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THE COMING WHEAT SCARCITY.

The Wheat Problem. Based on remarks made in the Presidential Address to the British Association at Bristol in 1898. Revised, with an answer to various critics. By Sir William Crookes, F.R.S. (London : John Murray, 1899.)

THIS essay by Sir William Crookes, as will be remembered, called forth much criticism when it was delivered as the Presidential Address at the Bristol meeting of the British Association. Now that it is reprinted with additions, it may demand a more careful review than was possible at the time. The general idea, it may be said, is by no means novel, and it is one which approved itself to common sense. The population of the world and of different races in the world increases at rates which are more or less ascertainable. The means of supplying its wants, either in the shape of coal, or metals, or food, is also limited, either by the amount of the accumulated stocks, or the means of working them, or the extent of the earth's surface available for producing the food. What more natural then than to calculate, as has been done by Malthus, as to food generally, by other statisticians as to food in particular districts, such as India at the present time, by Jevons as to coal in England, by Prof. Cairnes as to metals generally, and by Prof. Suess, an Austrian geologist and statistician, as to gold specially, that at a given date in future the supply must run short, and then a crisis arrive? Sir William Crookes applies specially to the study of wheat production this leading idea. The consumers of wheat, he tells us, are a little over 500 millions at the present time, having increased to that figure from about 370 millions in 1870, while the quantity of the earth's surface available for wheat is itself limited both by the capacity of the soil and the necessity for cultivating other products. He calculates accordingly that by the year 1931, if population increases as it has done, the supply of wheat will be seriously short, and he suggests that chemistry should come to the rescue by devising means to fix the nitrogen of the atmosphere so as to permit the growth of more wheat on the same soil.

In all this argument, except as to the last suggestion, Sir William Crookes is plainly on the common ground of men of science and philosophers. He may be right or wrong as to details, such, for instance, as fixing 1931 for the time when the "shortage" of wheat will be felt ; but given the initial hypotheses, there must be in time a deficiency of the supply to meet the demand for wheat—as well as for other food articles, it may be added—if present conditions of growth of population, and growth of wealth per head in that population, continue.

But at this point I fear the main commendation of Sir William Crookes' essay must stop. His attempt to give precision to the prospect as regards wheat (and the whole gist of his paper is to emphasise the precision of the forecast) appears to me rather to fail, while he does not handle statistical data in the skilled, scientific manner we should expect from a man of his eminence even in a field which he does not usually cultivate. Above all, instead of confining himself to the forecast that a certain position will be arrived at at a future date, if present conditions continue, the conclusion to which expert statisticians now confine themselves, he assumes the continuance of the conditions, and argues for practical measures to meet the apprehended difficulty. In other words, although the general idea of the essay is sound, the execution appears to be somewhat wanting, and the result is not altogether what we should expect from a man of science so distinguished as Sir William Crookes.

To take first the last point mentioned, the failure to recognise the necessary limitation of all such speculations in consequence of the assumption that must be made that present conditions continue unaltered. I hold this to be a capital error on the part of Sir William Crookes. There has been much experience of these discussions since the time of Malthus, and the whole effect of the experience is that, as yet, we are either too far away from the limits when shortness of supply of food and raw materials, which men of science and philosophers anticipate, will be felt, to engage in a precise discussion, or that we know too little as to the ultimate causes of existing conditions to be able to predict whether they will be soon changed or not. The forecasts of Malthus regarding England and the older countries of Europe that the supply of food would run short have not yet come true, because an outlet in the shape of emigration to new countries has been provided, with the double effect that the multitudes who were expected by Malthus to live in the old countries and press on the narrow supplies there are now largely settled in new countries, and are not only growing food for themselves, but for some of the multitudes remaining in the old countries as well, this last condition being rendered possible by the entirely new developments of means of communication which have taken place since Malthus wrote. Since Malthus wrote, also, there has been a general and vast improvement in the art of cultivating the soil. Similarly, as regards coal, the growth of the demand has by no means continued at the rate which Jevons found in existence when he wrote, while the influence of the price of coal as a factor in production has diminished in consequence of the greater effectiveness of the machinery which coal is used to drive. The scarcity of the supply of gold, which the Austrian geologist anticipated, seems also to be deferred indefinitely by the discoveries in the Transvaal, Western Australia, and the Klondyke ; while as to the demand for gold, it is equally plain that nothing is more uncertain than the continuance of the present condition of an overwhelming desire by military governments to secure and lock up enormous sums of gold. Experience is thus altogether against making precise forecasts on the lines laid down by Malthus. Consequently, when a new authority takes up a similar subject, we should expect him to be wide-awake to such considerations, as have been found so important in like cases. The conclusions should always be stated with an "if"—a big "if"—and there should be no attempt at precision in the forecasts, against which there are so many chances that they will not, in fact, be realised. The man of science should be

content with pointing out that if his previsions are not realised then existing conditions must change, and the future inquirer should be vigilant in observing the changes. Sir William Crookes has not done this, but has assumed that present conditions will continue, and that his prophecy must come true almost to the letter, which places the discussion altogether on a wrong basis.

The handling of the statistical data also, as I have said, is not what one should have expected from Sir William Crookes. To begin with, the relative place of wheat as an article of food supply to the Caucasian race appears to be very much exaggerated. Sir William Crookes, though he does not say so explicitly, really speaks of wheat as the principal food.

"My chief subject," he says, "is of interest to the whole world—to every race—to every human being. It is of urgent importance to-day, and it is a life and death question for generations to come. I mean the question of food supply. Many of my statements you may think are of the alarmist order. Certainly they are depressing; but they are founded on stubborn facts. They show that England and all civilised nations stand in deadly peril of not having enough to eat. As mouths multiply food resources dwindle. Land is a limited quantity, and the land that will grow wheat is absolutely dependent on difficult and capricious natural phenomena."

And more to the same effect. The identification of "wheat" in particular with "food" in general without any discussion of the relative importance of wheat among food articles, in the economy of the peoples concerned, is thus complete. The fact is, however, that wheat is only a fractional part of the food of some of the peoples who consume wheat, especially of the European peoples and the people of the United States, who are by far the largest consumers, and that it could be dispensed with and replaced by other articles wholly or in great part if necessity should arise. Take the case of the United Kingdom alone. Our imports of wheat and wheat-flour last year amounted to rather less than thirty-eight millions sterling, and if we allow for home production we may place our national expenditure on wheat at about fifty millions annually at the outside. Our total annual expenditure on food must be about eight times that sum. Our expenditure on imported food alone—meat, cereals, sugar, rice, &c.—was last year over 170 millions sterling, and if we add to that the home production of meat, dairy produce and cereals, we very soon get to a total figure of 400 millions or thereabouts. Sir William Crookes is thus anxious about an article of food on which we depend only to the extent of one-eighth. It may be rejoined that wheat is specially important on physiological grounds, but if so, these grounds should have been stated, and there is certainly no statement in the paper. The money test, the test of actual expenditure, is in any case not an unfair one. It would be the same, we believe, if Sir William Crookes were going farther afield. The people of the United States are very like ourselves as regards food consumption, and, to some extent, the peoples of France and Germany; while among others, whose diet is different from ours, wheat is still relatively unimportant, because, though they do not consume meat as the peoples of this country and the United States do, yet articles like rye and potatoes really constitute their main food, wheat being almost an article of luxury by comparison, and not a principal food. Nowhere, according to Sir William Crookes' own showing, is so much wheat consumed per head as in France, the United Kingdom, and the United States, the very countries in which its relative importance is lowest as an article of diet. It may be suggested, then, that in a scientific inquiry as to the possible shortage of food supplies in the near future the various chief articles of food of the peoples concerned, such as meat, dairy produce, fish, potatoes and sugar, should have been considered, and not merely wheat. There is another reason for this course. Suppose, as I believe to be the case, that a large part of the earth's surface is now used for the production of expensive articles of food like meat and dairy produce with the minimum of cultivation, the most that could happen as supplies became short might be a change of cultivation, involving some addition, but perhaps no great addition, to the cost of production, but resulting in a simultaneous increase of the quantities of meat, dairy produce and cereals produced. The play, then, between different articles of food must be considered. If one article like wheat is taken by itself, it is plainly only a question of price. At a point, the soil now used in growing meat and dairy produce by means of permanent pasturage could easily be taken to produce wheat or other cereals without any diminution, but rather along with an increase, of the production of meat and dairy produce at the same time, though at perhaps rather more cost. At what point will shortage of all supplies, taken together, be felt, and how? are the questions for the man of science and agriculturist, and they are not to be answered by the sort of rule of thumb which is here applied to wheat.

There is yet another serious oversight, in my judgment, when we look at the paper from a purely statistical point of view. Sir William Crookes goes into great detail as to the acreage under wheat in different countries at different periods, but regarding the other side of the comparison, the population of bread-eaters and their rate of growth, he gives no details at all. He confines himself to the following assertion:

"In 1871 the bread-eaters of the world numbered 371,000,000. In 1881 the numbers rose to 416,000,000; in 1891 to 472,600,000; and at the present time they number 516,500,000. The augmentation of the world's bread-eating population in a geometrical ratio is evidenced by the fact that the yearly aggregates grow progressively larger. In the early seventies they rose 4,300,000 per annum, while in the eighties they increased by more than 6,000,000 per annum, necessitating annual additions to the bread supply nearly one-half greater than sufficed twenty-five years ago."

Clearly a statement like this ought not to be made in a scientific paper, where a great deal turns upon the statement, without the details and references enabling any one to verify and appreciate it. Of course, it is quite possible for any one knowing population statistics, and content to classify large populations as bread-eating, without inquiring in detail what proportion in each population is really bread-eating, to make up a statement for himself; but there are cases of difficulty in any such grouping, and we are entitled to know what Sir William Crookes has done. In a scientific question like this he should have been more specific for another

reason. As the consumption of wheat per head in different wheat-eating populations varies a good deal, much may turn upon the nature of the increase, whether it is largest among the communities consuming wheat largely, or among the communities who consume little. To comprehend, in fact, the real growth of wheat-consuming power, we must have an average which allows for the different rates of consumption among the wheat-eating peoples, with references to the authorities for the statements as to each people. To set out this was of the essence of the problem Sir William Crookes had before him, and he has omitted it altogether. The nature of the increased consumption in each country should also have been investigated. It is asserted among farmers, for instance, that a considerable quantity of wheat, more than used to be the case, has of late years been taken in England for other purposes than the food of man, the wheat being given to cattle. Every one knows, again, that flour itself in domestic economy is more and more being applied as an element in cooking articles of luxury, and that it is not really used to a large extent as a principal food at all. All this adds to the interest of the problem as to any approaching shortage of wheat, and the means of making it good, because so much may at need be diverted back from other purposes to the primary use as food; and it shows also that the question of wheat consumption is not one that can be studied, for any such purpose as that contemplated by Sir William Crookes, without an infinity of detail. In any case, it was a matter of scientific good faith that he should have given the details and the references for the important statement we have quoted, which he has not done.

I am not making a mere formal objection. It is, of course, difficult to criticise without having before us the details which Sir William Crookes has not given, but I have not the smallest doubt that the largest increase of bread-eaters, which his details would show, is among the peoples consuming little per head, and not mainly among the peoples consuming much. One of the countries where wheat consumption per head is largest is France, and France is stationary in population.

Having made these general observations on the method followed in the essay, I do not feel called upon to go into detail respecting the actual acreage, and possible acreage, of wheat, in different countries, on which Sir William Crookes has so much to say. There is no question really more difficult. The capacity of a given population for agriculture is here just as much in question as the capacity of the soil, and I quite agree in principle with Sir William Crookes, that although additional soil might be available indefinitely for wheat in proper hands, yet as a matter of fact the soil practically available may be strictly limited. But what he fails to take sufficient note of, I believe, is the question of price. Land that would not be available for wheat with the price at 20*s.* to 25*s.* per quarter, might become available in indefinite quantities with the price at 40*s.* to 50*s.*, and even 60*s.*, which are by no means famine prices. But Sir William Crookes has little to say on this factor of price. Altogether, I may suggest, he relies too much on American statisticians, without having himself verified their methods. Mr. Davis for his purpose is not a quotable authority. He should have gone behind Mr. Davis and verified everything for himself.

The point on which the reference is made is rather a side one, but the danger of putting forth a sweeping statistical statement without adequate support is so well illustrated by it, that it may be useful to quote it. Sir William Crookes states, p. 35:

"Taking the cost of producing a given quantity of wheat in the United Kingdom at 100*s.*, the cost for the same amount in the United States is 67*s.*, in India 66*s.*, and in Russia 54*s.*"

Surely it is altogether erroneous statistically to put forward a statement like this without references. How does Sir William Crookes know that England and the United States and the other countries mentioned differ so much as he states? The cost of production he refers to is either a maximum or a minimum, or a mean of two extremes, or an average; but which is it? As he makes the statement it is really unintelligible. If he means an average, as I presume must have been intended, how does he get the average? The statement is not one to be made in a scientific study without references and authorities, and full explanations of what is really meant.

In conclusion, I may express the hope that in some future essay Sir William Crookes will revise his present work, and not only look into his statistics, but inquire into the question of the play among different articles of food in agricultural production and in human consumption, instead of dealing with one article only. As to his suggested remedy for too little wheat, the fixing of the nitrogen of the atmosphere, it is one which may well be disconnected from the paper itself. Whatever may happen to wheat, the problem is one which should be attractive to the chemist on its own merits. It is, perhaps, unfortunate that the suggestion should have been appended to an alarmist statistical paper, instead of being made from the chemical side only, as the statistics seem to give little support to the suggestion.

R. GIFFEN.

THE PHYSICAL ATLAS.

Atlas of Meteorology. A series of over four hundred Maps prepared by J. G. Bartholomew, F.R.S.E., and A. J. Herbertson, Ph.D.; and edited by Alexander Buchan, LL.D., F.R.S. (Westminster: Archibald Constable and Co., 1899.)

OF the making of meteorological observations there is no end, and some, who have only a partial acquaintance with the subject, might be tempted to add, no result. But such a criticism, however smart, is eminently unjust, and as a protest against such an uncharitable opinion it was a wise and happy thought to endeavour to combine the outcome of the labours of many observers into a monumental form, which could appeal to the eye of many untrained in scientific methods, and convince them that time and thought and money had not been lavished in vain on mere childish records, but that earnest endeavour had harvested an abundance of facts, which only needed orderly arrangement and skilful grouping to make them available for instruction and edification. To the scientific mind well versed in such matters this compilation can appeal more strongly and more worthily, for it

demonstrates not only what has been successfully accomplished already, but exhibits the deficiencies that demand attention and offer prospects for hopeful exploration. These deficiencies will be mainly of two kinds. One, due to the dearth of information from sparsely inhabited districts in inhospitable climates, or from regions where no well-ordered government obtains. Such lacunæ are regrettable, but will gradually disappear in presence of individual enterprise, employing the same means as those which have been successful in more settled lands. The other is more serious, and may be traced to the want of greater originality in the construction and management of instruments devoted to particular ends. Imitation and repetition have probably been two of the main causes from which meteorology has suffered. We have been too content with the readings of barometers and thermometers in convenient positions, and have made but few attempts to investigate meteorological phenomena at elevated stations above the earth's surface, leading, it may be, to a knowledge of vertical gradients of pressure, temperature, humidity, &c., and suggesting new lines of useful inquiry. It may seem an ungracious remark with this collection of valuable facts before us, but it would appear that we have been too much engaged in recording the results of particular combinations of the atmosphere in particular districts, and too little concerned in the antecedent processes that have produced the effects we are so eager to register.

This existing wealth of meteorological observations makes us gratefully recognise the amount of labour that has been bestowed upon the production of this atlas. The task must have been a leviathan one, and it has been grappled with manfully. The meagre bibliography of four pages attached to the work, and which we cannot help regarding as somewhat unworthy of its place, can only very feebly indicate the sources of information that must have been consulted in the preparation of this record of the climate and the weather of the world. Scattered over many lands and described in various languages are valuable observations and memoirs, which it must have been the object of the compiler and his assistants to weld into this convenient form; and the eminent authorities who have associated themselves with the editor of this undertaking are a sufficient guarantee that all that is serviceable, all that is trustworthy, has been extracted from these hidden journals and memoirs. The general result is a collection of maps which are to a certain extent diagrams or the pictorial representation of much tabular work, and their study affords not only grounds for congratulation, but will tend to prevent unnecessary duplication and suggest the necessity for more strenuous and more scientific application of the methods open to us.

The atlas, consisting in all of thirty-four plates, is arranged to afford information on two distinct objects of meteorological inquiry, climate and weather—that is to say, variations of the atmospheric conditions for short and long periods. Under the first heading, climate, we have eight subdivisions. These are (1) isotherms, showing the seasonal and annual distribution of temperature over the world generally, and in greater detail for those countries where a sufficient number of observations exists to permit the lines of equal temperature to be drawn with exactness; (2) isobars showing the distribution of atmospheric pressure, and arrows to indicate the prevailing direction of winds; (3) the relations existing between isotherms and isobars; (4, 5, 6) showing respectively the general distribution of sunshine, cloud and rain over the globe; (7) maps of hyetal regions and the seasonal distribution of rain; and (8) isobars and isohyets indicating monthly and annual distribution of barometric pressure and rainfall as related to each other for various countries.

It is impossible to enter here into details of the manner in which each and every of these subdivisions is treated, to discuss the principles which have guided the editor in constructing the maps and in overcoming the difficulties which naturally beset a diagrammatic representation. It goes without saying that the highest authorities have been consulted in the preparation, and, indeed, are to a certain extent responsible for the accuracy of the maps. These are executed in a very admirable manner, though sometimes the very neatness of execution makes it a little difficult to rapidly grasp the detail printed on them. As a rule, successive changes in the climatic element are shown by more intense washes of the same colour; and we could have wished that this rule had been more uniformly observed, since no abrupt change, such as that suggested by a change of colour, distinguishes the gradual variation of climate with latitude. For example, there is no sudden change of temperature to the north or south of an arbitrarily selected isotherm, yet one passes on these maps from red to yellow and from yellow to green with startling suddenness, as though some new feature had been introduced.

