THURSDAY, OCTOBER 1, 1903.

MRS. MARCET REDIVIVA.

Die Schule der Chemie. Erste Einführung in die Chemie für Iedermann. By Wilhelm Ostwald. Part i., General Considerations. Pp. vii+186. (Braunschweig: Friedrich Vieweg und Sohn, 1903.) Price 4.80 marks.

PROF. OSTWALD is an ingenious man; in his own language, the attribute might be expressed by the adjective "schlau." Having, as he tells us in his preface, published volumes of the greatest importance, and of the widest range, on physical chemistry for the use of investigators in the domains of chemistry and physics, and having next written his work on elementary chemistry for the ordinary student commencing the study of the subject in universities or Polytechnika (a work of which an excellent English translation by Dr. Findlay has been brought out), he now makes an attempt in this very elementary work to reach a larger public, and has written this most amusing book for the use of youngsters about ten to thirteen years of age. The plan adopted is to introduce by means of dialogue some chemical facts concerning hydrogen, oxygen, water, nitrogen, air, and carbon and its oxides, and incidentally to consider the nature of pure substances and mixtures, including solutions, the phenomena relating to change of state, and the behaviour of gases with alteration of pressure and temperature. All these subjects are treated in a philosophical manner, and his own views are incidentally, and one might almost say insidiously, introduced, so as to set the young mind on what he considers to be the right track.

Beginning with the notion of a "Stoff," or "stuff"—a convenient word, inasmuch as the word "Substanz," or "substance," from its derivational point of view, by no means accords with the views of the author—the properties of a stuff—sugar—are considered, and the pupil is made to reject the idea of a "substance" by subtracting properties, and recognising that there is no underlying entity. "You must rid yourself of the idea," the pupil is told, "that there is anything underlying the properties of a thing, which is more real or important than the properties themselves. Formerly, before science had progressed, people held such notions, and our language still retains expressions which almost force us to accept the notions. But when once that error is recognised, it can be avoided." To which the pupil replies that he is afraid that he will have difficulty in getting rid of the old views. "But," replies the teacher, "when you know more chemistry, you will see that you have to do only with the properties of stuffs, and never with their real nature; so that you will forget the incorrect method of expression."

Later on, in talking about the melting point of ice, the teacher defines it as "that temperature at which solid and liquid can exist beside each other"; and the pupil asks, "Then, who made this law?" The teacher answers, "The word *law* is only a way of speaking. It has been found that stuffs behave like this, and they have been compared to obedient pupils who always do what they are told. In science the word law means only that we find that things are related to each other in a certain way; and that is expressed in a general form."

In discussing change of state, the teacher refers to the term "state of aggregation," and explains it by the conception of atoms. He elucidates the word "hypothesis," but declines to accept the atomic hypothesis as an "explanation" of states of aggregation, and suggests the word "Formarten," and this leads to the consideration of differences between the states of solid, liquid, and gas. Having got the pupil to infer that liquids when cooled become solid, and solids when heated melt at definite temperatures, the pupil asks, "What determines these temperatures?" "That is a stupid question. You should rather ask: To what other properties do they show that they are related? It is just as if you were to ask: why are there camels? All that you can ask is, what are the properties of these animals, and how are these properties connected with those of other animals?"

Talking of the combustion of a candle and its disappearance, the pupil says, "But it really vanishes before my eyes." "Yes," says the teacher, "it becomes invisible. But can't it change into something invisible?" "There are no invisible things," says the pupil. "Oho!" replies the teacher. "No," says the pupil, "ghosts and goblins don't exist." "Even they are said to be sometimes visible," answers the teacher. "But can you see the air?" "Hum—no," says the pupil. "But the air is changed by burning. I don't see how." And so the formation of an invisible gas is brought out, and the method of determining its weight.

In considering heat and light produced by combustion, their absence of weight is remarked, and the pupil guesses that they are "forces." The teacher corrects, and explains that what used to be known as force is now known as energy, and that it is defined as "what causes things to change." Stuffs contain chemical energy when they can act on each other and form new stuffs, and part of their chemical energy takes the form of heat or light, and sometimes of electrical or mechanical energy. The pupil is made to throw out suggestions on the conversion of one form of energy into another, and his own energy is traced to the chemical energy he takes in as food. "But I am often hungry, even when I do nothing," says the pupil. And it is explained that his temperature has to be maintained, and that if he likes he can produce light by rubbing two pieces of sugar together, and electricity by rubbing sealing-wax with a cloth. In this way an idea is given of transformation and equivalence of energy.

Compounds and elements are next considered, and the pupil asks the natural question, "Are the constituents actually in the compound or not?" "You haven't considered your question. A compound is not a bag or a box in which something can be contained.

If you mean by 'in' that the constituents can be got out again by appropriate means, then they are 'in.' But you mustn't suppose that the constituents are locked up in the compound, somehow or other, with all their properties."

So far, it might be supposed that this system does not differ from the "heuristic" system which has been so much in evidence lately. But that is not so. There is no attempt made to prove anything exhaustively, or to let the pupil do so; as a rule, the experiment is made by the teacher, and the pupil is sometimes allowed to repeat it. A little later, in considering the classification of certain elements, the pupil remarks, "But it appears to me not very scientific to take anything on trust that I can't prove." To which the teacher answers, "You will be able to prove this, when you know more chemistry."

Teleological "explanations" are conspicuous by their absence. Yet when the pupil inquires, "Why have most chemical stuffs such a nasty smell?" he is told, "If they hadn't, we shouldn't notice them, and we should have our skin hurt and get a cold in the head." This is not quite consistent.

That the cost of an article depends on the amount of work put into it is illustrated in the case of aluminium, the compounds of which, such as clay, have almost no value, while the metal is costly. The pupil inquires, "Can the work be got out of the aluminium again?" "Yes," says the teacher, and shows the pupil the reduction of iron oxide by means of powdered aluminium.

The pupil is constantly afraid that he will not be able to retain in his head all that he is taught. But he is comforted by being assured that he will have to go over the subject again, and that he really knows a good deal. These little remarks are very natural, and the answers are most judicious. But we agree with the pupil when he says "Chemistry is a frightfully big subject!" Indeed, he is told that no one man knows all about oxygen, in reply to a remark, flattering to the teacher, "But surely you know all about this!" Much is in writing, however; and he then asks, "Is everything in these books right?" "Most of it," he is assured; and what is best about scientific books is that no one intentionally tries to deceive.

