taught us that this is not a diseased state, but a purposeful reaction against injury, gradually perfected in passing up from the lower to the higher animals. Almost without our being conscious of it, the idea of evolution has gradually effected a great change in the point of view from which we regard a large number of diseases, the symptoms and morbid changes in which we now understand as efforts of the body to maintain its integrity in face of the injurious agencies which threaten it. One might almost rewrite pathology from the evolutionary point of view

Last, but not least, of the great changes which have swept over medical science is that which was due in the first place to Pasteur, carried on by Koch, and brought to triumphant practical application by Lister. The discovery of the true nature of infection has of necessity transformed the outlook of medicine and surgery, but bacteriology and its daughter science immunology would demand a Harveian oration to themselves.

We loosely speak of such fundamental discoveries as those I have just mentioned as producing a revolution in medical science. It is not revolution, but upward growth. With the establishment of each great principle we gain a fresh height from which the field of science takes on a new and wider aspect, and we may be confident that we shall reach yet greater heights to reward us with an even ampler range of vision. There is no sign that the vitality of science in our civilisation is in any way spent; on the contrary, its fertility is unchecked. During the late war we saw for the first time the scientific forces of this country fully mobilised, and no previous five years have seen so many scientific problems brought to a successful issue. So forcible has been the lesson that science has gained mightily in public estimation, and research is on the lips of everyone. New facts are being gathered in, old facts are coming to be seen in a new light; we are almost bewildered by our own progress. The workers in the field of medical science are many, and it may not be given to any one of us to make an immortal discovery, such as that of the circulation of the blood. But the humblest of us can work in Harvey's spirit and bring his contribution to the building up of knowledge in the full assurance that even a single stone, if honestly and truly squared, will in due time find its proper place in the fabric.

Wheat from Seed-bed to Breakfast-table.

"THE History of a Grain of Wheat from the Seed-bed to the Breakfast-table" formed the subject of the concluding evening discourse given by Sir Daniel Hall at the Cardiff meeting of the British Association, and an account of it appeared in the October issue of the *Journal of the Ministry of Agriculture*. Of all industries there is not one which is older, more universal, or more essential than the growing, grinding, and baking of wheat and its kindred food-grains. Yet, in spite of the extreme age of the industry, the various processes involved in the passage of the wheat-grain from its seed-bed to the breakfast-table still demand the close attention of the best obtainable research men of the day; for it is only by research and by the utilisation of the results so obtained that the increased food production necessary for supplying the needs of the world's growing population can be attained.

Many experiments have been made to try to bring about an increase in yield by treating the seed either by electricity or by soaking it in some nutrient fluid. The results of these experiments are very doubtful, and it is improbable that such treatment can affect the ultimate yield. Attention has also been paid to the influence on the wheat yield of the rate of sowing. Ordinarily, wheat sown at the rate of 2½ bushels per acre gives a thirteenfold yield, but isolated wheat-plants are capable of giving more than a hundredfold yield. It is hoped that by using a suitable machine a perfectly effective seeding can be attained with 1 bushel per acre, and such a reduction in the amount of seed sown would mean a considerable gain to the country. Improvement in the quality of wheat grown has been brought about by careful breeding work. Prof. Biffen, working on Mendelian principles, has obtained a variety of wheat, "Little Joss," which produces very good crops on certain soils because of its resistance to rust attacks, the rust-resistance power having been introduced into the grain by careful selection and breeding. Another wheat, "Yeoman," has been bred for the high milling quality of the grain, and on soils to which it is suited the "Yeoman" wheat yields a very heavy crop, while the quality of the flour is almost equal to that obtained from the best Canadian grain. At the present time millers are compelled to mix strong foreign wheat with our home-grown wheat in order to produce bread of the spongy type desired by the public, but it is hoped that extension of Prof. Biffen's work will ultimately supply strong wheats of the "Yeoman" type suited to the varying conditions of all our different wheat-growing districts, and in this way the millers may be rendered independent of foreign wheats.

Although wheat is *the* crop for breaking in virgin land, yet it will not stand competition; at Rothamsted a wheat crop left unharvested to sow itself without further cultivation entirely disappeared in a grassy wilderness in three years. Wheat, though thus dependent on cultivation, possesses a remarkable power of yielding a good crop upon all sorts of soil. One of the Rothamsted plots has carried wheat for seventy-seven successive years without any manure, and the yield is still about 12 bushels per acre—approximately the average crop for the wheat-lands of the world. The manurial requirements of a wheat crop have long since been decided, and the problem now is to prevent the lodging which occurs with big crops on good soils. It may be possible to breed varieties with stiffer and shorter straw, or it may be that manurial treatment, time of sowing, width of rows, and spacing of the seed have some effect on the lodging, or, again, there may be some actual disease factor involved. All these points are being investigated.

The growth of the wheat-plant, so far as gathering material from the air and from the soil is concerned, is practically completed about five weeks before the grain is harvested. This latter period is occupied by the transference of stored-up food from the leaves and stem to the seed. The transference, however, is never complete, and the straw still retains about half of the valuable material manufactured by the plant. Since the amount of such material depends largely on conditions of soil and water-supply, which are outside our control, one line of development must be to increase the migration into the seed. This is especially urgent in drier countries where insufficient water-supply sets a definite limit to the amount of growth. With regard to the flour, considerable differences in milling operations have been brought about under the stress of war. The miller's object is to crack the wheat "berry" with the least possible breaking up of the husk, so that the endosperm falls out in a clean condition. The endosperm is the most digestible part of the grain and yields the best white flour. Before the war only about 68 per cent. of the weight of grain was recovered as white flour, while the remainder passed into various offals. During the war the extraction of flour from wheat rose to more than 90 per cent.; this brought into use certain valuable food elements which, however, are not suited to all constitutions.