The second main division, under the generic title "weather," naturally deals with the atmospheric conditions which have to be taken into account in making a forecast whether for a shorter or longer period. Here possibly there is opportunity for the exercise of greater originality in the selection of the necessary material than in the earlier section, which deals simply with the direct results of observation. For the systematic study of anomalous weather is of comparatively recent growth, and the information, based as it usually is, on shorter series of observations made in districts where observatories are more sparsely scattered, is not so definite nor so precise as that which characterises the older observations made in climates which do not experience those typical storms whose careful study has been attended always with interesting, and generally with beneficial, results. In this section, if anywhere in the volume, some alteration may be necessary hereafter in the detail and arrangement, occasioned either by the deductions from more recent observations, or by greater generalisations due to theoretical application. But it is safe to say that a very admirable use has been made of the information that at present exists, and in the description prefixed to the maps will be found a careful summary, not only of the inquiries instituted by national bureaux, such as that of the United States with its widespread network of stations, but also of the individual researches of such physicists as Hann, Eliot, Van Bebber, Doberck and others whose names are household words.

The sections into which the editor divides the subject of typical and anomalous weather, or the groups under which our present knowledge of this subject can be

presented, are five in number. Barometric pressure of necessity plays the principal part in the arrangement and subdivision of the section. The maps are constructed to exhibit the pressure conditions which obtain in abnormally hot and cold seasons and months in differen regions, those which produce recognised types of wind and weather, or accompany typical storms of all kinds. To these are added maps showing the tracks of storms and the distribution of storm frequency, with a final series showing typical distributions of deviations from the normal monthly pressure, upon the study of which the forecasting of the probable weather for a season will be based, as well as the distribution of the mean deviations from these normals. From this description of the contents of the two sections, it will be seen that the atlas is essentially a book of results. It summarises what has been already accomplished by patient effort and long-continued observation, and the result is encouraging. Mr. Buchan, who signs the introduction in his capacity of editor, contends—

"If the present state of the science [of meteorology] as regards the geographical distribution of results be compared with that of the other sciences, such as geology and the biological sciences, it stands second to none. None of these sciences can show such a world-wide distribution of precise results as are collected in this Atlas of Meteorology in illustration of the geographical distribution of temperature pressure, humidity, cloud, rainfall and movements of the atmosphere, with illustrations of their influence over, and inter-relations with each other."

How far this remark is justified must be left to the individual judgment of those who it is hoped will read and digest this first instalment of the Physical Atlas.

W. E. P.

THE NORTH AMERICAN SLIME MOULDS.

The North American Slime Moulds. By Prof. T. H. McBride. Pp. xvii + 231, and plates. (New York: the Macmillan Company. London: Macmillan and Co., Ltd., 1899.)

THE group of organisms known as Myxomycetes, or as Mycetozoa of De Bary and Rostafinski, has of late years received much careful study in the United States. In 1834 Schweinitz published his "Synopsis of North American Fungi," and his large collection of Myxomycetes has been recognised in that country as the standard authority for reference. In 1848 Curtis contributed articles to journals on the subject, and both he and Ravenel made extensive gatherings in the south-eastern States. Since that time American investigators, conspicuous among whom should be mentioned Prof. Peck and the late Dr. G. A. Rex, have done excellent work; new species have been discovered, and large collections have been made in different parts of the States. The professors of botany have brought the Myxomycetes into their course of instruction, and a literature has sprung up founded to a considerable extent on local research.

Prof. McBride, of the University of Iowa, has made an important addition to this literature in the work under notice. In an interesting preface he pays a well-deserved tribute to the labours of Rostafinski, and we are glad to see that he founds his classification on the lines laid down in Rostafinski's monograph of the Mycetozoa, but he prefers the older name Myxomycetes for the designation of the group. In this he follows Dr. Scott in his admirable book on structural botany; at the same time, Prof. McBride fairly discusses, from a botanist's point of view, the claims that have been advanced for including them in the animal kingdom, and sums up by saying—

"Why call them either animals or plants? The Myxomycetes are independent. All that we may attempt is to assert their nearer kindred with one or other of Life's great branches."

From this standpoint, however, we do not think that the adoption of the name "slime moulds" is a happy one. If, as the professor remarks, their position is "a matter of uncertainty, not to say perplexity," and in the face of the high authority of Rostafinski, under De Bary's supervision, for the name Mycetozoa, an English translation of either word seems to be hardly needed.

The question of nomenclature is perhaps a more burning one in the States than it is with us, where De Candolle's law is very much accepted in practice.

Prof. McBride speaks warmly on the subject on p. 10 of the preface. Instead of adopting the earliest published specific name of a species in the genus in which it now stands, and giving as the authority the name of the person who first placed it in that genus (leaving the history of the first describer to be traced in the unfortunately necessary list of synonyms), he aims at giving the earliest published specific name, under whatever genus it appeared, giving as the authority the name of the first describer in brackets, followed by the name of the placer in the present genus. If an important object in appending the authority were to commemorate the name of the first recorder, we should agree with the professor, and as a matter of sentiment there is much to be said in favour of his view; but if the object in quoting the authority be solely to establish the identity of a species, apart from personal considerations, De Candolle's rule has the advantage of simplicity. The ideal conception of a uniform system of classification universally accepted appears to be unattainable, at least in the present generation, considering the strongly-held and diverging views which now prevail; but Prof. McBride has devoted much labour to searching the oldest records, short and incomplete as many of them are and compiled with the aid of imperfect instruments, and we cannot but admire the thoroughness with which he has endeavoured to carry out his principle.

When we bear in mind the wide variation which we find in many species that offer abundant material for observation, as, for example, in *Physarum nutans* Pers., the adoption of a main centre as the type and the description of diverging forms as varieties appears to be in accordance with the actual facts, and is of assistance to students. Prof. McBride, however, avoids the introduction of varieties, and therefore multiplies the species recorded in his work to an extent which may not meet with universal approval; but it is fair to note that in many cases he leaves the specific value an open question.

On the other hand, in those species which have come under his personal observation—and these embrace a very large proportion of the whole—his descriptions are admirable. We read them with the confidence that they are accurate and drawn from nature; they give us new information and a graphic picture of many species which have seldom or never been recorded in Europe, and it is needless to say that the measurement of spores can be entirely relied upon.

To those who are within reach of the University of Iowa, the fact that the species described are represented by type specimens in the herbarium of that institution is of the utmost value; for, however excellent the description, it is to the type itself that we must fall back as the last resource when so much depends on minute microscopical examination.

The physiology of the Myxomycetes does not appear to have received the careful study in Iowa which we may hope for in the future, considering the wealth of material which the region affords. On more than one occasion Prof. McBride refers to formation of spores as preceding that of the capillitium. On p. 108 he says, in speaking of the capillitium:

"It is necessary to recall the fact that in the best case all such structures of the fructification are but forms of the residue after the formation of the spores."

A laboratory experiment of no great difficulty shows, by a series of stained preparations of maturing sporangia, that the capillitium material, together with the calcareous matter when present, is separated from the spore-plasma before the karyokinetic division of the nuclei takes place preparatory to the formation of the spores; thus the capillitium is formed before the spores.

With regard to the systematic part, Prof. McBride's work must take a pre-eminent position as a guide for students in America, and its value will not be confined to those on the other side of the Atlantic. We lay the book down with a refreshing sense that it is a trustworthy history written in a pleasing manner by one who has a wide grasp of his subject.

A NEW MATERIA MEDICA.

An Introduction to the Study of Materia Medica. Being a short account of the more important crude drugs of vegetable and animal origin. By Henry G. Greenish, F.I.C., F.L.S. With 213 illustrations. Pp. xxi + 511. (London: J. and A. Churchill, 1899.)

THE position of Mr. Greenish as Professor of Materia Medica and Pharmacy to the Pharmaceutical Society of Great Britain has enabled him to produce in the book before us a very useful aid to the students attending his lectures, as well as a valuable handbook to the subject for the use of those of riper years. In his preface the author is careful to explain the meaning of the term Materia Medica, and to qualify the meaning of the words "crude drugs" as distinct from those that have been subjected to preparation. In this connection he says:

"The term Materia Medica literally interpreted signifies all remedial agents of whatever kind, but it is more commonly used to designate that department of medicine devoted to the consideration of simple medicinal substances known as 'drugs.' In medicine the term is usually employed in this sense, but in pharmacy it is generally understood to include only those drugs that are derived from the animal and vegetable kingdoms, and have not undergone any process of elaboration whereby their characters have been materially altered; such drugs are termed crude drugs. Thus the poppy capsule is a crude drug, and opium, which consists of the dried latex of the unripe capsule, is also classed as a crude drug; but the alkaloid morphine, which is the chief constituent of opium, and can be extracted from it only by a comparatively elaborate process, is not regarded as such. Similarly the resins, oleo-resins, gum-resins, various dried juices, &c., are included amongst the crude drugs. The term is also extended to certain vegetable extracts imported from distant countries in which alone they are prepared, even if they have been partially purified, as, for instance, Cutch and Gambier, although similar extracts prepared in this country would no longer be considered as crude drugs."

This explanation will serve to show the nature and aim of Mr. Greenish's work, which is carried through with much distinctness, and each subject is treated in the clearest possible manner and on the same system throughout.

The arrangement of the subjects under the headings of leaves, flowers, fruits, seeds, woods, barks, resins, oils, and so on, is a novel one in works of this kind, so far as English publications are concerned, and for students' purposes it is perhaps the best that could be adopted, especially with the aid of the tabular classification according to the natural orders, which Mr. Greenish gives at the end of the book; but we are inclined to think that this classification would have been more useful, especially to those with a botanical knowledge, had it been arranged in scientific sequence rather than alphabetical, and, further, to have separated the plant products from those of animal origin. This classification, however, will be found of much use, inasmuch as one sees at a glance what medicinal plants are included in any given order, together with a statement as to what part of the plant is used and a reference to the page where the description is to be found.

That the arrangement of each individual subject under its special head is the best that could have been devised there can be no possible doubt. Each drug appears first under its English name, as, for instance, Red Rose Petals in large capitals, followed by its Latin equivalent *Petala Rosae Gallicae;* or, again, Foxglove leaves, *Folia digitalis.* Following these are paragraphs under the heads of source, &c., description, constituents, and uses, and, where necessary, substitutes and adulterations. The whole is written in such a clear style, and in such plain language, that there is no difficulty in understanding at once what is intended. Moreover, the summing up of the description and the points to be observed by the student are terse yet sufficient, and being printed in italics at once catch the student's eye. Thus under Chiretta (*Swertia Chirata*) the following occurs:

"The student should observe—
(*a*) The purplish-brown colour of the stem.
(*b*) The large continuous pith.
(*c*) The intensely bitter taste.
(*d*) The opposite leaves.
(*e*) The bicarpellary, unilocular fruits."

The first three characters will suffice to distinguish the genuine drug from other species of *Swertia* which some-

times are mixed with it or substituted for it, as well as from other substitutions that have been occasionally noticed. The last two are characteristic of the natural order Gentianeæ, and are also useful in identifying the drug.

That the book is not without errors and omissions we are not prepared to say. What book, especially in its first edition, can ever be so regarded? Thus, for instance, under the head of capsicum fruits, Mr. Greenish, though mentioning that the plant is cultivated in Eastern Africa, does not mention Zanzibar in particular as one of the commercial kinds known in the British markets, nor does he even allude to Japan as a source of these pungent fruits, though of late large quantities have been imported thence to this country. But with a book so carefully worked out and so thoroughly well got up, it is ungracious to find faults, many of which have no doubt already been observed by its author and noted for correction in a new edition, which will probably not be long before it is called for, as the book is one that must be in the hands of the continuously increasing number of pharmaceutical students.

We had almost forgotten to say that the numerous illustrations add much to the value of the book. They have been carefully selected, and the source from which they are taken is acknowledged beneath each figure.

OUR BOOK SHELF.

Descriptive General Chemistry. By S. E. Tilman. Second Edition. Pp. x+429. (London: Chapman and Hall, Ltd. New York: John Wiley and Sons, 1899.)

THE author of this volume is professor of chemistry, mineralogy and geology in the United States Military Academy, and the book embodies an attempt to present chemical science in a form and compass adapted to special circumstances. Whilst in the opinion of the author "the chemical knowledge most requisite to the average professional soldier differs but little from that essential to other educated men . . . the experience and judgment of the Academic Board and of their military superiors" has limited the course to about two months. From this statement, as well as from the concentration of three sciences in one professor, it would appear that the dogged resistance to the encroachment of science on the art of war which distinguishes the Anglo-Saxon in this country, is well maintained in America. It is evident, also, that the task of the author is no light one. He has discharged it by presenting a tolerably full and very lucid account of the chief principles of chemistry, followed by a considerable amount of descriptive matter, illustrated, and we may say illuminated, where possible, by reference to things of military interest. The outcome is a very readable volume, containing information which, if it could be conveyed under reasonable conditions, would be of great value to the future soldier. But it need hardly be said that a mass of scientific information, however skilfully selected and well written or well spoken, will give in no important measure a scientific habit of mind, or an animate knowledge of science. On the whole, however, Prof. Tilman has probably done the best possible under the circumstances.

Among matters of special interest in the book are the accounts of American metallurgical processes. The descriptions of important chemical industries are also clear and concise. The weakest point to be noticed in the book is the treatment of fuel calorimetry. There is no description of a calorimeter or a pyrometer, and the old misleading formulæ for the calculation of "calorific power" and "calorific intensity" are introduced. The exhaustive experiments of the late Scheurer-Kestner, which showed the uselessness of such formulæ, do not seem to have become as well known as they should be.

A. S.

Zoologia. By Prof. Achille Griffini. Pp. xvi + 384. (Milan: Ulrico Hoepli, 1900.)

THIS book is divided into an introductory part (26 pp.), dealing with the history and scope of zoology, and the broader principles of morphology and physiology of animal forms, followed by a main part (337 pp.), in which the great groups of animals are successively dealt with in a roughly descending order, the whole ending with an "epilogue" (16 pp.), embodying an ambitious classificatory table, and certain philosophic deductions which, in deference to the scruples of his countrymen, the author is willing to let pass unread! It is in places very thin and antiquated, and its illustrations are on the whole the most interesting feature, since they alone proclaim it a text-book mainly begotten of the text-books, with little fresh thought or aim at originality. There are five hundred and five figures in all, many representing animals in a state of nature, at times with theatrical sensationalism, others delineating the facts of anatomy and minute structure, still others schematic. Taken collectively, they are an *omnium gatherum* of an inferior order. Page after page bears the time-worn figures which we find in nearly every text-book under the sun, here reproduced without acknowledgment and in some cases in a disguised form; and when originality is attempted the result is in places ludicrous; as, for example, in the physiological scheme on p. 81, and the figure of the Molluscan nervous system on p. 329. A set of figures is repeatedly introduced in supposed representation of the eggs and larvæ of the frog (*Rana*)—the egg-mass is that of *Pelodytes*, the larvæ are a combination of the old, old figures of Rösel von Rosenhof (which, for that matter, still do duty in current works in our own tongue), of Ecker and others with which we have long been familiar. On p. 224 there is a figure of a presumed *Ascidia*, which, as Huxley would have said, "illustrates, but does not adorn" the text, since it is that of a *Ciona*, curiously enough copied (but with reversal) from Huxley's "Manual of the Invertebrata," in which it is erroneously named *Phallusia mentula*. The figure of a horse (p. 121) simply insults that graceful beast. The author in a lengthy preface deplores, with just cause, the existing methods of teaching natural science in the Italian schools, for which his book is especially designed in accordance with the requirements of the State; and in support of his plea for improvement he cites forcible passages from addresses on the subject by Profs. Emery, Camerano (his teacher) and others. Proceeding to the question of nomenclature, he excuses himself the adoption of its modern rules on the grounds of his having been on a former occasion reproached for writing *Molge* instead of *Triton*. For this, something may perhaps be said from his point of view, but there is no excuse for the elevation of the racial names of mankind to specific rank (*Ex. Homo arcticus*, *H. cafer*, *et sic de caeteris*). Both figures and Latin names of some of the humbler creatures—transcribed from books which are old and out of date—are antiquated, and we deem further comment unnecessary, except to remark that the treatment of many great groups is so meagre that it is well-nigh useless.

G. B. H.

The British Journal Photographic Almanac for 1900. Edited by Thomas Bedding. Pp. 1516. (London: Henry Greenwood and Co., 1899.)

REGULARLY every year we receive this most useful annual, and as regularly we have to record its growth.

This year the volume reaches the grand total of 1516 pages, and is the largest yet issued, exceeding that of last year by about 40 pages. The popularity of such a book can be best judged by its sale, for photographers soon find out which of the numerous books on this subject are suited to their needs. We gather from the *British Journal of Photography* that the 1899 edition of this almanac, an edition which was composed of 20,500 copies, was rapidly disposed of within three months of publication, a fact which speaks for itself. This, the thirty-ninth annual issue, is quite up to, even if it does not exceed in interest, the previous volumes. It will be found an absolute mine of information: we notice a great number of articles dealing with all branches of the art which gives the reader hints for future work, and results of the experience gained by others. Other parts are devoted to a summary of the progress made during the past year, practical notes and suggestions, miscellaneous information, and many other sections of interest. As usual, the advertisements form a great portion of the book.

The almanac is carrying on the crusade of advocating the use of the metric system in all photographic matters, and has great hopes of the practice becoming universal. To further this object the metric equivalents of the British system are given in all tables and formulæ. Much more might be written about the contents of this volume, but it is hoped that sufficient has been said to enable the reader to form the opinion that it ought to find a place in every photographic studio.

The frontispiece is an excellent bromide print by Messrs. Wellington and Ward from a negative by Mr. H. Walter Barnett, and numerous other illustrations will be found intermingled with the text.

The Elements of Blowpipe Analysis. By Frederick Hutton Getman. Pp. 77. (New York: The Macmillan Company. London: Macmillan and Co., Ltd., 1899.)