The action of iron oxide in accelerating the evolution of oxygen from potassium chlorate is likened to that of oil on a rusty machine, or of a whip on a horse. And so catalytic phenomena are introduced. There are many such digressions, and often the teacher lets them go on to a certain point, and then harks back to the actual subject of the lesson.

The pupil is introduced to the idea of mass-action after he has made the natural remark, "But iron is stronger than hydrogen, and takes the oxygen from it." "First iron was stronger than hydrogen, and afterwards, hydrogen stronger than iron. That's surely a contradiction." "The contradiction is owing to your looking at the reason of chemical changes as a mechanical power or force; such a force has never been proved to exist or measured." And when pressed, the teacher fences thus, "A man can carry a good lot of water; but a larger quantity of water can carry a man." "So you mean, chemical change depends on which stuff is present in largest quantity." "That's about it; but we must go back to hydrogen." And the digression closes.

The laws of recurrence and of continuity are illustrated and formulated; the existence of allotropic forms of carbon is referred to the difference in their content of energy, and the source of all terrestrial energy, except that of the tides, is traced to the sun, due attention being paid to the reciprocal action of plants and animals.

One admirable feature of the work is that the pupil is allowed to fall into all kinds of traps. For example, he calculates the conversion of the Fahrenheit into the centigrade scale in every conceivable wrong manner before he finds the right use of the "32"; and after he has seen experiments on the compressibility of air and the observations have been written down, he is made to find the law. The method is so good that it is worth quoting. "Suppose you have ten apples: some in your pocket, some in your hand. Call the number of apples in your pocket t, and those in your hand h. Now you know you can calculate t if you know h, and h if you know t. Why is that?" "Because I know that together they make 10." "You see then $t+h=10$; and you can calculate t if you know h, and *vice versâ*." "That's neat. But I could have done that without a formula." "Yes; but only because the formula is so simple. Now try if your pressures and volumes can be calculated as simply." "Let me see:—$75+100=175$; $62.5+120=182.5$; $60+150=210$. No; the sum is always getting bigger." "The sum formula doesn't fit, then. You might have seen that you can only add like things, such as apples to apples: you can't add a pressure to a volume." "What sort of formula can it be, then?" "If p gets bigger, v gets smaller. What kind of combination of p and v will give that result?" "Probably a whole lot." "Quite true; but not many simple combinations. Try the simplest you can think of, besides the sum." "Perhaps the product. If one factor gets smaller, the other must get larger, so as to make the same product." And so he gets it out.

It must be allowed that this is excellent teaching. The whole book is so lively and conversational, and withal so amusing, that it well deserves reading by those of an older generation. It is probably likely to be more useful to teachers than to pupils, for it will serve them as a guide. As the publishers say in their preface, the standpoint from which the book is written is the most modern one; some, perhaps, may consider it too modern, and that some of the doctrines expounded are as yet not in general circulation, and perhaps never will attain universal consent. That is a matter of opinion, and, of course, the author believes that they will. Anyhow, he has taken advantage of the lessons of all missionaries—get hold of the children, and the doctrines will spread. And if an attractive book can help their dissemination, this is one.

W. R.

EXPERIMENTAL EMBRYOLOGY.

Lehrbuch der vergleichenden Entwicklungsgeschichte der wirbellosen Thiere. By Profs. E. Korschelt and K. Heider. Allg. Theil, Erste Lief., Erste und Zweite Auflage. Pp. x+538. (Jena: Fischer, 1902.) Price 14 marks. Zweite Lief., Erste und Zweite Auflage. Pp. 539 to 750. (Jena: Fischer, 1903.) Price 5.50 marks.

ZOOLOGISTS who are already acquainted with the "special" part of Profs. Korschelt and Heider's "Comparative Embryology" will have been anxiously looking forward to the publication of the present volume; we are sure that they will in no wise be disappointed. At present we have only a first instalment, but even this contains an enormous amount of matter, including, as it does, a review of all the recent work on the physiology of development, besides a complete history of the sexual cells.

The latter portion, we may as well say at once, should have come first. Logically, the phenomena of what Roux has called "Vorentwickelung" are more closely related to descriptive than to experimental embryology; and if the order of the first and second portions had been reversed, the authors would have been able to include under a common discussion the kindred problems of ontogeny and heredity.

Of this second portion we have no space to treat at length. It must suffice to say that the student will find here an excellent *résumé* of all that is known on the structure, maturation, and fertilisation of the germ-cells. Criticism is hardly called for; but the definition of the mammalian placenta (p. 292) is out of date, and we should have liked to have seen a less fragmentary account of the maturation phenomena in plants. On the other hand, the difficult subject of maturation is treated with remarkable lucidity, while the attitude of the authors towards the vexed questions of qualitative reduction, and, in the next chapter, the individuality of the centrosome, is admirable in its judicial impartiality.

By far the most important part of the book, however, is the first section—that dealing with the work of the new school of experimental embryologists. The problems at issue are sharply defined in an introductory preface. As the authors rightly remark, ontogeny consists of a series of changes in which every stage is—in the strictest sense of the word—a cause of that which immediately follows. The business of the experimenter is to analyse the phenomena, to determine what is due to external, what to internal factors, and, in respect to the latter, how much is attributable to the initial structure visible or invisible of the ovum, how much to the mutual interaction of the parts that are successively developed.

With this object in view the ground is first cleared by a discussion of the external factors, beginning, quite rightly, not only from a logical, but from a historical point of view, with the pioneer work of Pflüger on the influence of gravity on the segmentation of the frog's egg. An account of the subsequent, and consequent, work of Born, Roux and Hertwig naturally follows. Next are described the effects of heat, light, and physical and chemical changes in the gaseous and liquid environment, and lastly, a little out of their proper place we think, the few experiments that have been made to determine the influence of electricity and magnetism, and of mechanical disturbances on the course of development.

It is a pity that the authors have not introduced at this point a critical summary of the results. It is of the first importance to decide whether these external conditions constitute a series of "specific" or merely "indifferent" causes. Hertwig's artificial production of monsters by heat and salt solutions would have made an apt text for an interesting essay on "Abhängige Differenzirung," and would have served to carry on the reader to the next chapter, "Das Determinationsproblem," in which we are taken straight to the heart of the "Streitfrage" of modern embryology.