Prior to the war only one-fifth of the wheat we consumed was home-grown; the rest came from North and South America, Russia, India, and Australia. Some of these supplies are now cut off, and although America has considerably increased her wheat acreage, the world's supply is still perilously short. For the next year the supplies are safe enough, but the permanent position is by no means assured. Unless more land is put under wheat a bad crop in one or two of the exporting countries would create a serious world shortage, so that as a national insurance we must grow more wheat. We can extend our acreage, and we can increase our production on the existing wheat-land, but in both cases better skill and more knowledge are required. The country, then, must be ready to encourage the attainment of knowledge, for "on knowledge hangs our assurance of a progressive food-supply in the future."

The Origin of Primary Ore Deposits.[1]

THE author commences at the period when the outer silicate shell of the earth was molten. The primeval magma is regarded as having been practically homogeneous and containing about 60 per cent. of combined silicates. All water was then in the atmosphere, giving a pressure more than 300 times as great as at present. As temperature fell, water and oxygen were absorbed; crust-formation, foundering, and resorption went on for a long period, producing a flat temperature gradient in the liquid. Viscosity eventually rendered further foundering impossible; the crust became permanent, granite developed, and below it the segregated basaltic magma long remained liquid. At this stage the isostatic balance was adjusted. Ore-minerals in large quantity were given off at the surface of the granite; these were denuded and dispersed in sediments and solution. This, with later absorption by intruded basic magma, is assumed to have been instrumental in causing the present erratic distribution of primary ores. All so-called water in magmas is held to exist in combination as hydroxyl with silica not in solution as a gas.

Magmatic differentiation is regarded as having been caused by the agency of silicic acid—silicon combined with hydroxyl—which extracts potash alumino-silicate producing a solution lighter than, and immiscible with, a melt of basic felspars and ferro-magnesian minerals. It is believed that in this way the first great split of primary magma into the world-wide granitic and basaltic types was brought about. Evidence regarding the existence of silicic acid in magmatic liquids and elsewhere in Nature is adduced. The ultimate result of the action of water on rock magmas is that silicates are completely removed and a residue of ore-minerals such as magnetite, ilmenite, and chromite left.

Vein-fissuring was brought about in and above batholiths by the expansive force due to the increase in solid specific volume of various elements. This increase is very considerable, exceeding in amount the contraction on solidification of the granite, and continues throughout the whole of the crystallisation period. The effect of this force appears in waves as fissures in successive series. These developed very rapidly, were instantly filled with magmatic mother-liquor, and were quickly sealed by the deposit of solids therefrom.

Quartz is almost always present in veins along with ore-minerals, and silica often occurs in solution in thermal springs, especially such as carry gold, arsenic, antimony, and mercury. For these and other reasons it is regarded as probable that primary ore-minerals passing up from magmas to veins do so in silicic acid solution, and possibly in combination. The deposition of these ores is usually caused by loss of heat and reduction of pressure. It is believed that there are definite, but narrow, limits of temperature between which each ore-mineral develops. These correspond to the temperatures in the strata at the bottom and the top of the ore at the time of deposition. Ore persisting for a vertical depth of 2000 ft. would, therefore, indicate normally a temperature range of 20° C.

The pneumatolytic theory of the origin of the high-temperature ores is rejected because the phenomena of their occurrence are quite inconsistent with what would result if these metals had been given off as gases by magmas. The boiling points of tungsten fluoride (19° C.) and tin fluoride (705° C.) are so far apart that it would be impossible for wolfram and cassiterite to have developed in contact with one another, as they frequently do. Accessory minerals such as fluorite and tourmaline lose the genetic significance usually attached to them owing to the fact that they are not invariably present with tin and tungsten ores, and are frequently associated with a variety of other ores which are admittedly of hydrothermal origin.

In introducing the paper the author directed attention to the probable importance of variations of pressure in ore solution and deposition. Separation from simple solution would involve deposition of ore along the whole upward course of the solvent. This does not take place, the end being usually abrupt in an upward direction. The phenomena in Nature seem to indicate that reduced pressure causes dissociation and, at some point, the total removal of ore from solution. High temperatures and pressures are not entirely correlative, and, since they usually accompany one another in Nature, it is possible that as regards ore-deposition we may in the past have been confusing the two.

[1] Abstract of a paper by J. Morrow Campbell read before the Institution of Mining and Metallurgy on October 21, 1920.

University and Educational Intelligence.

BIRMINGHAM.—The Tebbutt lectures on administration will be given during the coming term as follows: "The Central Departments of Government and their Relation to Local Administration," by Prof. W. G. S. Adams; "Municipal Administration," by Mr. Arthur Collins (treasurer of the City of Birmingham); "Educational Administration," by Sir Graham Balfour; and "Business Administration," by Mr. Gilbert C. Vyle (managing director of Avery's, Ltd.). The lectures will be open to the public.

SIR WILLIAM BRUNYATE has been appointed Vice-Chancellor of the University of Hong Kong in succession to Sir Charles Eliot.

IT is stated in *Science* of December 3 that an anonymous gift of 200,000 dollars has been made to the fund which is being raised by the American En-