THE contents of this slight book include the orthodox blowpipe tests such as are found in most books on qualitative analysis, together with an account of the behaviour of some of the principal ores before the blowpipe. A meritorious feature is that the general chemical action of the common fluxes is explained. In other respects it is not easy to find points calling for special praise. An incorporation of some at least of the admirable tests described in Bunsen's "Flammenreactionen" would have made an improvement. The following minor errors are perhaps worth noting. On p. 10, decrepitation is described as "the crackling of a substance due to the sudden expansion of combined water on heating," and incandescence as "the white light emitted by a substance that is infusible when subjected to a high temperature." On pp. 11 and 13, silver oxide is printed AgO. On p. 17, the formulæ of borax and microcosmic salt are given without water of crystallisation—an important omission from the assayer's point of view. On p. 40, the only test for phosphates is that of flame colouration, the reduction with sodium or magnesium being omitted.

The Elements of Euclid. Books i.–vi. By R. Lachlan. New and revised edition. Pp. ix + 489. (London: Edward Arnold, 1899.)

THE editor of these Elements tells us in the preface that he has endeavoured to make the subject as easy as possible for beginners by the use of simple language, and by presenting the argument in the clearest form. Further, he has attempted to embody in the book, and with great success, the additions and improvements in statement and method which twelve years' experience as an examiner and teacher has shown to be desirable. Throughout the book Euclid's sequence of propositions has been maintained, but in many cases several well-known alternative proofs have been substituted for those of Euclid. In places where the student might experience difficulties fuller notes are added; and attached occasionally to propositions are others which it is important for the beginner to know. The appendix to the last book contains many interesting problems of theorems for more advanced students, and this is followed by a considerable number of miscellaneous exercises. Students and teachers should find this form of the Elements of Euclid in many respects serviceable.

Essais du Commerce et de l'Industrie. By L. Cuniasse and R. Zwilling. Pp. viii + 302. (Paris: Carré and Naud, 1899.)

THE essential features of a book dealing with the subject of commercial analysis, whether intended for student or professional analyst, are careful elaboration and extreme minuteness of detail. As it is impossible for any analyst to have had an experience of more than a limited number of analytical processes, or at least such an experience as would justify him in publishing them, one naturally expects a book on commercial analysis to be devoted to special branches of the subject, unless, of course, a number of writers co-operate in its production. There are many special treatises of the kind relating to assaying, iron and steel analysis, to the analysis of soaps and fats, tanning materials, &c., which supply everything that is needful in this respect. To state that the present volume contains an account of nearly every branch of commercial analysis within the compass of 279 small octavo pages, that the subjects of leather, glue, vinegar, &c., are dismissed in one page, and that the analyses of other products are treated in the same cursory and superficial manner, is a doubtful recommendation.

Dairy Chemistry: a Practical Handbook for Dairy Chemists and others having control of Dairies. By H. Droop Richmond. Pp. xix + 384. (Charles Griffin and Co., 1899.)

THIS is a handbook for the chemist's laboratory, and deals especially with the matters on which his opinion will be asked, and with the methods of examination he may employ. Although of considerable size, it by no means includes the whole subject of dairy chemistry. The relations of the cow's diet to milk production, and its influence on the quality of the milk, and also the chemistry of dairy operations, are not discussed, though some parts of these subjects are referred to by the way. The author has had peculiarly favourable opportunities for becoming a master of his subject, and the book is full of information which will be valuable to the dairy chemist. Nevertheless, it is not unfrequently disappointing. The different parts of the subject are treated with very different degrees of fulness, and the expositions are not always clear. The book will be of most use to those who are already acquainted with the subject.

A Manual of Surgical Treatment. By Prof. W. Watson Cheyne, F.R.S., and F. F. Burghard, F.R.C.S. In six parts. Part ii. Pp. xix + 382. (London: Longmans, Green and Co., 1899.)

THE second part of this manual of surgical treatment fully justifies the good opinion which was recently expressed in these pages of the first part. It deals with deformities, the surgical affections of the skin, nails, lymphatics, bursæ, muscles, tendons, nerves and blood-vessels. The authors prefix to the volume a very proper statement that it is their endeavour to give only the salient points in the symptoms and pathology of surgical diseases, whilst they enter more fully into the question of treatment. The various topics are treated in a clear and concise manner, the information is accurate and modern, and there is an excellent index. If the future parts fulfil the promise of those already issued, the work will take rank as one of the best amongst the many surgical treatises which have recently issued from the English press. D'A. P.

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Stockholm International Conference on the Exploration of the Sea.

MR. KYLE'S letter in the current number of NATURE is interesting as an expression of individual opinion as to the proposals of the Stockholm Conference, but it may be doubted whether he succeeds in his aim of conducing to "greater clearness on the points at issue."

I do not know to what extent Mr. Kyle is authorised to represent the British delegates who attended the Conference. They remain silent, while he replies—interpreting their report. In one place he tells us that "this [hydrographical] work was not intended to hinder the further prosecution of strictly biological research"—for which assurance I hope biologists will be duly grateful—and further on he says that "the areas of investigation will assuredly come under re-consideration." Will the delegates endorse that? Re-consideration of certain points was exactly what I asked for (see NATURE, p. 78).

But whether authorised to speak for the delegates or not, Mr. Kyle is certainly not entitled to say that I do not fully appreciate, and have not fully weighed, the Stockholm report. I have weighed it over and over again, and still adhere to my statement that it does not contain a definite programme of biological work. The sections Mr. Kyle quotes and refers me to (I., II., III*a*., III*b*., &c.) consist merely of statements of a quite general nature as to what is "desirable"—admirable sentiments which are neither new nor definite, but have been before the public for some years, and are in the main agreed to on all sides. We looked for something more from this Conference under the heading "programme" than pious wishes of the same unexceptionable nature as—that it is desirable to have full information about everything. If Mr. Kyle is satisfied with a "definite programme" of this nature, I am not; and, moreover, I think we have reason to believe that *the delegates themselves are not.* What are we to understand from their ominous silence; and what is the meaning of the following remarkable statement in the protocols of the Committee No. II. (see Report, p. lv.)? "It is thereupon expressly stated on different sides that a more precise and detailed elaboration of the biological programme is desired." And then further on: "such a detailed elaboration of the programme is rejected. This document is agreed to in the more general form in which it has been proposed, in order that *unanimous* acceptance of it may be arrived at." It is evident then that some of the delegates felt the same want of a more precise and detailed programme that I do. It would be interesting to know if the biological delegates played the part of the eleven obstinate jurymen who had to be convinced in order to secure unanimity. At any rate, this reference to the words of the report must effectually dispose of Mr. Kyle's contention that the programme is sufficient. It was evidently *not sufficient* in the eyes of some of the delegates themselves.

Finally, Mr. Kyle asks if I can show a more definite programme. There can be no great difficulty in that, but I would rather it came from those who were officially appointed to draw it up; and I hope that those delegates who evidently had something of the kind in their minds will publish it. It will be too absurd if any idea of official reticence is allowed to deprive independent biologists of such ideas and advice as the delegates can furnish, whether unanimously or no. If, however, our official representatives do not speak, I shall probably publish soon a detailed programme I have had in my mind for some time in connection with the work of the Lancashire Sea Fisheries Committee.

It is unnecessary for me to answer the latter part of Mr. Kyle's letter, which deals with Mr. Allen's criticisms, and contains a curious caricature of the work of the Marine Biological Association. But however much I may differ from the rest of Mr. Kyle's remarks, it gives me pleasure to agree most cordially with the sentiment expressed in his final paragraph.

Liverpool, December 16. W. A. HERDMAN.

Meteorology at the Berlin Geographical Congress.

IN the report of the Geographical Congress at Berlin (NATURE, vol. lx. p. 633), it is said that the last meeting of the Congress was to have been addressed by Prof. Hergesell, but as he had somewhat rashly made an ascent in a balloon the previous day, the Congress had been formally closed before he returned to Berlin.

In justice to my colleague, the President of the International Aeronautical Committee, and to maintain the customary accuracy of NATURE, I beg to correct this statement by saying that although Prof. Hergesell, in my stead, did make a high balloon ascension with Dr. Berson, and so co-operated in the eighth international ascent of balloons on the Continent, yet he also presented his paper to the Congress at the appointed time the next day.

It may be well to explain that with the idea of extending the sphere of geography, it was arranged to have recent results of the exploration of the atmosphere brought before the Congress by members of the Aeronautical Committee. Accordingly, Prof. Hergesell, of Strassburg, spoke of the instructional balloon ascents in Europe, in which, unfortunately, England has not participated; Prof. Assmann, of Berlin, described the scientific balloon ascents executed by the German Aeronautical Society; M. Teisserenc de Bort, of Paris, explained the work that he has been doing with *ballons-sondes* to get information about the high atmosphere; and I myself gave an account of the use of kites in America to study the meteorological conditions of the lower mile or two of air. A. LAWRENCE ROTCH.

Blue Hill Meteorological Observatory, Mass., U.S.A.
December 1.

I AM happy to hear that Prof. Hergesell returned to Berlin in time to read his paper. My mistake is due to hearing it officially announced in the morning that it was feared he could not return in time, and to the report in a Berlin newspaper that he had not returned. It was of course impossible for me to attend all the meetings, and in summarising so vast a programme as that of the Seventh International Congress, some mistakes are sure to be made. It is almost unnecessary to add that no aspersion on Prof. Hergesell was intended, the completion of an unexpectedly prolonged experiment is worth more to science than the reading of many papers.

THE WRITER OF THE REPORT.

Shadows of Insects.

I HAVE only just seen the letter of your correspondent (Capt. D. Wilson-Barker) in your issue of the 7th inst. on the subject of "Butterfly Shadows."

The habit he observes in the butterfly of always adjusting its position after alighting, I have also frequently remarked in the ordinary garden fly and bluebottle. They are fond of congregating on shrubs or ivy in bright sunlight, whence they make short excursive flights in the air returning as nearly as possible to the same place; but no matter which way they are turned when they alight, they immediately readjust their position, and will always be found with their heads directed to the same point of the compass.

I have constantly observed this habit of theirs, but have never seen it mentioned in any natural history. It seems hardly likely that in the case of flies the practice can have anything to do with *shadows.* WM. PARKINSON.

Deerhurst, Coventry Park, Streatham, December 15.

Mosquitoes and Malaria.

IT may be of interest to record the fact that though during the months of June, July and August I collected and examined about 300 mosquitoes in this town, I only came across one specimen of the spotted-winged mosquito which is described as the malaria-conveying species by Major Ross. The majority, quite 75 per cent. of the specimens captured, were the harmless grey kind, the rest being chiefly the equally harmless tiger or brindled species. The single spotted-winged specimen I found in my house on a mosquito curtain. The rarity of its occurrence will, according to Major Ross's theory, account for the comparative absence of malaria in Singapore.

An account of this was given in the *Straits Times* of Sept. 4. A selection of the three species caught in the town of Singapore, together with about three other species from the neighbouring jungle, were sent in August to the British Museum, where they await further examination. R. HANITSCH.

Raffles Museum, Singapore, November 24.

THE GREAT PARIS TELESCOPE.

DURING two or three visits to Paris and Nice some years ago, I discussed with many French astronomers, whom I was privileged to count among my personal friends, the question of the large telescopes of the future. Among the conclusions come to, the first was that the glass industry was not in a position to grapple with astronomical requirements, and hence when reflectors of 8 or 10 feet diameter were talked of it was understood that they must be made of porcelain with a glass surface. Other conclusions were that the coudé mounting designed by M. Lœwy, and carried out so far as the optical parts were concerned by the brothers Henry, should be replaced with object-glasses of or about 25 inches by the use of a siderostat.

I subsequently (1884) gave two lectures at the Society of Arts on these and other questions,[1] in which I pointed out what I considered the best way of using an 8-foot reflector, and with regard to refractors I said: "With an object-glass of 30 inches diameter for physical observations I should certainly prefer the siderostat, thus reducing the cost of an instrument of this size to about one-third of the present price."

During the last few years we have heard a great deal of an enormous telescope to be constructed on the

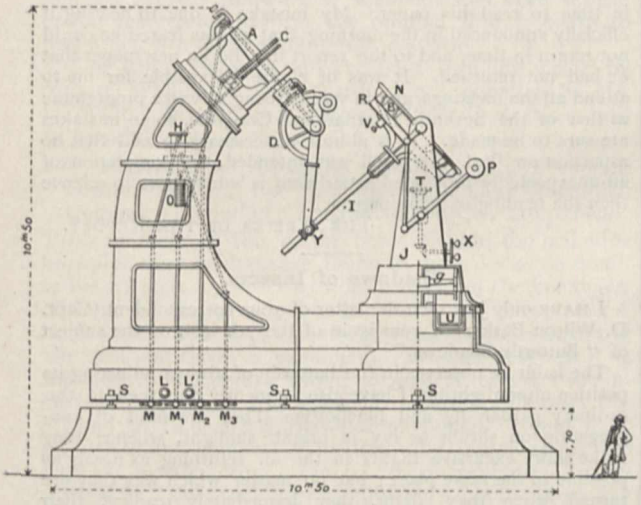


FIG. 1.—The siderostat.

occasion of the Paris Exhibition of 1900; a reflector of 10 feet aperture, such as was discussed in 1875, was indeed spoken of at one time, and renewed one of the old discussions, but it would seem that now as then the glass industry is not able to furnish a disc of this size, for after all it has been determined to construct a refractor, and mount it as I suggested nearly twenty years ago in front of a siderostat.

I have recently received from "Le Conseil d'Administration de la Société l'Optique" details of the scheme which it is proposed to carry out; while information regarding the telescope and siderostat has been given in the *Annuaire du Bureau des Longitudes*, and more recently in the *Scientific American*.

The Council in its memorandum is at some pains to excuse the exaggerations which have been so generally made regarding the power of the new telescope. They state that they hope for such a magnifying power that the surface of the moon will be seen as if our satellite were only 67 kilometres away from us. Under these conditions it was calculated that an object of one metre square might be seen. Hence the short phrase "La lune à un metre," and the consequent nonsense. One of the objects which finally determined the siderostat arrangement was the desirability of having a very long focus, and a focal length of 100 metres (328 feet) has been decided upon.

M. Deloncle seems to be the chief of the band of astronomical amateurs who have enabled MM. Gautier and Mantois to employ their well-known skill. M. Despret, the Director of the Jeumont Glass Works, has produced the siderostat mirror which has a diameter of 2 metres, a thickness of 30 centimetres, and a weight of 3600 kilos. This certainly could not have been produced with the appliances in use twenty years ago.

The siderostat avoids all the expense of a dome—even if one of 340 feet diameter could be constructed—and saves considerable expenses for installation; it secures greater stability, and saves the astronomer unnecessary fatigue and serious loss of time.

The apparatus constituting the instrument termed a siderostat comprises a pedestal of cast iron, the north part of which supports the polar axis, and the south part the mirror with its frame. The cast iron pedestal, 8 metres long by 8 metres high, is furnished with six screws, which fit in sockets fixed to the stone base 1·70 metres high.

The north part of the pedestal supports the polar axis with its divided and driving circles. This axis is driven by a clock-work movement by means of a tangent screw.

At the lower end of the polar axis a fork is fixed, to which are adjusted the pivots of the declination circle. The toothed declination wheel is set in motion at the foot of the instrument by a handle placed beside that one which produces movement in right ascension; both of these are near the two telescopes which serve for the reading of the two circles.

The mirror, with its cell, has a total weight of 6700 kg. This cell of cast steel is furnished with two pivots; to the back is fixed the directing rod. The interior of the cell is covered entirely with felt, in such a way that the mirror has no point of contact with the metal. Being supported by as great a surface as possible, all deformations are avoided.

The mirror and its cell are kept in equilibrium by a system of levers and counterpoises; the pivots rest on rollers adjusted at the top of the frame, which permits a circular movement by a vertical shaft and a system of independent rollers between two rails.

The base of this frame floats in a cavity two metres in diameter on the south side of the pedestal, containing sufficient mercury to float $\frac{9}{10}$ of the total weight of the movable part, which weighs 15,000 kg.

The clock-work movement is set in action by a weight of 100 kilos. The total weight of the siderostat is 45,000 kg.

To cast the mirror a special furnace was made at the Jeumont Works, capable of holding over twenty tons of glass. This enormous plane mirror was, naturally, the most difficult part of the apparatus to make.

The mould, 2·05 metres in diameter and 0·30 metres in height, was placed on a wagon near the furnace, in order to receive the melted glass coming from the crucible. When the mould was full, the wagon was immediately taken to an annealing oven of the right temperature and then walled up; the cooling lasted a month. The operation of annealing the glass is very difficult to carry out; numerous experiments had to be made; out of twelve discs only two have been successful.

The transportation of such a huge disc of glass to Paris was a difficult matter, and a special train carried it there, and it was conveyed to the optical establishment at night, in order to have a clear roadway.

[1] Cantor Lectures: "Some New Optical Instruments."

The discs for the object-glasses, visual and photographic, of 1·25 metres in diameter, were cast by M. Mantois; the flint weighs 360 kilos., and the crown 220, and the figuring, polishing and mounting of these enormous discs have been confided to M. Gautier.

The following interesting account of the casting of the glass for the lenses is given in the *Scientific American*:—

"Great attention was paid to the casting of the glass. Specimens of the glass were constantly taken out during the heating and examined with a lens under different conditions of illumination in order to judge of the degree of purity which they have reached. After several specimens have been found to be free from bubbles the temperature is reduced, the glass thickens, the crucible is opened, and a certain portion of the surface is skimmed off to get rid of impurities. The glass is then stirred, and the cooling is allowed to proceed rapidly for five or six hours until the surface of the glass emits a well-defined sound when it is struck with an iron bar. After this step it is necessary to proceed with annealing. The furnace is walled up and a cooling is allowed to proceed, which requires from four to six weeks. When the crucible is opened the glass is found to have been broken into pieces of varying sizes. In order to obtain a 792 pound flint glass lens it is necessary to find a block which weighs nearly 1300 pounds, and such a block having been found among those in the furnace it is removed and placed upon a car. Slabs of glass are sawed from two parallel sides in order to obtain polished surfaces that facilitate a perfect examination of it. The striæ in the surface are removed, and if after this the block exhibits any defects situated at such a depth that they cannot be removed, it is submitted to a moulding which changes its form and brings the chief defects near the surface. The block is placed in a mould of refractory clay and put into a furnace and heated to 800° to 900° Centigrade. By this means it becomes slowly heated and softened until it assumes the form of the mould, but it must not become fused, or the whole operation must be gone over again. If the outcome of the process is successful, the glass is slowly annealed, and is then taken from the mould and examined anew. If any defects deep in the glass are seen, a second operation is begun with a mould of another form. Finally, when the glass is very pure and perfect, another and final moulding produces the plano-convex lens. After this comes another heating and cooling which takes two or three weeks."

