared for more than an hour, but on Tuesday the 26th, at 7.30 a.m., they again began in millions, and notwithstanding the wind had shifted to the south during the night, they held the same course from north-west by west, heading south-east by east. The streets, shipping, and every place were full of them. They did not fly very high, and seemed to avoid going into open doors and windows. Some hundred or so alighted on the gooseberry bushes, apple and pear trees in this garden, but never touched the fruit. I observed one sitting on the dead tip of an apple-twig, and I pushed it off with my stick *thirteen* times, the insect returning each time after flying away about five or six yards. . . . The flight ended that night about 8 p.m., having been incessant for more than twelve hours. On the 27th they appeared again about noon, flying the same course, but in much reduced forces. Each day since I have seen a few, but very few. . . . The papers say they were observed in all southern and Central Sweden, and in many places in Denmark, and they swarmed about the ships in the Sound. With their disappearance came the hot weather."

The foregoing extracts seem to me worthy of record in the pages of NATURE, and I accordingly forward them with that view. ALFRED NEWTON

Magdalene College, Cambridge, July 11

[1] I mention a hen as foster-mother because the ducklings can have no instinctive knowledge of any note of alarm or warning she may give.

Sheet Lightning

WE had here last night a violent rain and lightning storm without thunder. The lightning was very vivid and incessant, and seemed nearly overhead, but there was no sound but that of rain. We are near the crest of the Apennines, and the storm seemed to have gathered along that crest, having been preceded by a furious sirocco suddenly supervening on a north-west wind.

I have twice before witnessed the same phenomenon of electrical storms with vivid lightning overhead and no thunder. Both instances occurred on the abrupt edge of the Montenegrin highlands, where they fall off into the low, wide plains of the Scutari district, and where thunderstorms are more common than in any other country I have ever visited. On these nights we were encamped on the edge of the hill country, on broken rocky land, with much low scrubby vegetation, but the lightning was so incessant and vivid that we were able to walk about, choosing our way amongst the stones and shrubs as readily as by daylight, the intervals between the flashes being, I should judge, never more than a minute, while much of the time they seemed absolutely continuous, the landscape being visible in all details under a diffused violet light. Looking overhead the movements of the lightning were easily discernible, the locality of the discharges varying from one part of the vault to another in a manner which it was impossible to confound with the reflection of lightning from a distance. Like the storm of last night those were followed by copious rain, but not a single peal of thunder was heard during the whole night. W. G. STILLMAN

Cutigliano, Pistoiese Apennines, July 11

ALGÆ[1]

DR. BERTHOLD tells us in his preface that he was induced by his discovery of the processes of fructification in *Erythrotrichia obscura* to study the small but interesting group of the Bangiaceæ, in the knowledge of which so many gaps still existed. The Zoological Station at Naples afforded him every facility for carrying on his researches on these algæ, not only in what may be called their wild state, but also under cultivation. To these advantages may be added, although in an inferior degree, that of the use of a great number of dried specimens. The results of his two years' study are embodied in the work mentioned at the head of this notice.

The small group of algæ, now included by Dr. Berthold under the general name of Bangiaceæ, consists of the three genera, Bangia, Porphyra, and Erythrotrichia; under the last genus are included *Bangia ciliaris*, and *B. ceramicola* of Harvey ("Phyc. Brit.," Pls. cccxxii. and cccxvii.). To these genera may probably be added Goniotrichum.

The exact systematic position of these algæ has, from the fact that little was known of their fructification, been hitherto uncertain. While their red colour induced Cohn, Thuret, and Bornet to place them with the Florideæ; other algologists, among whom may be mentioned J. Agardh, Kützing, Harvey, and Zanardini, grounding their opinion on the structure of the vegetative thallus, have classed them with the Chlorosperms.

For the first information relative to the fructification of the Bangiaceæ, we are indebted to Derbès and Solier, who had discovered in *Bangia fusco-purpurea* and *B. lutea* two different kinds of fructification, namely, the "common spores" and antheridia. Then followed the researches of Nägeli, Thuret, and Janczewski on Porphyra. Janczewski had actually discovered and described the carpospores of Porphyra, to which he gave the name of

[1] "Die Bangiaceen des Golfes von Neapel." Eine Monographie von Dr. G. Berthold. Fauna und Flora des Golfes von Neapel. (Leipzig: Wilhelm Engelmann, 1882.)

octospores; but he failed to interpret their true significance as reproductive organs, and laid down his pen under the firm conviction that the cystocarpic fruit was entirely absent in Porphyra. Thuret's representation of this kind of fruit proved that Janczewski was mistaken. Dr. Berthold mentions that he was fortunate enough to obtain by his researches at the Zoological Station at Naples satisfactory proof that the reproductive processes in the Bangiaceæ correspond exactly with those of the other Florideæ; he further states (p. 21) that they are true Florideæ, but that they undoubtedly occupy the very lowest position in the class

The first part of the work describes at some length the structure of the vegetative thallus of each of the three genera. A minute description follows of the organs of fructification, namely, the tetraspores, cystocarps, and antheridia, and of the mode in which the cystocarps are fertilised. The fructification of all the genera is illustrated by a plate containing twenty-five figures. We have then an account of the germination of the spores and of their development into plants, followed by observations on the systematic position occupied by the Bangiaceæ and their relation to the Chlorosperms. To these are added descriptions of the genera and species, with a notice of the habitat and time of appearance of the several species.