While the restoration of the eighteenth century doctrine of preformation to a prominent place in embryological literature dates from His's theory of "Organbildende Keimbezirke," the attempt to gauge its worth experimentally begins with Roux's work on the production of half-embryos from a single blastomere of the frog's ovum. Roux's results, or rather his interpretation, were wholly in favour of this doctrine; their value has, however, been diminished by Hertwig's criticism and Herlitzka's work on the newt. The Amphibia, indeed, together with Amphioxus, the Teleostei, and the Cœlenterata, stand, so far as the "regulative" capacity of their ova are concerned, at one end of a series, at the other extreme of which are forms, the Ctenophora and Mollusca, the isolated blastomeres of which are incapable of developing into anything but partial larvæ. The intermediate position is occupied by the Echinoderms and Ascidians; here the segmentation of such blastomeres is partial, but a whole larva is ultimately formed. Any general theory, therefore, of the necessary predetermination of the parts of the organism in the cytoplasm of the ovum is out of the question. A similar criticism, based on the pressure experiments of Driesch (Echinus) and Hertwig (Rana), is applicable to the nucleus, and, of course, cuts at the root of the "Mosaik-Theorie."

The failure of the attempt to demonstrate a preformed, though invisible, structure in the ovum throws us back on epigenesis, and compels us to search for the internal causes of ontogeny in the mutual interaction of the parts as they are formed. To deduce such interaction, however, from the known functions of cells is a very different matter; but such facts as are significant for the purpose are brought together in the third chapter under the heading of "morphogenetic cellular processes."

The general discussion of the whole problem is reserved for a separate appendix. The authors display a commendable caution in reviewing the theories of Weismann, Hertwig, and Driesch. This caution, indeed, is characteristic of the whole book, and will certainly win the approbation of every embryologist who is content to say with the authors, "wir werden die Speculation nie entbehren können, aber es wird die Aufgabe sein, das ihr zu Grunde liegende Beobachtungsmaterial möglichst zu erweitern."

THE STUDY OF ECONOMICS.

The New Cambridge Curriculum in Economics. By Alfred Marshall. Pp. 34. (London: Macmillan and Co., Ltd.) Price 1*s.* 6*d.*

"IN the United States of America, in particular, and in Germany, the subjects of Economics and Political Science are commonly represented by a strong and numerous staff, and afford the main route by which large numbers of students obtain University Honours. . . . England, on the other hand, which long held undisputed leadership in Economics, has suffered in recent years from the lack of adequate provision for the study of that subject at the Universities."

From all sides evidence is forthcoming of attempts to remedy this defect. There is a widespread revival of interest in the subject-matter of economics, and a corresponding determination on the part of its teachers to seize the opportunity to place the subject on firmer and broader foundations in the schools. Development has taken place in several directions. The "monarchical" supremacy of Mill was broken up in the 'seventies by Jevons, Cliffe Leslie, Bagehot and others. In 1890, Prof. Marshall published the first edition of the first volume of his "Principles." In the last three decades of the nineteenth century economics lost much of its insularity on the one hand, and gained in human interest on the other. The work of economists in Germany, Austria, and the United States broadened the horizon and tested the conclusions of the native researcher by an appeal to a richer experience. The advent of the working-classes to political power and the influence of a cheap Press kept social questions ever prominent, and ideas of material well-being, efficiency and comfort occupied an increasing part of economic reflection. The writings of Mr. Charles Booth, Mr. Sherwell, the Rowntrees, Mrs. Bosanquet, and other investigators have recently enjoyed a wide currency in various pure and diluted forms, and have driven many to study economics in a systematic fashion. Municipal enterprise has had a similar effect. With all these writers and students the ruling motive has been the desire to lessen poverty and to improve the quality of human life. In the book before us, Prof. Marshall voices this practical aim in a significant passage:—

"The motto of Sidgwick's 'Political Economy' is: 'Things are in the saddle and ride mankind.' What had made men become economists, in three cases out of four, was the belief that in spite of our growing command over nature it is still things that are in the saddle, still the great mass of mankind that is oppressed—oppressed by things. The desire to put mankind into the saddle is the mainspring of most economic study."

But not only has there been a quickening of interest in the condition of the people at home. The sense of imperial responsibility has deepened. Schemes of federation, sentimental and economic, have filled the air. The competition of advancing rivals has made itself felt in our markets. We have been driven to ask with Sir Robert Giffen, Is the central force of the Empire, the power to hold it together, increasing as rapidly as the Empire generally? It would be fatal while widening the circumference to weaken the centre; to fix the spokes in a rottening hub. The Empire drains the home country of valuable administrative energy of which it never has too much for high social efficiency. And in business, managers of elastic minds, wide outlook, and great organising power, in command of large masses of capital are still relatively scarce.

It is unnecessary to point out how the controversy of the last few months has impressed impartial observers with the complexity of practical economic problems, and with the urgency of studying these problems in an atmosphere uncharged with the passion of parties. The people are suddenly confronted with political choices of international moment, and their instructors are too often politicians and pressmen whose hastily acquired information displays all the symptoms of indigestion. Can the universities do something to provide the nation with more capable administrators for central and municipal government, and for the diplomatic and consular services? Can they train men for the supreme positions in the industrial and commercial world? Prof. Marshall's booklet tells us that the University of Cambridge has answered in the affirmative by instituting a new honours school in economics and associated branches of political science, and it supplies us with the ideas which have guided the Senate in framing the curriculum. This is not the place to make detailed comparisons with the similar courses newly arranged in the Universities of London, Birmingham, and Victoria. Speaking broadly, the Cambridge curriculum makes its appeal to advanced students who will be called upon to decide main questions of policy in politics and industry rather than to subordinates who wish to be equipped in the technique of administration and business. It is theoretical and scientific rather than practical and professional. Only shallow thinkers will infer that, on this account, it is out of touch with reality. Prof. Marshall is under no illusion on this point. His little book is a plea for a training which, while it fits a man for his duties as a citizen, never loses sight of the practical demands made upon the employer and the civil servant in these strenuous days. Prof. Marshall himself is his own best argument, for these pages mirror the wisdom and fairness and humility and idealism of a life devoted to economic study.

T. J.

OUR BOOK SHELF.

A Treatise on Electromagnetic Phenomena and on the Compass and its Deviations Aboard Ship. Vol. ii. By Commander T. A. Lyons, U.S. Navy. Pp. vii+582. (New York: Wiley and Sons; London: Chapman and Hall, Ltd., 1903.) Price 25*s.* 6*d.* net.