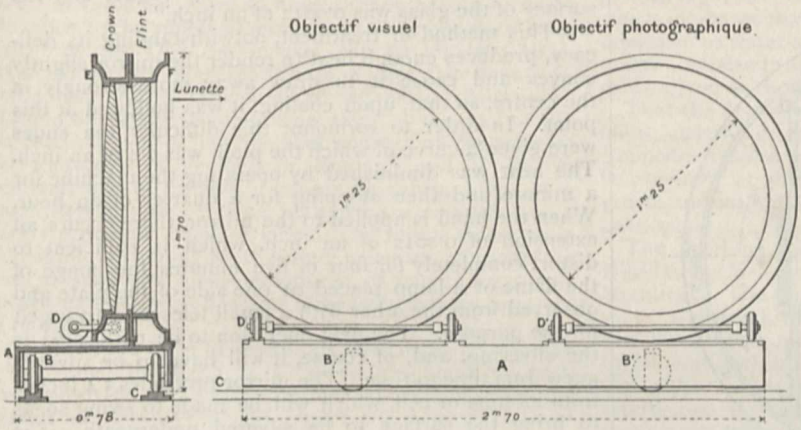


FIG. 2.—The object-glasses.

Telescope.—The telescope tube, which is of sheet steel 2 mm. thick, weighs 21,000 kg.; it is 1·50 metres in diameter, and is composed of twenty-four pieces united by bolts. It rests on eight supports of cast iron resting on stone pillars. In view of expansion, the supports move on rails fixed to the pillars.

I confess this *iron* telescope tube astonishes me.

The two object-glasses are both mounted on the same carriage, which moves on rails in such a manner as to place them easily, the one or the other, at the end of the tube; the weight of each of these object-glasses, without their cell, is about 600 kg., and with the cell 900 kg. Each lens is adjusted in a separate cell; that of the crown is carried on rollers, in order to be able to remove it from the flint and render the cleaning of each disc easy.

The tube carrying the eye-piece is supported by four wheels on rails. It is attached to the telescope tube by an adjusting screw 1·50 metres long, which is used for focussing. In the interior of this tube there is another 1·20 metres in diameter, which can be rotated by clockwork. This carries the adapter for the eye-piece end, which is made to slide in two rectangular directions by means of screws. The eye-piece end can carry either an eye-piece, a micrometer, a photographic plate, or a projecting lens.

By means of the arrangements realised in the eye-piece the observer is rendered independent of the apparent movement of the heavens, and is enabled to follow the object in right ascension and declination.

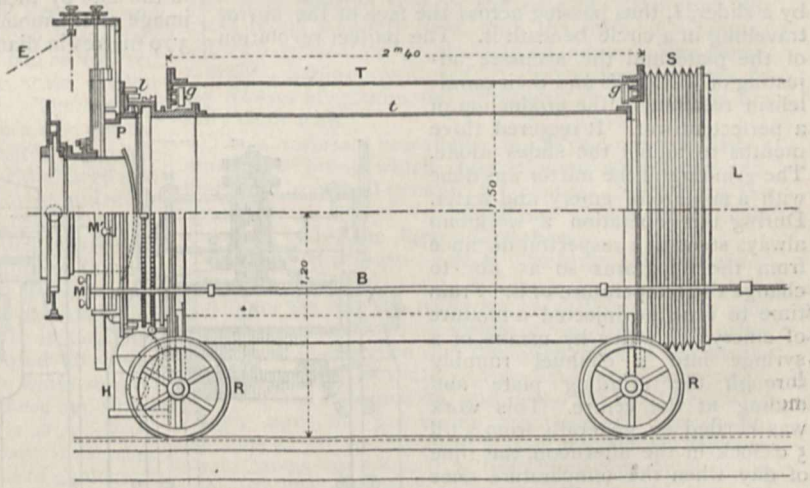


FIG. 3.—The eye-piece and travelling adapter. (Side view.)

It is stated that M. Gautier has been entirely successful, not only with the plane mirror, but with the two object-glasses.

The grinding apparatus consists essentially of a large cast iron plate, *C*, covered with an inch of flannel, upon

which the glass disc, *A*, was carefully laid. The *Scientific American* thus describes it :—

"This plate revolves slowly around a vertical axis by gearing, G, the whole being stepped in a cone. Above

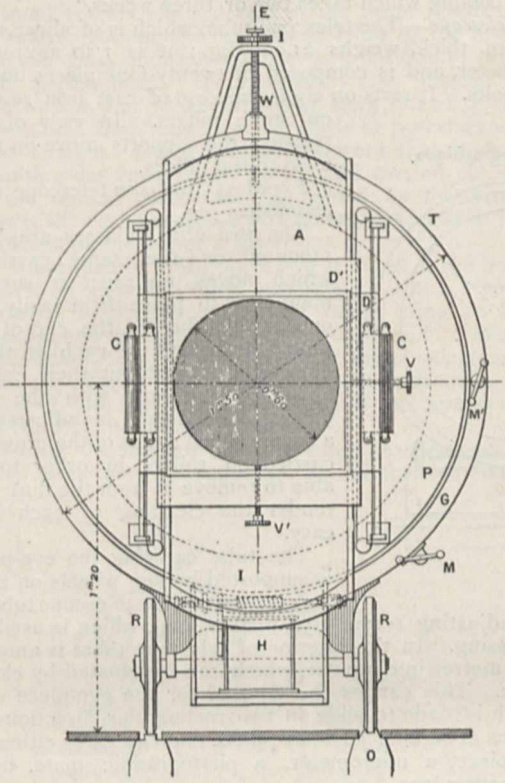


FIG. 4.—Details of the eye-piece. (Front view.)

there is a stationary circular bronze rubber, B, 47¼ inches in diameter, which is given a reciprocating motion by a slider, I, thus passing across the face of the mirror travelling in a circle beneath it. The perfect revolution of the plate and the accurate adjusting of the slides and their parallelism resulted in the production of a perfect mirror. It required three months to adjust the slides alone. The grinding of the mirror was done with a mixture of emery and water. During this operation a workman always stood at a respectful distance from the apparatus so as not to change the temperature of it. From time to time he injected a mixture of emery and water by means of a syringe into a channel running through the grinding plate and ending at the centre. This work was carried on generally from 2 till 5 o'clock in the afternoon, the time of day when the temperature does not change perceptibly. The entire morning was devoted to the cleaning of the machine, and to the verification of the parallelism of the grinding plate with the surface of the mirror, an operation which was performed with four scales which were accurate to $\frac{1}{1000}$ of a millimetre."

"As the grinding proceeded, finer and finer emery was used, and the closer the grinding plate was brought to the surface of the glass. With the finest emery the distance between the plate and the glass was 0·008 inch. The grinding lasted eight months and was followed by the operation of polishing, which required two months. The lower surface of the polishing plate was covered with a sheet of albumenised paper like that used in photography, but unsensitised. The workmen spread upon this paper a small quantity of the finest Venetian tripoli and as much as possible was removed with a soft brush. The distance between the rubber and the surface of the glass was 0·0012 of an inch."

"This method of treatment, notwithstanding its delicacy, produces enough heat to render the mirror slightly convex and cause it to draw away more strongly in the centre, so that, upon cooling, it was hollowed at this point. In order to surmount this difficulty the slides were given a curve of which the pitch was 0·4 of an inch. The heat was diminished by operating the machine for a minute and then stopping for a quarter of an hour. When the hand is applied to the mirror, there occurs an extension of 0·0012 of an inch, which is sufficient to distort completely for four or five minutes the image of the flame of a lamp placed at one side of the plate and observed from the other with a small telescope arranged for the purpose. The next operation to be performed is the silvering, and, of course, it will have to be silvered anew from time to time. The mirror protrudes 5·4 inches from its tube or cell, which will be made to swing so as to bring the surface to be silvered underneath. The reservoir containing the bath will be lifted by means of a winch until the mirror enters it at a proper depth. When the operation is finished, the reservoir will be lowered and the silvered surface turned upward and the mirror readjusted in its cell."

I am indebted to M. Gautier for the use of the illustrations, which have already appeared in the *Annuaire Scientifique du Bureau des Longitudes*.

It is the intention of the Syndicate to erect in connection with this telescope a Palais de l'Optique near the Eiffel Tower, containing a hall capable of holding some 4000 persons, and in fine weather images of the various celestial bodies are to be thrown on a screen 20 metres in the side by means of secondary magnifiers. Thus an image of the moon 16 metres in diameter, and of Mars 3·70 metres in diameter, are promised to the abonnés.

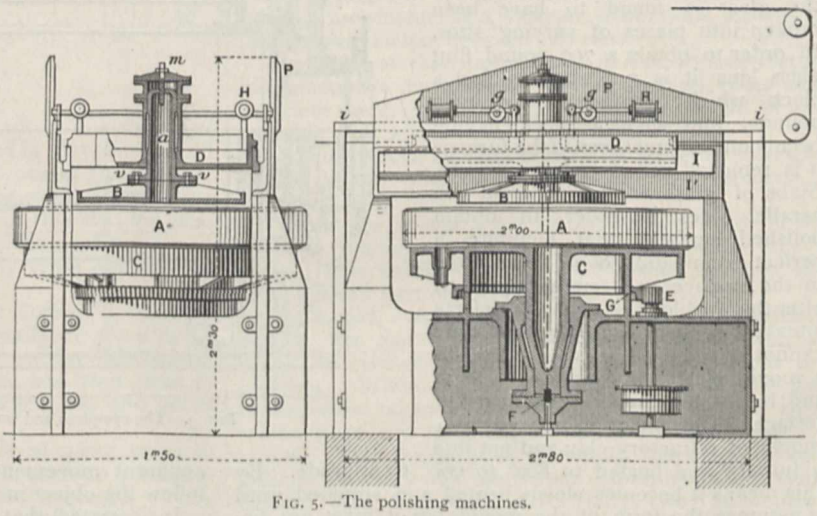


FIG. 5.—The polishing machines.

No doubt the great telescope will be largely capable of advancing science, and this will certainly be taken advantage of by the highly skilled French astronomers. Its erection, therefore, will be a great gain.

Whether the hoped-for 6000 visitors (paying, we presume, a franc each) per half-hour night and day will visit it and help to provide the sinews of war is another matter. NORMAN LOCKYER.

GEOLOGICAL SURVEY OF THE UNITED KINGDOM.[1]

REPORTS of the progress of the Geological Surveys in India and Canada have already been noticed in NATURE. The report of our home survey has since been issued by the Director-General, Sir Archibald Geikie. It is more voluminous than those of the other countries, and appears rather to be a full record than a "Summary" of the observations made during 1898 by the staff of the Survey. Whatever may be said concerning the state of our knowlege of geology in England and Wales, in Scotland and in Ireland, it cannot be gainsaid that very much remains to be done both from a scientific and a purely economic point of view. The report before us is a striking testimony to this, and when we consider the limited staff and poor equipment of our Survey, it is surprising how much has been done to further the progress of knowledge.

So far as the main field-work of the Geological Survey is concerned, the mapping of entirely new areas has been confined to the mountainous regions of Scotland and to the islands of Arran, Jura and Skye; but it is not in these areas alone that fresh observations of striking importance have been made. Re-surveys are being made of the coal districts of South Wales, North Staffordshire, Leicestershire and South Derbyshire; of the mineral districts of Cornwall and Devon; and of the agricultural districts of the southern and midland counties. In all these cases the work done actually amounts to a new survey, on a larger scale than the original map, and carried out with that attention to minute accuracy which nowadays is absolutely essential. Revisions have also been made in the Silurian areas in Ireland.

A glance at the little index-maps which accompany this report show how much field-work yet remains to be done. Of the 131 sheets of the Scottish one-inch map, fifty-nine only have been published. In England and Wales ninety-nine only of the 360 one-inch new series maps have been published. It has long been recognised that for practical purposes a survey on a scale smaller than six inches to a mile is of little value. The work of the Survey has for many years been conducted on the larger maps, MS. copies of which are deposited for public reference in the Survey Offices in London, Edinburgh and Dublin. In illustration of certain mineral areas and other regions, a number of six-inch maps have been published, but the issue of further maps was some few years ago discontinued, mainly, we believe, on account of the expense of engraving. Cheaper processes, however, are available, and it is to be hoped that the publication of six-inch maps may ere long be resumed. It is not only in mineral areas that these maps are utilised—they are quite as necessary in inquiries relating to water-supply, sanitary engineering, and agriculture. In these important questions the highest attainable accuracy is as necessary as in mining questions. Those who compare the earlier published one-inch maps with the new series of geological maps in England and Wales will recognise the great advances which have been made in the method of mapping, and if these again are compared with the six-inch maps (*e.g.* of the South Wales coal-field) it will be seen how much work is lost or obscured in the small one-inch reproduction. This difference was strikingly shown in the one-inch and six-inch maps of the Durness area in Scotland, published a few years ago.

[1] "Summary of Progress of the Geological Survey of the United Kingdom for 1898." Pp. v + 216. (London: Printed for H.M. Stationery Office, 1899.)

The present "Summary," like the first of the series which was issued a year ago, is arranged stratigraphically, commencing with the Pre-Cambrian and continuing to the Recent deposits; it contains also records of new railway-cuttings and well-borings, and accounts of the microscopic and chemical work carried on in the Petrographical Department and of the varied work performed in the Palæontological Department. Brief notice is also taken of the numerous public and private inquiries made at the offices of the Survey, work which increases from year to year, as help and advice in reference to water-supply, soils, sites for houses, building-materials, various ores and minerals, are as far as possible freely given to those who seek them.

That the field-work of the Survey must be conducted on a strictly scientific basis is not to be questioned. Economic results must follow, and they may not always be apparent at the time of the survey. It is, however, satisfactory to find that discoveries of importance have been made.

The puzzling question of the age and origin of the Highland schists continues to attract a large amount of attention. The evidence gathered tends to show that the "Moine-schists" of the north-west highlands are metamorphosed arkoses, sandstones, and argillaceous rocks, and that there is unconformity between them and the older (Archæan) gneisses. Associated with the schists are several types of foliated igneous rock, and these in some cases were intruded into the original sediments before their present foliated structures were developed. The Dalradian or so-called Younger Schists of the central highlands have also received much attention, and structures similar to those seen in the Moine Schists have been recognised in these rocks in the Braemar area. What is termed the "hornfels" type of alteration, producing a cordierite-hornfels, has been found where the old granites, such as that of Ben Vuroch, were intruded prior to the movements causing schistosity. This type of metamorphism is not observed in connection with later granitic intrusions, such as those of Cairngorm and Lochnagar. Interesting observations are made on the intrusions of these younger granites, and it is inferred that in the case of Cairngorm the mass, on its southern side, took the form of a cake or sill with vertical or highly inclined edges. The metamorphic changes produced in the bordering rocks by the masses of granite and by various igneous dykes are fully dealt with.

The Cambrian limestones in Skye have yielded a number of fossils which connect them with the Balnakiel and Croisphuil groups of Durness. Several of the species occur also in Newfoundland—and these indicate a horizon below the Arenig formation.

Analyses have been made of Cambrian dolomites from Skye and Durness.

Among the Silurian rocks in Ireland several horizons have been determined by means of Graptolites and other fossils. It is observed that the older rocks of the south-eastern portion of that country have undergone much crushing and deformation, and in the Ribband Series (of Arenig age) the grit-bands are curiously broken up, portions of grit having been pushed into the argillaceous strata so as to produce a brecciated appearance, deceptively like that of a conglomerate; indeed, some of these crush-breccias have actually been described as conglomerates. From the Upper Silurian rocks of Central Scotland a new genus of fishes (*Ateleaspis*) is recorded, and also a new species of *Eurypterus*.

Observations are made on the Old Red Sandstone of Caithness, Ross-shire, the Lorne, and South Wales. In the Lorne district a fish-bed has been discovered on the mainland shore of Kerrera Sound, about three miles south of Oban. The volcanic rocks in the Lower Old Red Sandstone form a conspicuous feature in this region.

Particular attention has been given to the granites of Ben Cruachan and Glen Etive, and it is noted that the porphyrite dykes and sills so numerous in the Cruachan granite are entirely absent from the Glen Etive mass. The evidence tends to show that the chronological order was (1) Ben Cruachan granite, (2) Porphyrite dykes and sills, and (3) Glen Etive granite and quartz-porphyry dykes and sills. It is observed that the huge granitic mass of Ben Cruachan affords special facilities for the study of the phenomena of contact-metamorphism, of which particulars are given. A careful study was made of the Cordierite-bearing rocks which occur among the altered sediments at the back of Loch Awe Hotel, and the discovery in them of Corundum is noted and discussed.

Among the Devonian and older slaty rocks of Devon and Cornwall and the associated eruptive rocks much interesting work is in progress.

In Carboniferous regions the chief work has been done in the coal-fields of South Wales, North Staffordshire and Leicestershire; and there are some new observations on the volcanic rocks in the Carboniferous Limestone of Somerset.

The changes which take place in the Carboniferous Limestone series of Glamorganshire are duly noted, and we have some account of the Millstone Grit and its beds of "silica stone," from which the celebrated Dinas fire-bricks are made. The faulted anticlinal disturbances of the Vale of Neath and Cribarth are described and illustrated. A study of these disturbances is of the highest practical importance, an instance being given where the Pennant escarpment exhibits a gentle and uniform dip, while the soft Lower Coal-measures below are thrown into sharp folds. Explorations are now showing that the lower measures are too much crushed and broken over considerable tracts near the head of the Rhondda valleys for their coals to be workable, though the Pennant rock overlying them is unbroken. Reference is made to the anthracitisation of the coals which proceeds from the eastern side of the South Wales coal-field in a direction somewhat west of north. It is remarked that the lower seams of the north crop in the Vale of Swansea are true anthracites, while one seam becomes a steam-coal at Resolven, and is intermediate between a steam-coal and an anthracite at Crynant. Of the Neath seams, one alone is a house-coal, all the others being steam-coals, although they correspond to the Llantwit group, the most noted house-coals of the coal-field. No connection has been traced between the anthracitisation and the faulting of the district, but the change seems rather to be a form of regional metamorphism dependent upon the temperature to which any part of the coal-field has been subjected during depression, as was suggested many years ago by De la Beche. The results of further investigations on this subject will be looked for with interest, for although much has been done by local observers, the question can only be solved by patient detailed and continuous mapping, and the tabulating of evidence over a large area.