This very interesting work concludes with some remarks on Goniotrichum, and short descriptions of the two species *G. elegans* (*Bangia elegans* of the "Phyc. Brit.," Pl. ccxlvi.) and *G. dichotomum*. MARY P. MERRIFIELD

GAUSS AND THE LATE PROFESSOR SMITH

IN the centenary notice of Gauss (NATURE, vol. xv. pp. 533-537) I more than once refer to notes placed in my hands by the late Prof. Henry Smith. These took the form of two MSS. (*A*), (*B*). The former of these I used in its entirety (p. 537), the latter I withheld, with Prof. Smith's sanction, on account of the length to which the article had already extended. Many mathematicians may now like to read these further criticisms on Gauss by such a kindred genius. R. TUCKER

We proceed to give brief references to some of the most important points which have caused a new epoch in certain branches of analysis to date from the publication of the "Disquisitiones Arithmeticæ," and from the researches with which, some years later, Gauss supplemented or further developed the theories contained in that work. It may be proper to premise that Gauss found the theory of numbers as Euler and Lagrange had left it. Of these the former had enriched it with a multitude of results, relating to diophantine problems, to the theory of the residues of powers, and to binary quadratic forms; the latter had given the character of a general theory to some at least of these results, by his discovery of the reduction of quadratic forms, and of the true principles of the solution of indeterminate equations of the second degree. Legendre (with many additions of his own) had endeavoured to arrange as much as possible of these scattered fragments of the science into a systematic whole in his "Essai sur La Théorie des Nombres." But the "Disquisitiones Arithmeticæ" was in the press when this important treatise appeared, and what in it was new to others was already known to Gauss.

The first section of the "Disquisitiones," "De Numerorum Augmentiâ in genere," occupies hardly more than four pages of the quarto edition, and is of the most elementary character. Nevertheless, the definition and the elementary properties of a congruence, which were for the first time given in it, have exercised an immense influence over all the branches of the higher arithmetic; an influence which is perhaps surprising when we remember that it is a question of notation only, and that (as Gauss has said himself in a letter to Schumacher) nothing can be done with this notation which cannot (though less conveniently) be done without it.

The second section, "De Congruentiis Primi Gradus," contains applications of the definition and of the elementary properties of congruences to linear congruences, and to systems of such congruences. The problems solved in it are of an elementary kind, and may be regarded as either well known, or as lying within the scope of what was well known, at the time of the publication of the "Disquisitiones Arithmeticæ."

The same remark applies to the third section, "De Residuis Potestatum," which, notwithstanding the immense advantage of clearness and simplicity obtained by the use of the congruential notation, may be said to lie almost wholly within the aid of ideas to be found in Euler's memoirs. The demonstration of the existence of primitive roots (a demonstration which Euler had failed in rendering rigorous), is, however, a very noticeable exception.

The fourth section—"De Congruentiis Secundi Gradus"—opens with an exposition of the elementary theorems relating to quadratic residues and non-residues; and so far we are still entirely within the ground already occupied by Euler. But the greater part of this section is occupied with a research which of itself alone would have placed Gauss in the first rank of mathematicians. "If p and q are positive uneven prime numbers, p has the same quadratic character with regard to p that q has with regard to p, except when p and q are both of the form $4n + 3$, in which case the two characters are always opposite instead of identical." This is the celebrated Fundamental Theorem of Gauss, known also as the law of quadratic reciprocity of Legendre. Gauss discovered it (by induction) in March, 1795, before he was eighteen; the proof given of it in this section he discovered in April of the year following. He cannot at the earlier date have been aware that the theorem had been already enunciated (though in a somewhat complex form) by Euler; and that Legendre had attempted, though unsuccessfully, to prove it in the *Mémoires of the Academy of Paris* for 1784. But the question to whom the priority of the enunciation is due is of even less moment than questions of priority usually are; for the discovery of the theorem by induction was easy, whereas any rigorous demonstration of it involved apparently insuperable difficulties. Gauss was not content with vanquishing these difficulties once for all in the fourth section. In the fifth section he returns to it again, and obtains another demonstration reposing on entirely different, but perhaps still less elementary, principles. In January of the year 1808 he submitted a third demonstration to the Royal Society at Göttingen; a fourth in August of the same year; a fifth and sixth in February, 1817. It is no wonder that he should have felt a sort of personal attachment to a theorem which he had made so completely his own, and which he used to call the gem of the higher arithmetic. His six demonstrations remained for some time the only efforts in this direction; but the subject subsequently attracted the attention of other eminent mathematicians, and several proofs, differing substantially from one another and from those of Gauss, have been given by Jacobi and Eisenstein in Germany, and by M. Liouville in France, the simplest of all perhaps being that which has been given by a Russian mathematician, M. Zeller, and which is of the same general character as the third proof of Gauss (see *Messenger of Mathematics*, vol. v. pp. 140-3, 1876). It would certainly be impossible to exaggerate the important influence which this theorem has had on the subsequent development of arithmetic, and the discovery of its demonstration by Gauss must certainly be regarded (indeed it was so regarded by himself) as one of his greatest scientific achievements.

The fifth section—"De Formis Æquationibusque Inde-