SOME forty years ago there appeared the second edition of the "Admiralty Manual for Deviations of the Compass," and as the compass is "the soul of the ship," so the teaching of that manual remains the soul of the numerous works on the subject which different maritime countries have since published, albeit that chapters on cognate subjects may have been added thereto. Naturally America has provided her quota, and this book is her latest contribution.

This second volume of the treatise, which is devoted to the "compass and deviations aboard ship," can hardly be fully mastered until after reading the first volume, but it is in a great measure complete in itself, especially to those who have already some knowledge of terrestrial magnetism. All will agree with the author of this book when he insists upon the necessity for every navigator knowing as much as possible about his compass and that magnet—his ship—which is ever in antagonism to the earth, which does its best to direct the compass to magnetic north.

Of the five parts into which this volume is divided, part ii. treats of the manufacture of the liquid compass (the only kind in use in the U.S. Navy), giving in full detail the principles of magnetism and mechanics connected with its construction and use afterwards.

In part iii. the ship is shown to be a magnet by experimental magnetic surveys of ships illustrated by diagrams. The physical representation of the theory of the deviation of the compass is fully given, but decided exception must be taken to the instructions for determining the position of the compass after the ship is launched. It is then too late, and the experienced Superintendent of Compasses and the constructors should long before have agreed upon a place for it in the ship's drawings, and afterwards worked in harmony to keep iron fittings at a proper distance.

Part iv. treats of the mathematical theory of the deviations of the compass, and here, as in other of the mathematical investigations he gives, the author gives valuable assistance to those who are not skilled mathematicians by "filling up those gaps in the sequence of the formulas that often yawn forbiddingly."

On the question of compensation of the deviations of the compass, to which part v. is devoted, we have the least satisfactory part of the book. Thus the formula for correcting the heeling error with spheres in place is very convenient in practice, but not mathematically correct. The instructions for compensating the secondary part of the quadrantal deviation known as coefficient E by spheres are incorrect. Again, the residuary quadrantal deviation, after compensation, is described as "practically constant the world over"; but this is certainly not so in the example given of the "Machias," where, between Aden and Pechili Strait, the quadrantal deviation differed nearly 3°, as might be expected where soft iron correctors are placed near the long powerful needles of the Ritchie compass. Further, the Flinders bar will not compensate any important part of the heeling error due to soft iron as here proposed.

There is much to recommend this book to the student, both as regards the mathematical treatment of the subject and for its numerous explanatory diagrams. Its weak point lies in the parts relating to the application of theory to practice, which require modernising and a careful revision. E. W. C.

Comité international des Poids et Mesures. Procès-Verbaux des Sciences. Deux. Série. Tome ii. Session de 1903. Pp. 170. (Paris: Gauthier-Villars, 1903.)

THE *Procès-Verbaux* recently issued by the Comité international des Poids et Mesures refers to their meeting at Paris in April last. The committee included Dr. W. Foerster (president), Prof. P. Blazerna (secretary), Dr. Benoit (director of the bureau), and MM. Arndsten, D'Arrillaga, de Bodola, Egoroff, Gautier, Hasselberg, and von Lang. Their proceedings mainly had reference to the work at their bureau (Pavillon de Breteuil, Sèvres, Paris) for the current year, including the consideration of the annual expenses of the committee (100,000 francs).

The committee lament the death of their distinguished colleague, Prof. A. Cornu, on April 12 last, and also of Dr. H. von Wild, September 5, 1902, an honorary member of the committee. They announce the unanimous election on the committee of M. E. Mascart, and of Dr. A. Chappuis as an honorary member. Count de Macedo (Portugal), Dr. A. Michelson (United States), and Mr. H. J. Chaney (Great Britain) were unable to attend the present meeting.

During the past year the verification of length standards at the bureau included standards for the Board of Trade, the Education Department, the National Physical Laboratory, and other authorities in England. On the application of the British Government, indeed, an important work was undertaken by the committee, that of the graduation and verification of a new linear standard of the metre and yard, a standard made of iridio-platinum, X section.

Although the scientific work of the bureau last year does not appear to have covered a wide field, it has followed important paths, as in some investigations (Appendix iii.) as to the linear expansion by heat of platinum, iron, nickel, steel, glass, and quartz, and the results reported by the committee are now probably among the most authoritative of such thermometric investigations. Dr. C. E. Guillaume also adds (Appendix i.) an essay on the theory of the alloys of steel and nickel, and M. E. Sauvage (Appendix ii.) an account of an international series of screw-threads, based on metric measure, as formulated at a congress held at Zürich in 1898–1900, a series which appears to be now adopted for engineering purposes in France.

Flora of the Island of Jersey. By L. V. Lester Garland. Pp. xv+205. (London: West, Newman and Co., 1903.)

ALTHOUGH in most parts of the country a botanist can generally make a goodly collection of plants within a day's journey of his residence, there is always a desire to visit those localities in the British Isles which have a special flora of their own. Such are the Scotch mountain ranges, the counties of Devon and Cornwall, and by no means the least interesting to the southerner, the Channel Islands. On these visits it is a great boon to have a flora which will give the information where certain plants may be sought. For Guernsey and the adjacent islands of Alderney and Sark, Mr. Marquand has published records, and no less welcome is the compact little book which Mr. Lester Garland has compiled on the flora of Jersey. The book presents one essentially new feature, since the system adopted is that of Engler. Some excuse is offered for the innovation, but there can be no question that Engler's system is bound to supplant that of the "Genera Plantarum," and considerable credit is due to the author for acting up to his convictions. In conformity with this change some of the generic names have been altered, and Erucastrum, Lobularia, and Parentucellia take the place of others more familiar; for the same reason *Tillaea muscosa*, L., becomes *Crassula Tillaea*, Lester. No trouble has been spared to test uncertain or critical species and records, and the notes on these are sound and practical; also distinction is made between native plants and aliens. The genus Centaurea serves to illustrate the author's caution and care; he declines to split up *Centaurea nigra* into uncertain varieties, queries *Centaurea scabiosa*, accepts *Centaurea scabra*, and classes the species cyanus, paniculata, calcitrapa, solstitialis among the aliens. The last few pages are devoted to an account of the geographical distribution and affinities of species, and these complete a book which, in addition to its convenient form, is to be recommended for its extremely practical and scientific value.

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.*]

Radium and the Geological Age of the Earth.