In the North Staffordshire coal-field much has been done to determine and map in detail the main subdivisions of the Coal-measures. The uppermost division, known as the Keele series, comprises a considerable thickness of red sandstones, marls, and occasional bands of cornstone—beds formerly regarded as Permian, but now recognised to be strictly conformable to the Upper Coal-measures. Some of the red marls in this series contain plants of Coal-measure species, and it is remarked that the division cannot be classed with the Permian formation of Lancashire and the north-eastern counties. It remains to be proved how far it corresponds with the Supra-Carboniferous or Permo-Carboniferous division which is engaging much attention on the continent and in other regions abroad. It is remarked that the determination of the horizons in the Coal-measures may prove to have an important industrial and commercial bearing. The fact that the limestone-bands of Newcastle-under-Lyme lie at the base of a group of grey Coal-measures, intercalated between an upper group of red strata (Keele Series) and a lower group of red strata (Etruria Marls), has enabled the survey to detect true Upper Coal-measures in Keele Park, Shutlanehead, and to the west of Leycett; and there seems to be little doubt that the Coal-measures of the Pottery Coal-field lie not far from the surface under Little Madeley and Craddocks Moss. Evidence has been obtained that the strata on the north-west side of the North Staffordshire anticline do not uninterruptedly descend beneath red rocks (so-called Permian) to the west of Leycett, but rise locally westward under Hayes. The effect of this change of inclination is to bring to the surface strata which lie considerably below the unproductive red series, and to bring the principal coals and ironstones within reach further west than might have been expected. Iron-ore has been discovered in the Fenton Park Clay-pits. It is a sphero-siderite yielding 38·7 per cent. of metallic iron. This may prove to be of considerable importance.

A small patch of Carboniferous rocks has been determined at the Bridge of Awe, in the Lorne area, a fact interesting in connection with the discovery, made many years ago by Prof. Judd, of Carboniferous rocks on the east shore of the Sound of Mull, near Ardtornish. Further evidence of Lower Carboniferous rocks in Arran has also been obtained.

Brief observations on Permian rocks in Leicestershire and in Arran are recorded, and there are fuller notes on the Trias (including the Rhætic Beds) in South Wales, and on the Trias of the Midland Counties and Skye. Short notes again are given on the Lias of Glamorganshire, but the only reference to the Oolites is in a note of a deep boring (439 feet) at Oxford. We hope to hear more of this boring, as it is stated to pass from Inferior Oolite into Lower Lias with no evidence of Upper and Middle Lias, which outcrop at Fawler, near Woodstock.

The Cretaceous rocks have received attention in the southern and eastern counties. There are notes on Chalk inliers which form remarkably bold features in the neighbourhood of Cranborne Chase. There are detailed accounts of the Lower Greensand series of Norfolk, but these facts, which convey much new information, have now been printed in full in the Geological Survey memoir on "The Geology of the borders of the Wash." It is mentioned that the name Selbornian, from Selborne in Hampshire, is proposed as a term for the Gault and Upper Greensand, formations which have long been held to be portions of one stage, although it is useful and necessary on geological maps to separate the clayey Gault from the sandy Upper Greensand. The Selbornian stage will include the Red Chalk of Norfolk, Lincolnshire and Yorkshire, as well as the Gault, and the sands Malmstone and Chert-beds of the Upper Greensand. Where fully developed it is divisible into four palæontological zones, in descending order: (4) zone of *Pecten asper* (as usually known), which would more conveniently be called the zone of *Holaster fossarius;* (3) zone of *Ammonites rostratus*, with its local sub-zone of *A. varicosus;* (2) zone characterised by *Ammonites lautus*, *A. denarius*, and *A. interruptus;* (1) the zone of *Ammonites mammillatus*.

The observations on Tertiary strata refer to Bagshot Beds, and to records of new wells at Mundesley and North Walsham which passed through Pliocene strata as well as Glacial Drift. More important are the researches on the volcanic rocks of Skye, which tell of the numerous sills of basalt and diabase which have been intruded into the basaltic lavas. Though the lavas are older, these sills are younger than any of the great plutonic intrusions of gabbro and granophyre. Reference

is made also to the presumably Tertiary granite of Arran, whose intrusive character was so clearly appreciated more than a hundred years ago by Hutton.

The Pleistocene notes include some general remarks on the method of investigation of the deposits of this and Recent ages. These notes are followed by an excellent account of the Drifts near Uttoxeter. It is remarked that the prevalent drift of the higher ground is a red sandy loam, or more rarely clay, containing numerous rounded quartzite and other pebbles mainly derived from the Bunter. Evidence was obtained that in spite of its general resemblance to rain-wash the material is the local equivalent of the true boulder clay, and has had a similar derivation from the moving mass of land-ice by which the whole country has been covered. It is remarked that the movement of the ice has not been determined by the shape of the ground in the vicinity, nor by the presence of the elevated Carboniferous Limestone tract of the Weaver Hills, but has been consequent upon the pressure of the great ice-sheet which was piled over the lower ground to the westward and north-westward. The occurrence in new localities of marine shells in the Drift of North Staffordshire is likewise noticed. Further particulars are also given of the Glacial Drift in South Wales. The height to which this extends seems limited only by that of the ground. Not only till with glaciated boulders, but numerous striated rock-surfaces have been observed at heights ranging up to 2000 feet on the Old Red Sandstone. In the Isle of Man the Glacial series has been found by a deep boring to be of unusual thickness, apparently descending to between 470 and 500 feet below sea-level.

From various parts of Scotland observations on the Drifts are recorded. In Aberdeenshire there is evidence of the occurrence of blocks of the Glen Derry diorite on the hillside above Allanmore, at a distance of more than six miles to the south-east of the parent-mass. These blocks could not have been brought to their present position by the later or local glaciation, but must have been transported by the ice-sheet over ridges nearly 3000 feet in height. In Inverness-shire the high-level terraces of fluvio-glacial gravel have been traced to an elevation of 1020 feet. Many observations have been made on the Drifts in Ross-shire and in the Black Isle. Again, in Skye it has been observed that at the epoch of maximum glaciation only the highest summits of the Cuillins stood above the ice. This is true also of Blaven, and probably of the Red Hills, though the crumbling granite of which these latter are composed is not so well fitted as the gabbro to retain evidences of glaciation.

In the southern counties of England, as well as in Scotland and Ireland, various notes have been made on Pleistocene and Recent deposits, on the "Head," clay-with-flints, raised beaches, sand-dunes, peat and other accumulations.

The new railway-cuttings which have been examined are those made by the Great Western Railway Company between Stert, near Devizes, and Westbury, in Wiltshire, and those between Wootton Bassett, in Wiltshire, and Patchway, in Gloucestershire. Cuttings on the Great Eastern Railway between North Walsham and Mundesley are briefly noted.

In this abbreviated account of some of the leading observations recorded in the "Summary of Progress of the Geological Survey for 1898," we have sufficiently indicated the work that is being done, and which we hope will be carried on until the whole country has been mapped as carefully as possible on the six-inch scale. Until that work is accomplished, it can never be considered that the more pressing work of the Survey has been carried out. Regarding this as necessary, and looking to the work already performed, it is not to be denied that a very great deal of the more important work of the Survey has yet to be done. This remark applies, not only to the maps, but to the explanatory memoirs so needful in illustration of each map. The list of publications which is appended to the report before us shows that a number of new memoirs have been issued, while others are in progress; and it is hardly necessary to add that the surveying alone will not supply the public needs if the maps are not accompanied as soon as possible with the memoirs which describe the facts and explain the structures depicted on the maps.

SIR RICHARD THORNE THORNE, K.C.B., F.R.S.

SANITARY science has suffered a severe loss by the death, on Monday, of Sir Richard Thorne Thorne, K.C.B., F.R.S., principal medical officer to the Local Government Board. As a guardian of the public health, he was largely responsible for the security of the United Kingdom against serious epidemics, and for the introduction of sanitary measures which have resulted in a diminution of mortality; and as an investigator he made numerous important contributions to the science of preventive medicine.

Sir Richard Thorne Thorne was born at Leamington on October 13, 1841, and was therefore fifty-eight years of age at the time of his death. From an obituary notice in the *Times* the following particulars concerning his career have been derived. He received his medical education at St. Bartholomew's Hospital, and obtained the membership of the Royal College of Surgeons in 1863. In 1866 he became M.B. of the London University, taking a double first class, and for a short time he held some hospital appointments in London; but about 1870 he accepted office in the Medical Department of the Privy Council, which was afterwards transferred to the Local Government Board. In this capacity he continued for many years to discharge the routine work of the office, in the way of inspections and reports, until 1885, when his mastery of the French language led to his selection as delegate of the British Government at a first International Sanitary Conference, which was held at Rome, and was followed by others at Venice, Dresden and Paris. In these conferences he took from the first a leading part, and was mainly instrumental in convincing the representatives of other Governments of the futility of quarantine and of the facility with which, notwithstanding the presence of infectious disease, commerce might be liberated from vexatious restrictions which had previously hampered it. In this way he became a conspicuous public benefactor, not of this country alone, but of many others; and he was appointed her Majesty's Plenipotentiary for signing the Sanitary Convention of Dresden in 1893 and that of Paris in 1894. He early received the distinction of C.B., and that of K.C.B. was conferred upon him in 1897, soon after he had succeeded the late Sir George Buchanan as the head of his department. He was a Crown member of the General Medical Council, vice-president of the Epidemiological Society, Fellow of the Royal Society and of the Royal College of Physicians, LL.D. of Edinburgh, Doctor of Science of the Royal University of Ireland, and held numerous foreign distinctions. Apart from his many official reports relating to the public health, he was the author of works on the progress of preventive medicine during the Victorian era (1887), the "Milroy" lectures on the natural history and prevention of diphtheria (1891), and of the "Harben" lectures on the administrative control of tuberculosis (1898).

By these and other publications Sir Richard Thorne Thorne assisted scientific progress, and improved the conditions of public health. The influence of his works on national sanitation will long be felt.

NOTES.

AT a recent meeting of the Paris Academy of Sciences, M. Berthelot reported that the total amount subscribed for the erection of a statue to Lavoisier was 98,000 francs. M. Barrias has been commissioned to construct the statue and the bas-reliefs for the pedestal. The Municipal Council of Paris has granted a site for the statue in an open space behind the Madeleine Church. The monument will be unveiled when the Paris Exhibition is open, probably some time in July.

THE Brussels Academy of Sciences has awarded the prize of six hundred francs, for an important contribution to geometry, to M. Léon Autonne, of the University of Lyon. The prize of six hundred francs for anatomical and systematic investigations of insects of the group Apterygota (Thysanura and Collembola) has been awarded to M. Victor Willem, of the University of Ghent. M. F. Keelhoff, of the same University, has been awarded the Prix Charles Lemaire (interest on twenty-five thousand francs) for a work entitled "Note sur le travail des forces élastiques." The decennial prize of five thousand francs for botanical science has been awarded to Prof. Alfred Cogniaux; and a prize of the same value for chemistry and physics has been given to Prof. Louis Henry. To fill vacancies caused by death, the Academy has elected as foreign associates in the section of mathematics and physics, Sir G. G. Stokes, Prof. Moissan and Prof. Jordan. In the section of natural sciences M. C. Vanlair has been elected a *membre titulaire*, Profs. Pelseneer and Gravis have been elected correspondents, and Sir John Murray and M. Maupas have been elected associates.

THE Berlin Academy of Sciences will celebrate the second centenary of its foundation on March 19 and 20, 1900.

THE annual meeting of the Australasian Association for the Advancement of Science will be opened at Melbourne on January 9, under the presidency of Mr. R. L. J. Ellery.

IN the December number of *Natural Science*, the announcement is made that the magazine is to be discontinued, the reason being insufficient support. The journal has always been of interest and value to students of the biological sciences, and it is to be regretted that financial considerations necessitate its withdrawal.

THE Council of the Manchester Literary and Philosophical Society have awarded the Wilde Medal for 1900 to Lord Rayleigh, for his contributions to mathematical and experimental physics and to chemistry; a Dalton Medal (struck in 1864) to Sir H. E. Roscoe, for his remarkable original researches in chemistry and for his distinguished services to scientific education; and the Wilde Premium for 1900 to Prof. A. W. Flux for his papers on economic questions read before the Society. The presentation of the medals and the premium will take place at a special meeting in February next, when Lord Rayleigh will deliver the Wilde Lecture for 1900.

A REUTER telegram from St. Petersburg states that the expedition of Baron Toll, organised for the exploration of the New Siberia Islands and Sannikoff Land, will set out in June next from a Norwegian port, whence it will proceed to the mouth of the Lena, on the banks of which river, at a point above the town of Yakutsk, it will pass the winter. During the summer of 1901 the expedition will begin its explorations towards the north, picking up *en route* a detachment which will be sent forward from the main body during March, with a sufficient supply of dogs.

THE death of Dr. John Frederick Hodges, professor of agriculture and lecturer on medical jurisprudence in Queen's College, Belfast, is announced in the *Times*. Dr. Hodges was an honorary member of the Academy of Agriculture of Sweden, and of many other scientific societies. He was one of the oldest members of the Chemical Society of London, having been elected a Fellow in 1844—three years after the formation of the Society. Dr. Hodges was the author of the following works:—"First Book of Lessons in Chemistry for Farmers and Teachers" (a work which reached a twelfth edition in 1862), "First Steps in Chemistry," "The Structure and Physiology of the Animals of the Farm," and of several papers published in the proceedings of scientific societies. He was for some years editor of the *Journal* of the Chemico-Agricultural Society of Ulster.

AT the international congress on tuberculosis recently held at Berlin (see vol. lx. pp. 108, 154) it was decided to hold a similar congress in England in 1901. A meeting was held in Gray's Inn Hall, on Monday, under the presidency of the Earl of Derby, to make preliminary arrangements for the forthcoming congress. The following resolutions were unanimously adopted:—(1) In view of the fact that tuberculosis, although a preventible disease, still devastates health and destroys lives in all parts of the world, this meeting, consisting of representatives of medical, veterinary, and sanitary science, and also principal officials of municipal and county authorities, is unanimously of opinion that it is desirable to hold a national congress on tuberculosis in the spring of 1901, to which representatives from India and all dependencies of the Empire should be invited, and, in addition, honoured guests from other countries. (2) That this meeting has learned with very great pleasure that H.R.H. the Prince of Wales has graciously consented to preside over the proposed congress, and to open it in person, and desires to convey to his Royal Highness the appreciation of all present of this expression of his sympathy and support. (3) That this meeting heartily approves of the steps already taken by the National Association for the Prevention of Consumption to initiate the undertaking, and earnestly invites the co-operation of representative bodies interested in the public health in carrying out the necessary organisation. (4) That this meeting is of opinion that steps should be at once taken to obtain subscriptions and to open a Congress Fund.

THE death is announced of Mr. E. C. C. Stanford, Fellow of the Institute of Chemistry and Chemical Society, and managing director of the British Chemical Company. Mr. Stanford introduced several original methods of chemical manufacture, and prepared a number of new bodies. From the *Chemist and Druggist* we learn that while he was an assistant to the late Prof. Redwood, he began a research on kelp and iodine manufacture; and afterwards delivered lectures on the subject before the Society of Arts. These brought him into notice, and the improved processes of manufacture which he had invented were adopted on a practical scale by Mr. Patterson, of Glasgow, with whom Mr. Stanford became associated, and under his direction the production of iodine at Clydebank became a very profitable industry until the advent of Chilian nitrate crippled it. Mr. Stanford's original idea for the manufacture of iodine was to extract the salts from seaweed by diffusion and without burning it. This was found to be impracticable on a large scale, and therefore he turned his attention to less wasteful production of kelp. Through his efforts the kelp-makers of Ireland and the Hebrides gradually improved the quality of their product, while the Norwegian kelp-makers under Mr. Stanford's instructions have produced a kelp richer in iodides and more suitable for treatment than either Irish or Scotch kelp. The monograph upon the iodine industry in Thorpe's "Dictionary of Applied Chemistry" was written by Mr. Stanford. Arising from his researches on the isolation of iodides from seaweeds by

diffusion, he about fifteen years ago introduced into chemistry a new body called algin, the substance which gives seaweed its peculiar texture. This algin is an exceedingly viscous compound, and there appeared to be a future before it as a sizing-agent, but it never succeeded. One of Mr. Stanford's latest researches with the body was the preparation of an iron salt of it which has been found of considerable therapeutic interest, the compound being apparently more readily assimilated by the blood than any other iron compound. His last research was on the active principle of the thyroid gland, and it resulted in the isolation of thyroglandin. The results of this investigation were communicated to the meeting of the British Pharmaceutical Conference at Belfast.

THE Bavarian Government has granted a sum of 6000 marks to Dr. K. Giesenhagen for a botanical investigation of Malacca.

WE learn from the *Botanical Gazette* that Prof. R. von Wettstein, the director of the botanical garden at Vienna, has established a biological experiment station near the Bremerhütte, in the Gschnitzthal, in the Central Tyrolese Alps, at an elevation of 2300 m. The first object of research will be the production of species by direct adaptation.

THE United States Navy Board has issued a report on the results of investigations of the Marconi system of wireless telegraphy. The report is published in full in the *Electrician*, and from it the following statements concerning the efficiency of the system have been taken :—It is well adapted for use in squadron signalling under conditions of rain, fog, darkness and motion of speed. Wind, rain, fog, and other conditions of weather do not affect the transmission through space, but dampness may reduce the range, rapidity, and accuracy by impairing the insulation of the aërial wire and the instruments. Darkness has no effect. When two transmitters are sending at the same time, all the receiving wires within range receive the impulses from transmitters, and the tapes, although unreadable, show unmistakably that such double sending is taking place. In every case, under a great number of varied conditions, the attempted interference was complete. Mr. Marconi, although he stated to the Board before these attempts were made that he could prevent interference, never explained how nor made any attempt to demonstrate that it could be done. Between large ships (heights of masts 130 feet and 140 feet) and a torpedo-boat (height of mast 45 feet), across open water, signals can be read up to seven miles on the torpedo-boat and eighty-five miles on the ship. Communication might be interrupted altogether when tall buildings of iron framing intervene. The rapidity is not greater than twelve words per minute for skilled operators. The sending apparatus and wire would injuriously affect the compass if placed near it. The exact distance is not known, and should be determined by experiment. The system is adapted for use on all vessels of the navy, including torpedo-boats and small vessels, as patrols, scouts, and despatch boats, but it is impracticable in a small boat. For landing parties the only feasible method of use would be to erect a pole on shore and then communicate with the ship. The system could be adapted to the telegraphic determination of differences of longitude in surveying. The Board respectfully recommends that the system be given a trial in the navy.

THE great explosion which occurred in the central crater of Etna, on July 19, is by far the most striking phenomenon exhibited by the volcano since the eruption of 1892. According to Mr. S. Arcidiacono, who describes it in the last *Bollettino* (vol. v., No. 4) of the Italian Seismological Society, it exceeded in violence those which preceded the eruptions of 1886 and 1892. A gigantic "eruptive pine" rose to a height of more than 5000 metres above the summit of the mountain, and was then blown to the south-east into an elongated dark cloud, which covered a large part of the sky and hid the sun. Strangely enough, the great seismometrograph (25·3 metres in length), with which the observatory of Catania is now provided, was absolutely unaffected by the explosion. Three shorter tromometers showed, however, that it was preceded and followed by very slight and rapid vibrations; and a slight earthquake, accompanied by a prolonged rumbling sound, was felt by a few persons at Zafferana Etnea. Six days later there was a second, but much less violent explosion, which produced no disturbance whatever in the instruments at Catania. The observatory on Mount Etna was unfortunately damaged by falling stones during the first explosion.

A PAPER was read by Mr. C. Newton Russell before the Institution of Civil Engineers on December 12, upon the subject of refuse destruction, particularly in reference to its employment for raising steam. Details were given of ten combined plants, the data of which all tend to prove that a considerable amount of energy in the form of heat may be obtained from the burning of ordinary domestic refuse. At Shoreditch, where the largest of these plants is in operation, the total amount of refuse destroyed during a period of twelve months was about 26,000 tons. The plant consists of six Babcock-Willcox water-tube boilers and twelve refuse-furnaces of the Manlove-Alliot type, each boiler being placed between two refuse-furnaces, the hot gases from which are led into the boiler-tubes through short side-flues, each boiler being provided with a special grate, on which coal might be burned if required. Forced-air draught is supplied to the fires by electrically-driven fans, the pressure in the ashpits being one inch of water. No coal or other fuel is mixed with the refuse, which burns freely; the maximum temperature observed is 2500° Fahr., and the average, 1500° F. The steam generated in the boilers, at an average pressure of 140 lbs. per square inch, is disposed of mainly by the engines attached to the electric generators, although a small portion of live steam is supplied for clothes-washing purposes to the public baths and washhouses adjoining the electricity works; exhaust steam is also supplied to the Baths and Free Library, which are entirely heated from the steam produced by the refuse-destructor.

IT may be interesting to some of our readers to know that the U.S. Weather Bureau has just issued a *Bulletin* (No. 27), showing the probable state of the sky along the path of total eclipse of the sun on May 28, 1900, so far as relates to the United States. The track of totality begins on the Pacific Ocean just west of Mexico at sunrise, and leaves the United States near Norfolk (Virginia), and Cape Henry. It then crosses the Atlantic Ocean, and touches Europe at Coimbra, Portugal, takes in Algiers and Northern Africa, and terminates near the northern end of the Red Sea at sunset. This is the third report, and includes the results of observations made in the years 1897–9. The observations are divided into two parts; (1) the general state of the sky, and (2) the state of the sky near the sun, and show that Central Georgia and Eastern Alabama, about south of Atlanta, is the most favourable part for avoiding the tendency to cloudiness. It is, however, needless to remark that any special cyclonic disturbance on the day in question would seriously modify these calculations as to the mean amount of cloudiness.

IN *Das Wetter* for October, Dr. van Bebber publishes the first part of the results obtained in an interesting discussion on the possibility of scientific weather prediction for several days in advance, with special reference to the requirements of agriculture. Instead of attacking the subject in the usual way of dealing with the more mobile areas of low barometric pressure, he keeps in view the behaviour of the simpler and more

persistent areas of high pressure, among which he distinguishes five principal types, in which an anticyclone lies (1) in the neighbourhood of the British Isles (with depressions lying to the eastward); (2) over Germany (with depressions at a considerable distance off); (3) over North or North-East Europe (with depressions to the southward); (4) over East or North-East Europe (with low pressure in the west); (5) over South and South-West Europe (with low pressure to the northward). Tables are given showing the frequency in days of the weather types during twenty years, and of their mean duration. The cases in which the high pressure is situated in the western half of the horizon are much more frequent than those in which it lies to the eastward, especially in the summer season. The distribution of pressure corresponding to type (4) is a winter type, and shows a decided minimum during summer. The occurrence of type (3) in April is very marked, and it is comparatively rare in the summer season. The duration of the different types varies considerably in the twenty years' period, but the average time is about three days. The chief characteristics of the various types is explained; but although these refer more particularly to the weather of the Continent, the lines on which the investigation has been carried out may probably be followed with advantage in other similar discussions.

IN the number of the *Biologisches Centralblatt* for October 1, Dr. L. Reh, of Hamburg, contributes a discussion on symmetry and asymmetry in animals, in the course of which he disputes the correctness of several current views. It has, for instance, been asserted that asymmetry occurs only in land animals of a sluggish disposition and in aquatic creatures. But, observes the author, the majority of fishes are some of the most symmetrical of all animals; while in contrast to the unsymmetrical claws of land-crabs is the symmetry of those of their aquatic cousins. In regard to the occurrence of symmetry in rapidly moving creatures and of asymmetry in those of stationary habits, Dr. Reh admits that, so far as external characters are concerned, the former condition obtains in insects, most fishes and birds, while many tube-dwelling worms, univalve molluscs, and flat-fish are as markedly unsymmetrical. On the other hand, conspicuous asymmetry is met with in the intestines of birds and in the skulls of the toothed whales; while many barnacles, bivalve molluscs, and brachiopods are as distinctly symmetrical.

CAPTAIN GUIDO COUARDE contributes to the *Mittheilungen* of the Vienna Geographical Society an interesting paper on the island of Mayotto, the member of the Comoro group nearest to Madagascar. A short history of the island is given, and notes on its trade, population, climate, flora, and fauna.

PETERMANN'S *Mittheilungen* contains the first part of a detailed study of the geology of Celebes, by Prof. H. Bucking. The region described is that of Minahassa, in the extreme north-west of the island. Minahassa is remarkable for volcanic activity; there are large numbers of active volcanoes, solfataras, mud-volcanoes, and hot springs.

WE have received the first part of the fifty-sixth volume of the *Verhandlungen des naturhistorischen Vereins der Preussischen Rheinlande, Westfalens, und des Reg.-Bezirks Osnabrück*. The general meeting for 1899 was held at Aix-la-Chapelle, and the report contains papers on "Eyes and Industry," by Dr. Thier, oculist in Aix; on the rainfall of the Rhine Province, by Dr. P. Polis; on the geology of volcanic islands, by Paul Grosser; and on the spiders of the Rhine Province, by W. Bosenberg.

THE Hull Scientific and Field Naturalists' Club sends a copy of its *Transactions* for the year 1899. The club wisely confines its publications to local topics. Mr. J. W. Boult contributes a list of Macro-Lepidoptera collected within eight miles of Hull. Mr. Thomas Sheppard deals with the contents and origin of the gravels around Hull. Some of the gravels he regards as Pre-Glacial, although the evidence furnished by the mammalian remains is inconclusive. The mosses of the East Riding form the subject of an article by Mr. J. J. Marshall. Other papers relate to local water-supply, and to "A whale hunt at Goole over thirty years ago."

APPENDIX II. for 1899 of the Kew *Bulletin of Miscellaneous Information* consists of the names and origin of the new garden plants brought for the first time into cultivation during 1898, and the most noteworthy of those which have been re-introduced after being lost from cultivation. The list includes about 300 species.

HERR J. DÖRFLER (Barichgasse 36, Vienna iii.) is about to publish a second edition, revised and enlarged, of his *Botaniker Addressbuch* (Botanical Directory) and asks the co-operation of British botanists, who are requested to send him their full name and address, with their scientific distinctions or appointments, together with the special branch of botany in which they have worked. The price of the Directory will be, to subscribers 7*s*. 6*d*., to non-subscribers, 10*s*. post free.

Bulletin No. 17 of the U.S. Department of Agriculture (Division of Vegetable Physiology and Pathology) consists of a report by Mr. Erwin F. Smith on the "Wilt disease" of cotton, water-melon, and cow-pea (*Vigna sinensis*). It appears to be due to the attacks of a fungus, which is polymorphic, assuming somewhat different forms in the three host-plants. Besides ascospores, it produces three different kinds of conidial reproductive bodies. The fungus has hitherto been known as *Fusarum vasinfectum*, but Mr. Smith regards it as the type of a new genus, *Neocosmospora*, allied to *Cosmospora*.

WE have received a report on the spraying of Charlock and Runch (wild radish) issued conjointly by the Yorkshire College and the East and West Ridings Joint Agricultural Council. The writer, Mr. J. R. Campbell, advocates the destruction of these weeds by a spraying machine, the spray used being either iron sulphate or copper sulphate, preferably the former. It can, however, be used to advantage only in bright, sunny and calm weather. Solutions of the strength of 10 to 15 per cent. iron sulphate have no injurious effects on corn or young seeds, but they are injurious to other cruciferous crops, such as mustard or turnips, and to beans.

EARLY in the New Year Mr. John C. Nimmo will publish the first volume, by Prof. Sayce, of Oxford, of "The Semitic Series," an important new series of standard hand-books intended to present compactly and in popular scientific form a knowledge of the more important facts in the history, religion, government, language, customs, &c., of the Babylonians, Assyrians, and allied Semitic races of ancient history in a way that will be serviceable to the reading public generally, as well as to teachers and masters, students, the clergy, and others. The first volume is "Babylonians and Assyrians—Life and Customs (with special reference to the Contract Tablets and Letters)," by the Rev. A. H. Sayce, Professor of Assyriology at Oxford. Other volumes will follow at regular intervals; each will be complete in itself, and the series, taken as a whole, will neglect no phase of the general result of recent scientific research.

THE additions to the Zoological Society's Gardens during the past week include a Flying Squirrel (*Sciuropterus*, sp. inc.) from Chitral, presented by Captain S. A. Harris, I.M.S.; a Pheasant (*Phasianus colchicus*, ♂) from Russia, presented by the Hon. E. A. Stoner; two Crossed Snakes (*Psammophis crucifer*), two Rhomb-marked Snakes (*Trimerorhinus rhombe-*

atus), two Cape Bucephalus (*Dispholidus typus*), a Puff Adder (*Bitis arietans*) from South Africa, presented by Mr. J. E. Matcham; a Common Rattlesnake (*Crotalus durissus*), two Horrid Rattlesnakes (*Crotalus horridus*) from North America, deposited; four Common Sheldrakes (*Tadorna cornuta*), two White-fronted Geese (*Anser albifrons*), European, purchased; a Harnessed Antelope (*Tragelaphus scripta*, ♀), a Brush-tailed Kangaroo (*Petrogale penicillata*, ♂), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

NEW MINOR PLANET (1899 E.Z.).—Circular No. 25 from the Centralstelle at Kiel contains an ephemeris of the planet observed by Mr. E. F. Coddington in October and November last. Herr Kreutz thinks there seems no doubt that this is identical with the planet found by Dr. J. Palisa (1896 C.O.), and the ephemeris is given with the possibility that more observations may definitely settle the point.

Ephemeris for 12h. Berlin Mean Time.

1899.	R.A.		Decl.
	h. m. s.		° ′
Dec. 22	... 0 58 39	...	−4 59·0
24	... 1 0 45	...	4 36·4
26	... 2 56	...	4 13·3
28	... 5 12	...	3 49·7
30	... 7 33	...	3 25·8
Jan. 1 (1900)	1 10 0	...	−3 1·5

CHANGE IN PUBLICATION OF THE "ASTRONOMISCHE NACHRICHTEN."—We have received a card from Herr H. Kreutz, of the Central Bureau at Kiel, respecting an important alteration in the method of publishing the astronomical information hitherto given in the *Astronomische Nachrichten*, which is one of the most important foreign journals dealing with current astronomical observations. With the beginning of the New Year the original publication will be confined to the recording of general observations, while a separate paper will be issued to contain the ephemerides of comets, planets, &c. The subscription to the new part will be 10 marks yearly. Arrangements are being made for this addition at Kiel, Niemannsweg 103, and subscriptions should be sent there direct.

COMPANION TO THE OBSERVATORY.—We have received the *Companion to the Observatory* for the year 1900. In arrangement this closely resembles those of previous years, giving most of the more important data for the observation of celestial objects. Beginning with one page showing for every week the time of rising and setting of the sun, its declination at noon, mean and sidereal time, and the moon's phases, there follows a calendar, giving for every day in the year the setting, southing, declination of the moon and the longitude of its terminator. Mr. Denning again contributes his list of radiant points of the principal meteor showers during the year. Then follow useful particulars of the R.A., Decl., diameters, times of rising, southing and setting of the planets, with the times of elongation, opposition, conjunction, &c. Occultations, configurations of the satellites of Jupiter, Saturn, Uranus and Neptune occupy the next ten pages. Mr. Crommellin contributes an ephemeris of Eros for the period about the opposition in December. The rest of the book is occupied with an ephemeris for physical observations of the sun, and the mean places and times of maxima and minima, of the more noticeable variable stars.

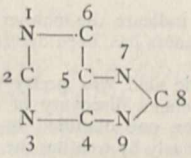
RECENT RESEARCHES ON URIC ACID.

THE uninterrupted stream of new researches which has issued from the laboratory of Prof. Emil Fischer at Berlin since 1895 threatens to bewilder even the careful student of chemistry or physiology. The following brief summary of the results may be found useful.

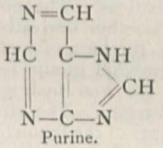
Uric acid is an excretory or waste product of animal life, and is closely related chemically to many substances such as paraxanthine and heteroxanthine, which are associated with it in urine; xanthine, adenine, and guanine, which probably form part of the nucleins of cells, and theobromine, theophylline and caffeine, the physiologically active constituents of tea, coffee and cocoa.

An accurate knowledge of the constitution of these substances is therefore of the first importance to physiologists, whilst a satisfactory process for utilising uric acid—which is a plentiful constituent of guano—in the synthesis of theobromine or caffeine would possess considerable therapeutic interest as well as commercial value. The many difficulties encountered by Prof. Fischer in the solution of these problems have been met with his accustomed skill and resource, which are the admiration and despair of the present-day chemist, and we are now not only in possession of a clear and complete knowledge of the relationship which exists between these complex products of animal and plant life, but we may anticipate before long their appearance as commercial products.

Fischer has shown that in all these compounds the same atomic framework is present and may be represented as follows, the relative position of the atoms being denoted by the numbers 1 to 9.

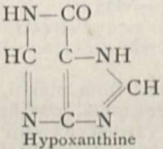


If the four additional hydrogen atoms necessary to satisfy the valencies of the carbon and nitrogen atoms be now added, the structure of the mother substance of the whole series is obtained, a compound which has been actually prepared by Fischer, and named *purine* (*purum uricum*).

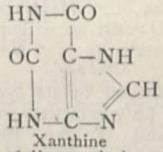


Purine.

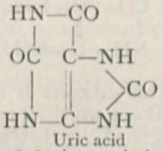
Hypoxanthine, xanthine and uric acid may be derived from purine by the addition of one, two and three oxygen atoms.



Hypoxanthine (6-oxypurine).

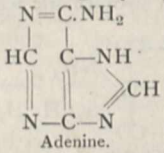


Xanthine (2 : 6-dioxypurine).

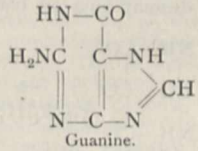


Uric acid (2 : 6 : 8-trioxypurine).

Adenine is purine in which the hydrogen atom in position 6 is replaced by an amido-group, whilst guanine is hypoxanthine with an amido-group in position 2.

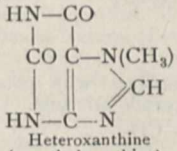


Adenine.

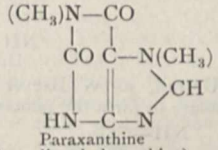


Guanine.

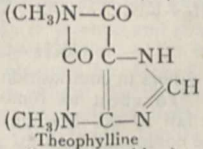
Heteroxanthine, theophylline, paraxanthine, theobromine and caffeine are respectively mono-, di- and tri-methyl xanthines.



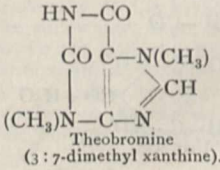
Heteroxanthine (7-methyl xanthine).



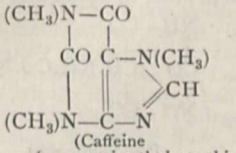
Paraxanthine (1 : 7-dimethyl xanthine).



Theophylline (1 : 3-dimethyl xanthine.)



Theobromine (3 : 7-dimethyl xanthine).



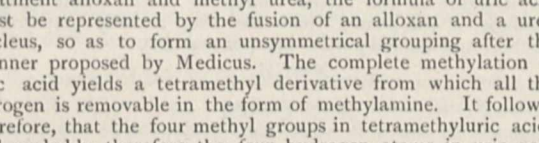
(Caffeine (1 : 3 : 7-trimethyl xanthine).