At various times since the appearance of Mr. W. E. Wilson's suggestion (NATURE, July 9) that the presence of radium in the sun might enter as an important factor in contributing to solar radiation, I had intended directing the attention of geologists to the direct application of this suggestion to the views entertained as to the extent of geological time. Absence from home led me to defer doing so.

Prof. Darwin has in a large measure anticipated my remarks (NATURE, September 24) by pointing out that the age of the sun can no longer be determined from dynamical considerations if supplies of energy from radio-active bodies go towards maintaining solar temperature. It will have to be shown, indeed, that such bodies do not enter even as a small ingredient into solar stuff (see Mr. Wilson's letter), or else that they do not retain their heat-generating properties at high temperatures. So far as experiments go—especially on the radio-active emanations—the latter contention seems improbable.

The gross dynamical supply of solar heat must no longer be regarded as affording a major limit both to solar age and geological time.

But there was one other good argument from the physical side opposed to the geological estimate of the earth's age: that derived from the observed gradient of temperature from the earth's surface inwards. Prof. Perry has pointed out (NATURE, Jan. 3, 1895) that an increase of conductivity towards the interior would lead to extension of Lord Kelvin's minor limit of time since the *Consistentior Status*. Quite equivalent to increased supplies from the interior would be a source of supply of heat in every element of the material. The establishment of the existing gradient of temperature inwards may, in fact, have been deferred indefinitely during the exhaustion of stores of radium and similar bodies at greater or shallower depths. In fact, we find these bodies here; the only question is as to how much of them exists, or at one time existed, in the earth's interior.

The remaining physical objection (that based on tidal retardation) being condemned for good reasons, it would appear that the estimates derived from physical speculations are now subject to modification in just the direction which geological data required. The hundred million years which the doctrine of uniformity requires may, in fact, yet be gladly accepted by the physicist. J. JOLY.

Trinity College, Dublin, September 26.

Some Overlooked Zoological Generic Names.

In the course of my reading, I have found a few generic names of animals which have been overlooked in the preparation of the invaluable "Index Zoologicus," recently published by the Zoological Society of London. It may be as well to direct attention to them, so that zoologists may take note of them, and avoid duplicating them for other animals. They are:—

Callobombus, Dalla Torre, Cat. Hymenop., x. p. 503 [nom. emend.].

Cephalacanthus, Lapworth, tenth Ann. Rep. U.S. Geol. Surv., p. 641 [nom. præocc.].

Fiorentinia, Dalla Torre, Cat. Hymenop., x. p. 334.

Helenia, Walcott, *Proc.* U.S. Nat. Mus., 1889, p. 39 [not Helena, Hartm., 1881].

Holmia, Matthew, 1890 (subg. of Olenellus).

Isoxys, Walcott, tenth Ann. Rep. U.S. Geol. Surv., p. 625.

Leptomitus, Walcott, *Bull.* U.S. Geol. Surv, 1886, p. 89.

Linnarssonia, Walcott, *Amer. Journ. Sci.*, 1885, p. 114.

Olenoides, Meek, *cf. Amer. Journ. Sci.*, 1888, p. 165.

Protopharetra, Bornemann, *Geol. Zeitschr.*, 1883, p. 274.

Protocaris, Walcott, *cf. Bull.* U.S. Geol. Surv., 1886, p. 148.

Protospongia, Salter, *cf. Bull.* U.S. Geol. Surv., No. 30, p. 90. [I suppose Protospongia, Kent, 1880, is different.]

Authorities will differ as to whether Helenia should be changed because of Helena. I think it should not; the difference of a letter is enough to constitute it a distinct name. T. D. A. COCKERELL.

Colorado Springs, Colorado, U.S.A.

Height of the Atmosphere Determined from the Time of Disappearance of Blue Colour of the Sky after Sunset.

THE extreme height of our atmosphere has been determined heretofore from the observation of meteors, which begin to glow when the friction becomes sufficiently intense to vaporise the materials of which they are composed. This method is very satisfactory from most points of view, and will perhaps continue to be used by astronomers. Nevertheless, I think it worth while to direct attention to another method, which is more simple, and which, I believe, will be found equally accurate. It consists in observing with the naked eye the gradual disappearance of the *blue* colour of the sky as darkness comes on. It is surprising how accurate a person of good sight can make this observation when the atmosphere is perfectly clear. The time of sunset should be noted, and the time of the last sensible blue of the sky. With the data in the Nautical Almanac a simple computation by spherical trigonometry gives the depression of the sun at the instant the blue fades out into black, and we at once calculate the height of the illuminated particles overhead. The following are the results of some observations taken by the writer at Annapolis, Md.:—

1903.	Height.	Remarks.
August 10	125 miles	A trace of blue remaining.
,, 21	130 ,,	Blue just vanishing.
,, 22	133 ,,	Sky just black.
,, 23	135 ,,	Blue has disappeared.
,, 24	132 ,,	Blue vanishing.

Average height, 131 miles.

The uncertainty of this value will probably be between five and ten miles.

The instant the blue disappears from the sky is a little indefinite, owing to the gradual thinning out of particles in the upper air sufficiently dense to reflect blue light which can be seen by the eye against a black night sky, but I have not found this indefiniteness so great as might be expected. It does not seem to lead to greater uncertainty in the height of the atmosphere than the method depending on meteors.

Prof. Newcomb, in his "Popular Astronomy," p. 397, says that, from observations taken at Richmond and Washington during the meteoric shower of November 13, 1867, "the general result was that they (the meteors) were first seen at an average height of 75 miles, and disappeared at a height of 55 miles. There was no positive evidence that any meteor commenced at a height greater than 100 miles. It is remarkable that this corresponds very nearly to the greatest height at which most of the brilliant meteors are ever certainly seen. These phenomena seem to indicate that our atmosphere, instead of terminating at a height of 45 miles, as was formerly supposed, really extends to a height of between 100 and 110 miles."

According to Lord Rayleigh's theory the blue colour of the sky is due to reflection of sun-light from minute particles of oxygen and nitrogen in the upper layers of our atmosphere. This theory receives its most striking confirmation from the long duration of the blue colour after sunset, showing the great height of the particles which scatter the blue light. There can, I think, be very little doubt that our atmosphere extends to a height of about 130 miles.

Washington, D.C., September 1. T. J. J. SEE.

The Lyrids of 1903.