Although most of the natural products are represented in the foregoing formulæ, the list of purine derivatives is not exhausted; for, as in the case of the sugars, the natural products have been supplemented by an even longer list of artificial compounds. Thus 4 monomethyl, 5 dimethyl and 2 trimethyl xanthines are possible, and most of them are known, and all the fifteen theoretically possible methyl derivatives of uric acid have been prepared together with an additional one, whose existence has not yet been accounted for.

Even this does not complete the list of purine derivatives, for there remain methyl purines, methyl adenines and methyl hypoxanthines still to record, as well as an 8-oxypurine isomeric with hypoxanthine and a 6:8-dioxypurine isomeric with xanthine, and many others.

It now remains to indicate the manner in which the constitution of these substances has been determined and their synthesis effected.

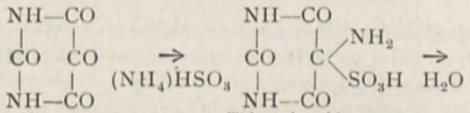
The structure of uric acid was pretty clearly established in the year 1884 by Fischer's discovery of a second methyl uric acid, in addition to the one obtained by Hill, both of which are formed simultaneously by treating the lead salt of uric acid with methyl iodide. Since one of these compounds gives on oxidation methyl alloxan and urea, and the other by similar treatment alloxan and methyl urea, the formula of uric acid must be represented by the fusion of an alloxan and a urea nucleus, so as to form an unsymmetrical grouping after the manner proposed by Medicus. The complete methylation of uric acid yields a tetramethyl derivative from which all the nitrogen is removable in the form of methylamine. It follows, therefore, that the four methyl groups in tetramethyluric acid, and probably therefore the four hydrogen atoms in uric acid itself, are linked to nitrogen. The structure of uric acid is represented by one or other of the following tautomeric forms:—



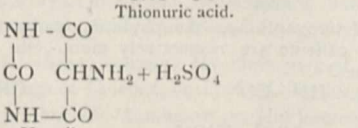
Uric acid.

This structure is confirmed by its synthesis from uramil, a synthesis which, it may be interesting to remember, was first suggested by Liebig and Wöhler, then carried forward a step by v. Baeyer's discovery of pseudo-uric acid, and finally realised by Fischer in 1895.

Uramil was first obtained by Liebig and Wöhler from alloxan and ammonium sulphite, which form together thionuric acid, the latter decomposing on boiling with hydrochloric acid into uramil.

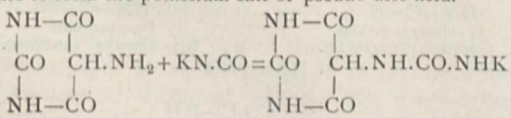


Alloxan. Thionuric acid.

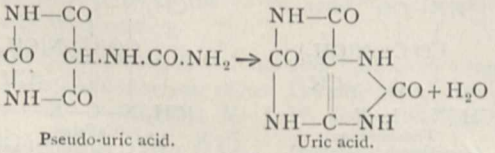


Uramil.

Uramil, as v. Baeyer showed, combines with potassium cyanate to form the potassium salt of pseudo-uric acid.



Pseudo-uric acid differs in composition from uric acid by one molecule of water. To effect its removal, which the usual dehydrating agents fail to do, Fischer found that it is only necessary to heat the compound with 20 per cent. hydrochloric acid in order to obtain uric acid.



Pseudo-uric acid. Uric acid.

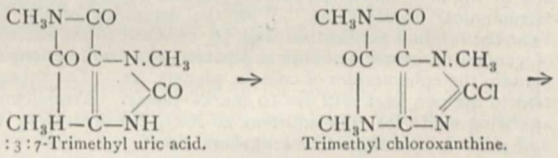
If in place of uramil its methyl derivatives are employed, various methyl uric acids are obtained; an important point, since the positions of the methyl groups in the acid are thereby determined.

Thus from 1 and 7-monomethyl uramil, 1 and 7 methyl uric acid have been obtained; 1:3- and 1:7-dimethyl uramil yield 1:3- and 1:7-dimethyl uric acid; 1:3:7-trimethyl uramil can be converted into trimethyl uric acid, whilst the imido-pseudo-uric acid of Traube is converted into an amido-uric acid.

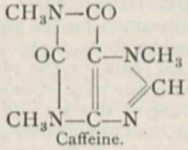
Having then established the structure of uric acid and the methyl uric acids as hydroxy-derivatives of xanthine, guanine, theobromine, theophylline and caffeine, &c., the question arises, How can these various compounds be obtained from the single raw material, uric acid? Since xanthine can be methylated and converted into theobromine, as Strecker first showed by treating the silver salt with methyl iodide, and since theobromine and theophylline, by a repetition of the same process, can be converted into caffeine, there are several ways in which the above problem might be attacked.

Uric acid might be reduced to xanthine and the xanthine methylated, or uric acid might be converted into monomethyl uric acid, then reduced to monomethyl xanthine and further methylated; or, finally, the di- and tri-methyl uric acids might be first prepared and then reduced to the corresponding di- and tri-methyl xanthines. All three methods have been utilised in turn by Fischer and carried to a successful issue; and since the process is similar in each case, one or two examples may suffice by way of illustration.

When 1:3:7-trimethyl uric acid is heated with a mixture of pentachloride and oxychloride of phosphorus, it yields trimethyl chloroxanthine. Tetramethyl uric acid yields the same product by the elimination of a methyl group in the form of methyl chloride. Trimethylchloroxanthine is then reduced with strong hydriodic acid to caffeine.

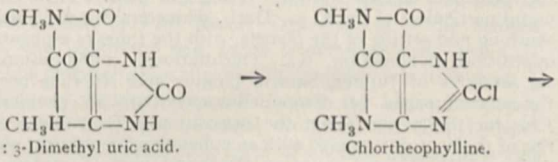


1:3:7-Trimethyl uric acid. Trimethyl chloroxanthine.

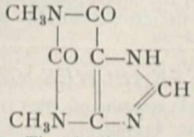


Caffeine.

1:3-Dimethyl uric acid behaves similarly and forms theophylline.



1:3-Dimethyl uric acid. Chlortheophylline.

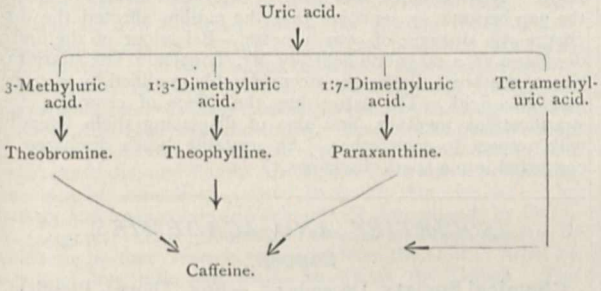


Theophylline.

This process cannot, however, be applied to uric acid in order to obtain xanthine, or to 3 or 7 monomethyl or 3:7-dimethyl uric acid, which might lead to the synthesis of theobromine; since in the first case the substance is destroyed, and in the other cases the chlorine atom replaces the wrong oxygen atom, *i.e.* instead of replacing it in position 8, which is essential to the success of the operation, it enters position 6.

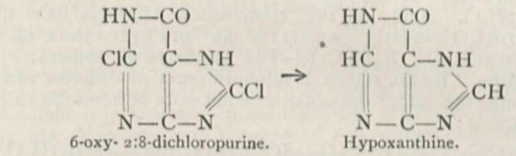
The happy idea of employing phosphorus oxychloride alone in place of the mixture of pentachloride and oxychloride has overcome this unforeseen difficulty, and given a fortunate turn to the investigation.

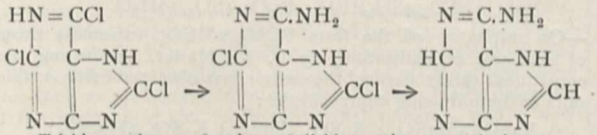
By this modification 3 : 7-dimethyl uric acid may be made to yield chlorotheobromine and theobromine, or better still, 3-methyl uric acid, which can be obtained by the direct methylation of uric acid, may be converted successively into 3-methyl-8-chloroxanthine, which may be either methylated with methyl iodide in presence of caustic potash to chlorotheobromine and chlorocaffeine, and then reduced, or first reduced to 3-methyl xanthine and then methylated. As a rule, however, the methylation of the chlorine compound is more easily effected than that of the reduced product. Paraxanthine (1 : 7-dimethyl-xanthine) may be obtained from 1 : 7-dimethy luric acid in a similar manner and also converted by methylation into caffeine. The following scheme will make clear the various directions in which the synthesis of caffeine has been accomplished :—

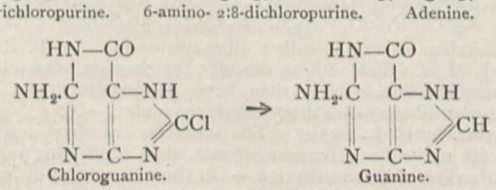


Heteroxanthine (7-methyl xanthine) has been obtained by the action of phosphorus oxychloride on theobromine, which by the elimination of one methyl group forms 7-methyl dichloropurine. By boiling this substance with hydrochloric acid, 7-methyl xanthine is formed. Xanthine cannot be prepared in so direct and simple a manner as the above from uric acid, even when phosphorus oxychloride alone is used, for the first product obtained in this way is 8-oxy-2 : 6-dichloropurine instead of 8-chloro-2 : 6-dioxypurine ; but by the action of a large excess of phosphorus oxychloride uric acid may be made to part with its last atom of oxygen. Trichloropurine is then produced, and this compound has served for the synthesis of xanthine and its more nearly related derivatives hypoxanthine, adenine and guanine.

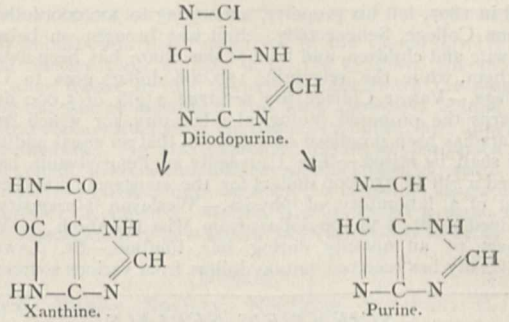
When trichloropurine is treated with aqueous potash it yields 6-oxy-2 : 8-dichloropurine. The latter compound may be directly reduced with hydriodic acid to hypoxanthine, or converted with alcoholic ammonia into chloroguanine, which on reduction forms guanine. Aqueous ammonia converts trichloropurine into 6-amino-2 : 8-dichloropurine, which yields adenine on reduction.







With strong hydriodic acid, trichloropurine is converted into diiodopurine, which yields, on the one hand, with hydrochloric acid xanthine, and with zinc dust and water purine, the mother substance of the whole group of compounds. Though neutral to litmus, purine forms salts, the nitrate and picrate being the most characteristic of these compounds.



UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

MR. FRANK LENEY, of the Geological Department of the British Museum (Natural History), who has been trained under Mr. Smith Woodward, has been appointed Assistant Curator of the Norwich Museum.

MR. A. RENDLE SHORT, a student of University College, Bristol, was awarded the scholarship in physiology at the recent final B.Sc. examination of London University. The scholarship is of the value of 50*l.* per annum for two years.

DR. J. W. GREGORY has been appointed professor of geology and mineralogy in the University of Melbourne, in succession to Sir Frederick M'Coy, F.R.S. Dr. Gregory has been an assistant in the geological department of the British Museum (Natural History) for several years, and is a member of the council of the Geological Society. He has been engaged in very successful explorations—notably in British East Africa in 1892–93, and in Spitsbergen in 1896—and has, in addition, contributed more than fifty papers to scientific societies. The salary attached to the post to which he has been appointed is 1000*l.* a year.

THE London Technical Education Committee have arranged for a second conference of science teachers to be held during the forthcoming Christmas vacation. Meetings will be held on Wednesday, January 10, and Thursday, January 11, 1900, in the morning and afternoon of each day. On the first day the meetings will be held in the conference room of the English Education Exhibition at the Imperial Institute, when the Rt. Hon. Sir John Lubbock, F.R.S., will preside at the morning meetings, and Sir Henry Roscoe, F.R.S., at the afternoon gatherings. The second day's proceedings will take place at the Shoreditch Technical Institute, Pitfield-street, Hoxton. The following addresses will be delivered :—Wednesday at 11 a.m., "Teaching of Botany in Schools," by Prof. L. C. Miall, F.R.S., and "Object Lessons in Botany," by Miss Von Wyss ; at 2 o'clock, on "Juvenile Research," by Prof. H. E. Armstrong, F.R.S., this address will be illustrated with lantern slides and experiments by juvenile assistants ; on Thursday at 11 a.m., on "Teaching of Natural History in Schools," by Prof. Woods Hutchinson, and on "Object Lessons in Natural History," by Mr. J. W. Tutt ; at 2 o'clock, "Metal Work as a Form of Manual Instruction in Schools," by Prof. W. Ripper. Free admission will be granted to as many teachers as the conference rooms will accommodate. Applications for tickets of admission should be made to Dr. Kimmins, Bermondsey Settlement Lodge, S.E., or to Mr. C. E. Buckmaster, 16, Heathfield road, Mill Hill Park, W.

THE following gifts to science and education in the United States are announced in *Science* :—The money, amounting to 11,400,000 dollars, obtained by Mrs. Jane Stanford for her 285,000 shares of Southern Pacific stock, which she sold recently, will at once be made available for the use of the Stanford University.—Mr. James Jennings McComb, of New York, one of the founders of the South-western Presbyterian University at Clarksville, Tenn., has given 70,000 dollars to the endowment fund, making his contributions amount in all to 100,000 dollars.—Brown University has received an unconditional gift of 10,000 dollars from the heirs of the late Lucian Sharpe.—The Rev. John Pike has left the reversion of half his property to found two scholarships in Bowdoin College.—Mr. Thomas Armstrong, of Plattsburg, New York State, who

died in 1897, left his property, amounting to 300,000 dollars, to Union College, Schenectady. Suit was brought on behalf of his wife and children, and half of the estate has been awarded to them, while the remaining 150,000 dollars goes to Union College.—Vassar College has received a gift of 5,000 dollars towards the proposed biological laboratory, for which 25,000 dollars has been promised on condition that an equal additional sum shall be raised.—The University of Pennsylvania has received a gift of 250,000 dollars for the construction and equipment of a laboratory of physics.—Wesleyan University has received a gift of 38,000 dollars from Miss Elizabeth A. Mead, subject to an annuity during her lifetime.—St. Lawrence University has received 34,000 dollars from various sources.

SCIENTIFIC SERIALS.

American Journal of Science, December.—The highest aim of the physicist, by H. A. Rowland. Physics is the science above all sciences which deals with the foundation of the universe, with the constitution of matter from which everything in the universe is made, and with the ether of space by which alone the various portions of matter forming the universe affect each other, even at the greatest distances. He who makes two blades of grass grow where one grew before is the benefactor of mankind; but he who obscurely works to find the laws of such growth is the intellectual superior as well as the greater benefactor of the two.—Notice of an aerolite that recently fell at Allegan, Michigan, by H. L. Ward. The mass in question, about 20 inches long and 10 or 12 inches thick, was seen to fall, and dug up a few minutes after it was buried. It was reported to be hot all through, and not cold at the centre as might have been suspected. The stone is very chondritic in structure. It is of a light ash-grey colour, and exceedingly friable, with a black crust averaging 1 mm. in thickness. Optical examination reveals the presence of enstatite, chrysolite, felspar, troilite and iron, the two last being distributed evenly and thickly as small irregularly shaped grains.—A new meteoric iron found near Iredell, Bosque County, Texas, by W. M. Foote. The meteoritic iron in question was not seen to fall. The three best instances of cleavage are exhibited in one specimen. These are three pairs of perfect adjacent planes forming angles of 120°. The fracture presents a glistening tin-white finely crystalline surface. Grains and plates as much as 2 mm. thick, of a brittle magnetic mineral of pyritiferous aspect are common. A qualitative examination showed the presence of iron, phosphorus and nickel, indicating it to be schreibersite.—Some of the results of the international cloud work for the United States, by F. H. Bigelow. The penetration of ordinary cyclones into the higher regions of the atmosphere is slight. They are only two or three miles deep. Hurricanes are five or six miles deep. The anticyclonic and cyclonic areas are hardly to be considered as centres of motion except in the very lowest strata, since currents of air blow directly across them from west to east, even in the cumulus region of the Rocky Mountain districts. The ordinary circulation theory does not hold good. In each stratum from the surface to the cirrus level about as much air moves north as south, for there are enormous counter currents passing by each other at the same level, and not over one another at different elevations. This puts a new aspect upon the entire problem of the general circulation.

Wiedemann's Annalen der Physik und Chemie, No. 11.—Moving bodies in the electric field, and the electric conductivity of air, by A. Heydweiller. If a sphere rotates uniformly in a medium of different conductivity and in an electric field, and the conductivity of the medium is negligible in comparison with that of the sphere, a couple acts upon the sphere tending to stop its motion. If the conductivities are reversed, the couple tends to accelerate the motion. The author shows that this may account for the stoppage of the moon's original rotation.—Ratio of the electric charge of kathode particles to their mass, by S. Simon. Using Kaufmann's method of magnetic deflection, the author determined the ratio e/m as accurately as possible. He found it to be $1{\cdot}865 \times 10^7$ C.G.S. units, or slightly higher than Kaufmann's value.—On the highest audible and inaudible notes, by R. König. The author investigates notes of pitches ranging from 4096 to 90,000 vibrations per second, produced by bowed tuning-forks. The method of beats is useful for estimating pitches up to the limits of audibility, but the method of Kundt's dust figures is available up to the highest pitches, and is easy to apply and to deduce results from.—Origin of frictional electricity, by C. Christiansen. A mercury jet was surrounded by twelve jets of zinc amalgam, and both were made to fall side by side through oxygen. As long as the oxygen was somewhat moist, the normal difference of potential of 0·88 volt was indicated between the amalgam and the mercury. But when the moisture was gradually reduced the difference of potential steadily decreased, and finally was reversed in sign at a point where the vapour pressure was about 0·5 mm.—Influence of Becquerel rays upon electric sparks and brushes, by J. Elster and H. Geitel. A spark gap 1 cm. wide, between a positive knob and a negative disc, was exposed to the influence of a radium preparation. The sparks or brushes were immediately converted into a glow discharge, a violet glow surrounding the knob. When the disc was made of cardboard instead of metal, the gap became so sensitive that the radium affected the discharge at a distance of over a metre.—Behaviour of the brush discharge in a magnetic field, by Mr. Toepler. The stratification of the brush discharge is considerably modified by a strong magnetic field. The latter has the effect of crowding the stratifications together, and also of displacing them laterally with respect to each other. An unstable brush discharge is converted into a spark discharge.

SOCIETIES AND ACADEMIES.

LONDON.

Chemical Society, December 7.—Prof. Thorpe, President, in the chair.—The following papers were read.—The oxidation of certain organic acids in presence of ferrous salts, by H. J. H. Fenton and H. O. Jones. The authors have examined the oxidation products of a number of carboxylic acids and of picric acid by hydrogen peroxide in presence of ferrous salts.—Oxalacetic acid, by H. J. H. Fenton and H. O. Jones. Free oxalacetic acid, $C_4H_4O_5$, is obtained on oxidising malic acid in presence of ferrous salts.—Determination of the constitution of fatty acids (Part ii.), by A. W. Crossley and H. R. Le Sueur. Ethylisopropylmalonic acid yields ethylisopropylacetic acid,

$$C_2H_5.CH(C_3H_2).COOH$$

by elimination of carbon dioxide. Ethylic α-bromethylisopropylacetate yields, on treatment with diethylaniline, a mixture of ethylic dimethylethylacrylate and ethylic methylisopropylacrylate.—The reaction between sulphuric acid and potassium ferrocyanide, by R. H. Adie and K. C. Browning. The action of acid of the composition H_2SO_4 or H_2SO_4,H_2O upon potassium ferrocyanide consists in the formation of potassium sulphate and hydroferrocyanic acid and in a partial evolution of carbon monoxide; all the cyanogen in potassium ferrocyanide is converted into carbon monoxide by acid of the composition $H_2SO_4,2H_2O$. Acid of the composition $H_2SO_4,4H_2O$ to $H_2SO_4,10H_2O$ similarly converts the salt into hydrocyanic acid and Everitt's salt, $K_2Fe_2Cy_6$.—The sulphates of bismuth, by R. H. Adie. By the action of sulphuric acid of different concentrations, the author has obtained solid salts of the following compositions:

$$5Bi_2O_3,11SO_3,17H_2O;\ Bi_2O_3,4SO_3,7H_2O;\ Bi_2O_3,4SO_3,3H_2O;\ Bi_2O_3,4SO_3,H_2O;\ Bi_2O_3,4SO_3,10H_2O.$$

—On sulphates of the form $R_2SO_4,2MSO_4$, especially those of isometric crystallisation, by F. R. Mallet. By fusing the constituent salts together, the author has obtained cubic double salts of the following compositions:

$$K_2SO_4,2MgSO_4;\ K_2SO_4,2ZnSO_4;\ K_2SO_4,2MnSO_4;\ K_2SO_4,2NiSO_4;\ K_2SO_4,2CoSO_4;\ Rb_2SO_4,2MgSO_4.$$

—Reactions of the so-called dibenzylamarine, by F. R. Japp and J. Moir. The authors describe the chemical behaviour of dibenzylamarine, which they have previously shown to be benzoyl-*s*-dibenzyl-*i*-diphenylethylenediamine.—Note on isoamarine, by H. L. Snape. The author has resolved isoamarine into its optically active components, thus confirming Japp and Moir's view of its constitution.—On the preparation of benzeneazoorthonitrophenol, by J. T. Hewitt. Benzeneazophenol is converted into benzeneazoorthonitrophenol by dilute nitric acid.—Some new osazones and tetrazones, by H. A. Auden.—A series of substituted nitrogen chlorides. Part ii. The trichlorophenylacyl chlorides, by F. D. Chattaway and K. J. P. Orton.—The reaction between cupric sulphate solution and magnesium, zinc and iron, by R. M. Caven.

Geological Society, December 6.—W. Whitaker, F.R.S., President, in the chair.—Dr. Blanford described certain photographs sent by Mr. E. H. L. Schwarz, and representing the Dwyka boulder-bed and the rounded and grooved underlying surface, in the neighbourhood of the Orange River near Hopetown and Prieska. The importance of these photographs lay in the evidence which they afforded on a disputed point. Dr. Sutherland and Mr. Griesbach had called attention to the evidence of ice-action presented by the Dwyka Conglomerate in Natal, and additional evidence had been brought forward by several observers, especially by Mr. Dunn from the Orange Free State and Cape Colony, and recently by Dr. Molengraaff from the Transvaal. Other observers, however, and especially the late Prof. Green, had disputed the glacial origin of the Dwyka beds. The photographs now exhibited would, the speaker thought, convince most geologists that the phenomena presented were due to ice-action. The resemblance to similar photographs shown to the Society in 1896 by Prof. T. W. Edgworth David, and representing the beds corresponding to the Dwyka Conglomerate in South Australia, was noteworthy. Evidence of glacial action in Upper Palæozoic times had gradually accumulated from India, Australia, and South Africa, and there was a probability that similar indications existed in South America.—On the geology and fossil corals and echinids of Somaliland, by Dr. J. W. Gregory. British Somaliland consists of a high plateau, of which the northern scarp is separated from the Gulf of Aden by a belt of low hills and plains known as the Guban. The southern plateau consists of Archæan gneisses, quartzites, amphibolite-schists, chloritic schists, and pegmatites. It is capped by purple grits, red sandstones, and conglomerates, which are covered by limestones of Neocomian, Turonian (? Cenomanian), and Eocene ages. The Neocomian limestone, which may be correlated with that of Singeli described by Rochebrune, occurs at Dobar in the Guban; while a Jurassic limestone, probably of Bathonian date, occurs at Bihendula in the Guban. Fossils collected from these limestones and from raised reefs of Pleistocene age, have been examined by the author, who tabulates a list of corals and echinids. The evidence of the collections is sufficient to show that a Neocomian limestone occurs both on the summit of the Somali plateau and on the floor of the Guban, and that some marine limestones of Lower Tertiary age (probably Eocene) also occur on the plateau. It is therefore evident that the foundering of the Aden Gulf is post-Eocene in age.—Note on drift-gravels at West Wickham (Kent), by George Clinch. The author describes two beds of drift-gravel at West Wickham. The first, occupying the bottom of a dry valley, yields in a section exposed at Gates Green, material derived from the Chalk and the Lower Greensand; and distinct, although perhaps not direct, relation with the denudation of the Weald is claimed for it. The other bed of gravel is of later age, and has yielded many Palæolithic implements and flakes.—On the occurrence in British carboniferous rocks of the Devonian Genus *Palaeoineilo*, with a description of a new species, by Dr. Wheelton Hind. The family Nuculidæ is represented in carboniferous rocks by the genera *Nucula*, *Nuculana*, and *Ctenodonta*, and to these must now be added *Palaeoneilo*, which the author describes from two fine specimens in the Museum of Practical Geology, from carboniferous shale (Yoredale Shale) south of Hammerton Hall, Slaidburn, Yorkshire. It is remarkable that a genus so well developed in Devonian times should be found at the top of the carboniferous limestone series, but not in intermediate beds. Hall's diagnosis of the genus is given, with additional remarks, and a new species is described and contrasted with *Ctenodonta* (*Palaeoneilo*) *lirata*, Phil., from the Devonian of Baggy.

Entomological Society, December 6.—Mr. G. H. Verrall, President, in the chair.—Mr. J. J. Walker exhibited a specimen of *Colias marnoana*, Rogenh., taken at Massowah, on the Red Sea. He considered this form to be only a dwarfed race of *C. hyale*, Linn.; and for comparison with it, he showed specimens of the var. *nilgherriensis*, Feld., from Central India, and of the var. *simoda*, De L'Orza, from Japan.—Dr. Chapman exhibited a series of specimens, selected from various English collections, together with a few foreign examples, to illustrate the English forms found within the genus *Fumea*. He read some notes relating to the genus, and to characters, chiefly drawn from structure, by which the different species may be distinguished.—Mr. Malcolm Burr called attention to Dr. Sharp's paper on the modification and attitude of *Idolum diabolicum*, recently published in the *Proceedings* of the Cambridge Philosophical Society (vol. x. part iii.). He exhibited the plate, drawn after nature by Mr. Muir, which illustrates the paper, pointing out that no drawing of this kind showing a Mantid in its natural colours simulating the petals of a flower, had hitherto been published. He also exhibited species of Mantodea of various genera, to show the different modifications by means of which insects of this group are made to resemble leaves and flowers.—Mr. Kenneth J. Morton communicated a paper entitled "Descriptions of new species of Oriental *Rhyacophilae*."

DUBLIN.

Royal Dublin Society, November 22.—Prof. E. J. McWeeney in the chair.—Prof. T. Johnson read a paper on the yellow blight of the potato-plant, an examination of which he had undertaken at the request of the Congested Districts Board of Ireland. The disease is especially prevalent in the west, but is found throughout Ireland. The two fungi held mainly responsible for the disease, of which an illustrated account was given, are considered to be *Sclerotinia sclerotiorum* (Lib.), Massee, and *Rhizoctonia Solani*, Kühn, the "small-pox" fungus of the potato-tuber. At the Winter Show of the Royal Dublin Society, of several hundred dishes of potatoes there was scarcely a dish with tubers free from the sclerotia and mycelium of *Rhizoctonia*, hitherto not recorded in Ireland.—Mr. G. H. Carpenter read a paper on some Collembola from Franz-Josef Land, collected by Mr. W. S. Bruce, of the Jackson-Harmsworth Expedition in 1896 and 1897. Seven species are represented in the collection, one of which—an Isotoma—is new to science. Mr. Carpenter also presented a paper on Pantopoda from the Arctic Seas, dredged by Mr. Bruce in 1897 and 1898.—Dr. F. T. Trouton, F.R.S., exhibited Caldwell's modification of the electrolytic interrupter, and drew attention to his explanation of the curious transference flow which occurs from one side to the other through the narrow opening or hole in the dividing partition. The direction of the flow being independent of the direction of the current points to a heating effect. When the explosion in the hole occurs through the sudden evolution of vapour liquid is ejected to both sides; but should the position of the explosion in the hole move, through any cause, to one side, more liquid will be thrown to the other. The bubbles of vapour must tend to form on the side of lowest pressure, thus accounting for the phenomenon. In the apparatus shown, the number of breaks per second was about 750, the volume of the hole about ·0011 c.c.; thus the limit to the rate of flow is about ·4 c.c. The maximum observed was about ·3.

Royal Irish Academy, December 11.—Dr. Benjamin Williamson, F.R.S., in the chair.—Dr. Henry H. Dixon read a paper on the first mitosis of the spore-mother cells of lilium. In this paper observations and arguments are adduced in favour of regarding the double twisted condition of the nuclear thread in this mitosis as arising from the folding and twisting together of parts of the dolichonematous thread. The double thread parting transversely forms the chromosomes, which are thus composed of two twisted portions, each a primary chromosome. In the equatorial plate each *primary chromosome* divides longitudinally. A pair of the longitudinal halves forms the V-shaped daughter chromosome. It is also shown that the unravelling of the halves of the twisted primary chromosomes naturally explains the constant V-form of the daughter chromosomes. From this it will be seen that the mitosis is not a "reducing" division in Weismann's sense. The manner of the formation of the chromosomes brings into proximity in the dispirem stage parts of the nuclear thread which were, in the spirem stage, distant from one another.—Prof. C. J. Joly read a paper on some applications of Hamilton's operator ∇ in the calculus of variations. In the case of positional variations, the conditions for a stationary value of the integral $\int f d\rho . f d\rho$ being a linear and distributive function of the vector element $d\rho$ of a curve, may be expressed by the relation $f\delta\rho = 0$ at the limits, and $fv\nabla v d\rho \delta\rho = 0$ at each point of the curve. In the second equation, ∇ operates on f alone. For surface integrals, $\iint F d\omega$ where $d\omega$ is a directed element of area, the conditions are $F\nabla = 0$ over the surface, and $F\lambda = 0$ over the boundary, λ being normal to a fixed surface on which the boundary lies. Examples were given for the use of these formulæ.

PARIS.

Academy of Sciences, December 11.—M. van Tieghem in the chair.—The perpetual secretary announced the receipt of the last American contribution to the Lavoisier Fund, the total amount received from the United States amounting to 3054 francs.—On the parallax of the sun, by M. Bouquet de la Grye. The Academy of Sciences in 1882 sent out ten parties of astronomers to observe the transit of Venus across the sun, and in the present paper the final results of these observations are given. The mean of the results obtained by Halley's method with the large telescopes is 8″·7996, with all the telescopes 8″·8068; the adopted result is: 8″·80 ± ·01. The calculations of the results from the photographical methods are not yet completed.—Note on the work done on Mt. Blanc in 1899, by M. J. Janssen. The note contains details of work done in two directions, (1) on the losses that an electric cable undergoes when it is placed bare upon the glacier, and (2) on oxygen in the sun. The first work was unfortunately attended by a fatal accident to one of the observers, M. Cauro, who fell on to the glacier on which the experiments were being carried out. The work was finished by M. Lespieau. It was found that naked wires of galvanised iron were quite serviceable for telegraphing between the observatory and points varying from 300 to 1700 metres distant, a 3 mm. iron wire lying on a length of 1700 metres of glacier ice not constituting a telegraphic "earth." As regards the solar oxygen, the photographs of solar spectra obtained during the year will be discussed subsequently.—Influence of the magnetic field upon the radiation of radio-active bodies, by M. Henri Becquerel. In a non-uniform magnetic field, constituted by a powerful electro-magnet, the radium rays are bent and concentrated on the poles. The results were most clearly shown by the aid of photography, a horizontal sensitive plate, covered with black paper, being placed between the two poles 45 mm. apart parallel to the field. Before exciting the magnet the radio-active barium chloride was placed upon the plate half-way between the poles. The maximum deviation corresponds to the direction normal to the field. These results have been obtained independently by MM. Meyer and Schweidler by the use of a fluorescent screen.—On a general method for the estimation of some elements contained in organic compounds, by M. Berthelot. By combustions in oxygen in the calorimetric bomb, at a pressure of 25 atmospheres, accurate estimations of carbon, sulphur and phosphorus are readily carried out if suitable precautions are taken, the most important for the two latter elements being the addition of a certain quantity of naphthaline or camphor. The determination of potassium, the alkaline earths, copper, iron, silver, or mercury presents no difficulties.—On the molecular refractions, molecular dispersions and specific rotatory power of some alkyl-camphors, by MM. A. Haller and P.-Th. Muller. Measurements are given for benzylidene-, piperonylidene-, cuminyl-, ethyl-saligenyl-, metamethoxybenzyl-, and anisyl-camphors, and the results compared with the figures given by the calculations of Bruhl and Conrady; the experimental results are in general higher than the calculated values. The authors suggest the double linkage connecting the camphor and aldehydic residues as the cause of the deviations.—Remarks by M. Duclaux on his treatise on microbiology.—Note on the Bielids observed at Algiers on November 28–29, by M. H. Tarry.—On the theory of discontinuous functions, by M. R. Baire.—Method for determining the mean density of the earth and the constant of gravitation, by M. Al. Gerschun. If a heavy sphere is brought near the free surface of a liquid at rest, this surface takes the form of a surface of equal Newtonian potential, arising from the simultaneous action of the earth and the heavy sphere. The expression $\frac{R}{\rho} = 1 + \frac{d}{\delta}\alpha^3$ is deduced, where R is the earth's radius, d the density of the sphere, δ the mean density of the earth, and α the ratio of radius of the sphere to the distance of its centre from the free liquid surface, and ρ the radius of the osculating surface to the liquid at its highest point. To determine ρ an optical method is employed of great delicacy, given by Foucault for verifying the truth of plane optical surfaces. Some preliminary experiments on the method show that its precision is not less than those previously in use, neither are the experimental difficulties greater.—On the principle of equality of action and reaction, by M. André Broca.—Action of aluminium chloride upon camphoric anhydride, by M. G. Blanc. The chief product of this reaction is isolauronolic acid. The secondary products are a mixture of acids, having formulæ, $C_9H_{14}O_2$ or $C_9H_{16}O_2$ and a lactone $C_9H_{14}O_2$.—Alkalimetry of the amines, by M. A. Astruc. The fatty amines examined ranging from methylamine to diamylamine are monoacid bases with either helianthine or phenolphthalein as indicator. The primary aromatic bases, on the contrary, are neutral to phenolphthalein, but behave as monoacid bases to methylorange.—On the co-existence of a reducing and an oxidising diastase in animal organs, by MM. J. Abelous and E. Gerard. It is shown that in aqueous extracts of the kidney of the horse, two ferments are present, one of which can reduce a nitrate to nitrite, and the other produce the inverse reaction.—On the presence of mannocellulose in the ligneous tissue of gymnosperms, by M. Gabriel Bertrand.—A contribution to the history of intraocular pressure, and to our knowledge of the mechanism of blood pressure in the capillaries, by M. W. Nicati. Measurements of the hardness of the eye show that the blood pressure of the capillaries is proportional to the ratio between the volume of the body and its surface.—New observations of American *Peripatoïdes*, by M. E. L. Bouvier.—On a new pathogenic *Mucor*, by MM. Lucet and Constantin. This fungus was found to be the cause of a disease of the respiratory organs, at first mistaken for tuberculosis. The disease was cured by treatment with arsenic and potassium iodide. The fungus was found to be a new species, differing from the four pathological species previously known. The name proposed by the authors is *Rhizomucor parasiticus*.—On a new mode of formation of the egg in *Piptocephalis*, by M. Matruchot.—On the mountain chain of Chartreuse, by M. H. Révil.—The *facies* and conditions of deposit of the Turonian in Aquitaine, by M. Ph. Glangeaud.—On new subterranean researches in Dévoluy (Hautes-Alpes), and on the deepest natural well known, by M. E. A. Martel. The shaft found has a depth of at least 310 metres, and is probably greater.—Approximate determination of the denudation of Cretaceous rocks on the coasts of Normandy, by M. J. Thoulet.

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