BEING absent I did not see the letter on the Lyrids of 1903 at the time of its appearance in NATURE of July 23. The Lyrid maximum occurred this year, it would seem, on the night of April 22, or a day later than an important display observed by Mr. Denning on April 21, 1901. The night of April 22 happened to be overcast here. There was a fair amount of meteoric activity seen by the present

writer and other observers on the night of April 19, several brilliant meteors having been observed. If the computed time of the maximum for that night be correct, viz. 10h. 30m., it would not, of course, have been possible for observers situated near the longitude of Greenwich to witness the display in its entirety.

The Lyrid activity on the night of April 21, judging from Mr. Alphonso King's letter, appears to have been somewhat exceptional, and scarcely inferior to that observed on April 22 It may be interesting to note that the well-known continental observer, Prof. A. A. Nijland, states that the night of April 19, as well as that of April 20, was almost constantly and entirely overcast, and that not a single Lyrid was observed at Utrecht in 1903, though the night of April 21 was both clear and moonless. This negative result might have been anticipated from the forecast which appeared in NATURE last April. JOHN R. HENRY.

Dublin, September 21.

Glow-worm and Thunderstorm; also Milk.

IN the *Daily News* of July 14 is printed an observation by a Mr. Haswell, of Handsworth, which bears the marks of genuineness, that during a thunderstorm a glow-worm extinguished its light for a second or a second and a half before each flash, relighting at an equal interval after the flash. May I ask if this has been noticed by anyone else?

It may also be worth while for someone to examine whether radium can assist milk to turn sour, or can otherwise influence organic processes of that kind.

OLIVER LODGE.

ILL-HEALTH OF THE RAND MINERS.[1]

THE two official reports described in the footnote are not pleasant reading; it seems that the War Office is not the only culprit with regard to South African affairs, for the waste of life among the Transvaal miners from disease and accidents may fairly be described as appalling. But here, as in the case of the War Commission, the Briton is not afraid to wash his dirty linen in public, and for this he must be commended. The remedy for an ill will be discovered most speedily, if the symptoms are proclaimed widely and discussed freely.

The first document tells us that the death-rate among the natives employed at the mines on the Rand is 42 per 1000, which is extremely high. To see exactly what this figure means, we should compare it with the mortality rate of males of like age and occupation in this country; and no one can say that too favourable a case is taken if we choose, as a standard, the Cornish miner, who notoriously is a great sufferer from the ills which pertain to work below ground. Unfortunately, the official report does not state the mean age of the Rand miners, but it may be fairly assumed that the majority are young, and probably no great error would be made if their ages were taken as ranging from 25 to 35. In the years 1890–92 the mean annual death-rate of Cornish tin miners of 25 to 35 years of age was 8·06 per 1000, and for the men of 35 to 45 it rose to 14·32 per 1000. In brief, the death-rate of the natives employed at mines on the Rand is five times as much as that of the Cornish miners for the life-period 25 to 35, and nearly three times that of the men in the life-period 35 to 45.

The endeavour to cast some of the blame upon the natives themselves by saying that they fail to take ordinary common-sense precautions is ungenerous on the part of the author of the report. In matters of hygiene, the natives must be regarded as children and treated as such. The blame for the ill-health of the native must in the main lie at the door of the British employer. It is satisfactory, however, to learn that the present heavy death-rate on the Rand is regarded as exceptional.

The second document is a Blue-book containing the report of a Commission appointed by Lord Milner to inquire into the disease commonly known as miner's phthisis. Judging by the facts and figures brought forward, the inquiry has taken place none too soon. The Commissioners report "that the disease prevails to a very great extent, and that a high mortality is due to it." Carefully prepared medical evidence shows very plainly that the malady is silicosis pure and simple, a dust disease. The miner inhales sharp, angular particles of quartz, and these cause such irritation that the lung tissue undergoes a change and gradually becomes incapable of carrying on its respiratory functions. At the end of a few years, often only six or seven, so large a proportion of the lungs is rendered useless that the man dies. The age at death of many of the victims is only about 35 years. In the majority of cases there is no tubercular phthisis added to the silicosis. As might be expected, the men working rock drills are the greatest sufferers, and especially in places where the holes are bored upwards without any water.

The remedies suggested by the Commissioners are sprays and jets of water to prevent and keep down the dust, and some of the witnesses advocate the use of respirators, which are already being employed to a certain extent. The Commissioners are of opinion that experience is needed before deciding how water can be best applied.

Though dust is the worst evil affecting the miner on the Rand, it is not the only one. Analyses show undesirable proportions of carbonic oxide in what is called "normal mine air under ordinary working conditions." This noxious gas is generated mainly by the dynamite and other explosives, but also in some cases by heat acting upon the lubricant during the compression of the air used for working the drills. Mine-managers are often unaware of this latter source of danger. Mr. E. Hill, in a paper read before the American Institute of Mining Engineers, puts the matter very plainly by saying, "Workmen at the front, instead of receiving pure, cool air from the exhaust of the drills or other machines, breathe a foul, stupefying, and sometimes fatal, mixture."

The Transvaal Commissioners deserve much credit for the painstaking inquiry which they have made, and the lessons taught by it should be taken to heart by English mine-owners, for both Dr. Ogle and Dr. Tatham in their well-known reports have pointed out that the Cornish tin miner is a great sufferer from his dust-producing occupation.

PHOTOGRAPHY AT THE NEW GALLERY.

THE forty-eighth annual exhibition of the Royal Photographic Society is, in general arrangements, much like its predecessors, and shows very little evidence of this being the jubilee year of the Society. In the scientific and technical division the only difference that we notice is the reappearance of several exhibits that have been seen before, and the presence of a few isolated frames of examples from the Society's own collection. We understood that the Society's fine historical collection was to have been on view in its entirety, and feel much regret that advantage has not been taken of this opportunity for its display.

The fact that many of the exhibits are old and already well known gives especial value to the present

1 "Rand Mines (Native Mortality). Return of the Statistics of Mortality, Sickness and Desertion among the Natives employed in the Rand Mines during the Period October, 1902–March, 1903." Pp. 6 folio. (London, 1903.) "Report of the Miners' Phthisis Commission, 1902–1903, with Minutes of Proceedings and Minutes of Evidence." Pp. 147 folio and 7 appendices. (Pretoria, 1903.)

collection, and that value would have been much enhanced if the scientific section had been subdivided into definite sections, and the order in the catalogue had corresponded to the order on the walls, as we have previously advocated. But the student will be well repaid for the trouble that is imposed upon him of sorting out the exhibits for himself.

Telephotography, or, as we prefer to call it, large-image photography—for the only function of a telephotographic lens is to enlarge the image before it falls upon the sensitive surface, and whether the original image is small by reason of the distance of the object or because of its size makes no difference—is better represented probably than ever before. The well known "Mont Blanc," by M. Fred. Boissonnas, is on view again, also an early telephotograph by the late Prof. W. K. Burton, of interest because of its age. But the most striking and new applications of this kind of work are shown by M. Fred. Boissonnas of enlargements of telephotographs. He gives several examples in sets of three:—(1) a photograph with an ordinary lens; (2) with a telephotographic lens; (3) an enlargement of the latter, the proportional sizes being approximately as 1 : 5 : 24. Thus a measurement of one inch on the first becomes two feet on the last, and the detail, vigour and general quality of the enlargements are surprising, and demonstrate the fine quality of the image given by the telephotographic lens.

The gradual changes that take place during rapid movement or slow development are well represented by three new series. Sixteen radiographs showing the various stages in the incubation of a pigeon's egg, by Mr. M. W. Martin, enable one to trace the process very clearly, the first appearance of blood vessels and of the beak being quite marked, and the final packing of the two parts of the shell together ready for removal from the nest by the old bird fitly completes the series. Mr. Martin also exhibits a beautifully made series of forty radiographs illustrating the evolution of the common frog, appropriately finishing with an old frog which has broken its leg. The life-history of a splash is well shown by Mr. A. C. Banfield in a series of thirty-six photographs.

Colour work is not so much in evidence as it was at the last two or three exhibitions. We have no opportunity of judging whether any appreciable advance has been effected, because in no case is the original object shown with the photograph. For this reason many of these exhibits have no value, for we do not need at the present day any proof that photographs in colour can be produced.

Photomicrography is well represented. The student will probably be specially interested in Mr. Spitta's "small garden spider," ×20, taken with a 50mm. planar, as a fine example of low-power work; the fourteen photographs of test objects, ranging up to a magnification of about 4300, also by Mr. Spitta, and Mr. Albert Norman's series of photographs of different bacilli.

We have not space to do more than mention the fact that the exhibition includes astronomical and spectroscopic photographs, as fine a series of photographs from balloons as, probably, has ever been brought together, photographs of many kinds of animals, birds, reptiles, insects, fishes, flowers, and plants; photographs in mines and quarries and dark factories, illustrations of waves and ripples and lightning, and many splendid reproductions by many different processes. The science of photography itself is represented by photomicrographs of film sections by Mr. Edgar Senior, including multiple films, and a Lippmann's colour photograph showing a very large number of layers of deposit due to the stationary waves, and Mr. Watkins's demonstrations of the validity of his time method of development.

NOTES.

THE fund established by Mrs. Elizabeth Thompson, of Stamford, Connecticut, "for the advancement and prosecution of scientific research in its broadest sense," now amounts to 26,000 dollars. As accumulated income will be available in January next, the trustees desire to receive applications for appropriations in aid of scientific work. Preference will be given to those investigations which cannot otherwise be provided for, which have for their object the advancement of human knowledge or the benefit of mankind in general, rather than to researches directed to the solution of questions of merely local importance. Further particulars can be obtained from the secretary of the Board of Trustees, Dr. C. S. Minot, Harvard Medical School, Boston, Mass., U.S.A. It is intended to make new grants in January, 1904. Decided preference will be given to applications for small amounts, and grants exceeding 300 dollars will be made only in very exceptional circumstances. The following list of grants for 1902 has not previously been recorded:—125 dollars to Dr. F. T. Lewis, Cambridge, Mass., for investigation of the development of the vena cava inferior; 150 dollars to Prof. Henry E. Crampton, New York, for experiments on variation and selection in Lepidoptera; 100 dollars to Prof. Frank W. Bancroft, Berkeley, Cal., for experiments on the inheritance of acquired characters; 250 dollars to Prof. John Weinzirl, Albuquerque, N.M., for investigation of the relations of climate to the cure of tuberculosis; 300 dollars to Prof. H. S. Grindley, Urbana, Ill., for the investigation of the proteids of flesh; 300 dollars to Dr. Herbert H. Field, Zürich, Switzerland, to aid the work of the Concilium Bibliographicum (an additional grant of 300 dollars was made June, 1903); 250 dollars to Dr. T. A. Jaggar, Cambridge, Mass., for experiments in dynamical geology; 50 dollars to Prof. E. O. Jordan, Chicago, Ill., for the study of the bionomics of Anopheles; 300 dollars to Dr. E. Anding, Munich, Bavaria, to assist the publication of his work, "Ueber die Bewegung der Sonne durch den Weltraum"; 300 dollars to Prof. W. P. Bradley, Middletown, Conn., for investigations on matter in the critical state; 300 dollars to Prof. Hugo Kronecker, Bern, Switzerland, for assistance in preparing his physiological researches for publication; 300 dollars to Prof. W. Valentiner, Heidelberg, Germany, for observations on variable stars.

PROF. VON BEHRING is reported to have brought before the Medical Congress at Cassel some new conceptions regarding tuberculosis. The fundamental idea of his theory is that tuberculosis in animals and in man represents different varieties of the same disease, and that it is transferable by the agency of tuberculous milk; in these respects he is in direct opposition to Prof. Koch. He distinguishes between adults and infants, maintaining that the former may as a rule safely partake of unsterilised milk, while infants are particularly liable to infection from that source, and he holds that infection may take place many years before the disease becomes manifest. Prof. Behring is now engaged in experiments upon new-born animals with the view of testing the possibility of rendering them immune against tuberculosis by supplying them with a suitable solution of tuberculous virus in the food. He is further inclined to believe that the milk of cows which have been rendered immune contains prophylactic elements which it will be practicable to employ in the treatment of the disease in human beings.

THE death is announced of M. A. Certes, formerly president of the French Zoological Society. M. Certes carried out numerous delicate researches on bacteria, and presented several memoirs to the Paris Academy of Sciences.

ON the invitation of the leading engineering societies of the United States, it has been decided that the next autumn meeting of the Iron and Steel Institute shall be held in New York on October 24–26, 1904. After the meeting there will be an excursion to Philadelphia, Washington, Pittsburg, Cleveland, Niagara Falls, and Buffalo, returning to New York on November 10. Arrangements will also be made for a visit to the St. Louis Exhibition.

THE death is announced of Mr. John Allen Brown, who was the author of numerous papers on geological and anthropological subjects, and of a volume "Palæolithic Man in North-west Middlesex."

THE trials on the electric railway between Zossen and Marienfeld, near Berlin, have been continued during the past week, and on September 26 a speed of 118 miles an hour was attained, as against 114 miles recorded last week.

IT has been decided to hold the American Conference on Tuberculosis at Washington on April 4–6, 1905, and not at St. Louis in 1904, as previously arranged. This course has been adopted so that the American meeting shall not clash with the International Congress on Tuberculosis to be held in Paris next year.

WE learn from *La Nature* that M. Dybowski, the Inspector-General of Colonial Agriculture, has just been appointed by the Minister of French Colonies to undertake a mission to Senegal and French Guinea to study the conditions existing in these possessions with a view to future enterprise in the direction of agricultural colonisation.

THE Harben lectures for 1903 will be given under the auspices of the Royal Institution of Public Health in King's College, London, by Prof. Ferdinand Hueppe, of Prague, on October 8, 12, and 15. The subjects for the respective days are:—(1) the etiology of infectious diseases from the standpoint of natural science; (2) hygienic lessons to be derived from the serum treatment; and (3) tuberculosis.

TWO violent shocks of earthquake were felt on the night of September 22 at Blidah at an interval of three seconds. The total duration is estimated at fifteen seconds. The direction was from the south-east to the north-west. A slight shock lasting from four to five seconds was felt at Algiers at the same time. Two earthquake shocks also occurred in the Canaries on September 22, and caused cracks in the walls of several houses.

M. DE LA VAULX made a balloon ascent from St. Cloud, Paris, at 7 p.m. on Saturday, September 26, and reached Hull at 11 o'clock on the following morning. The balloon started with a favourable wind, and reached the Channel at 1 a.m. on September 27, crossed it in an hour and fifty minutes, and passed over the Thames at 5 a.m. almost midway between Greenwich and Chatham. As the balloon skirted the Wash four hours later it was evident that the wind was changing. From there the voyage to the Humber occupied an hour and fifty minutes. When nearing Hull it was seen that the journey could not be continued without danger of being blown out to sea, so a descent was made at 11.40 six miles north-east of Hull.

A COMMITTEE has been appointed by the Cunard Steamship Company to investigate the application of marine turbines to steamers, with special reference to the suitability of this class of engines for the two great vessels which are to be built under the agreement with His Majesty's Government. The Admiralty is represented by Engineer Rear-Admiral Oram, Deputy-Engineer-in-Chief of the Navy, and he will be assisted by Engineer Lieutenant Wood as secretary of the committee. Sir William White, late Director of Naval Construction, has also consented to give his assistance. Ordinary marine engines powerful enough to propel the projected Cunarders at 25 knots would be so excessively heavy that the comparative lightness of marine turbines would be a considerable advantage if their trustworthiness could be demonstrated. The questions of steam consumption and fuel economy of the turbines will also be investigated.

IN a letter to the *Times* (September 15), Mrs. Garrett Anderson, M.D., gives a valuable analysis of the data published in the "Report of the Metropolitan Asylums Board" respecting the 1901–2 epidemic of small-pox, in order to discuss the evidence there afforded upon (1) the protective influence of infant vaccination and the limits of its duration; (2) the necessity for systematic revaccination at school age; (3) the cost to the ratepayers of the method now employed. In the epidemic of 1901–2, 9659 persons were admitted to the small-pox hospitals, of whom 1663 died, equal to 17·1 per cent. Disregarding all doubtful cases, in 1901, 264 vaccinated persons under twenty contracted small-pox, of whom 175 were between fifteen and twenty, that is, they had reached an age when the protective power of infant vaccination is seriously weakened. In 1901 there were no deaths of vaccinated children, whereas there were 65 deaths of unvaccinated children under ten. In 1902 there were no deaths of vaccinated children, but 337 deaths of unvaccinated children under seven. Among vaccinated children up to fifteen years of age who contracted the disease, the mortality did not exceed 1·7 per cent. at different age periods, while among the unvaccinated it was not less than 32 per cent. From fifteen to thirty years of age the mortality is 4·8 and 30·4 per cent. respectively among the vaccinated and unvaccinated. Even up to thirty years of age the protective power of infant vaccination is, therefore, still an important factor, but is evidently waning, emphasising the need for revaccination. As regards the cost of the epidemic, Mrs. Anderson points out the great expense the ratepayers have been put to in order to provide hospital accommodation; she estimates that in Battersea every case cost 7*il.* 7*s.* 1*d.* There has to be added to this, of course, the economic loss to the community of the able-bodied through the sickness and death of those attacked.

WE have received from Mr. H. C. Russell No. 7 of his interesting current papers. We are glad to see that the number of these papers is increasing year by year. Up to October, 1902, 105 notices had been recovered, and for the last seven years the number of papers amounted to 703. One of the bottles referred to in the last paper had a drift of 29·2 miles a day; it was thrown overboard in the Socotra Sea on January 28, and found in the Gulf of Aden on February 9, having travelled 350 miles in twelve days. With one exception, this is the most rapid drift on record, so far as this series of observations is concerned. The pamphlet is accompanied by charts illustrating the drift of the bottles.

Symons's Meteorological Magazine for September contains an interesting summary of the British Rainfall Organisation on the occasion of the retirement of Mr. Sowerby Wallis, who has been intimately connected with the undertaking for more than thirty years. Most of our readers are probably aware that the system was commenced by the late Mr. G. J. Symons in 1859, by hunting up old rainfall records and the collection of actual observations. The first results were published for 1860, from the records of 168 stations. In ten years the number of stations reached 1500, and in 1890 3000 stations. Dr. H. R. Mill,

who has undertaken the sole management of the organisation, which is now recognised as of great national value, directs attention to the power of initiation possessed by the founder, as shown by the fact that the page of "British Rainfall" in 1860 hardly differed in arrangement from that at the present day, and states that in all essentials the work will be continued in the straight course which its founder impressed upon it.

In the *Physical Review* for August, Mr. Edgar Buckingham describes a simple mechanical contrivance for tracing the family of curves which represent the adiabatics of a perfect gas.

Vol. iv. part ii. of the *Bibliotheca mathematica* contains an account of the life and works of the late Prof. P. G. Tait by Mr. Alexander Macfarlane, of South Bethlehem.

Mr. Franz Kerntler, of Budapest, has published a short article dealing with the potentials of the forces between elements carrying electric currents, according to Ampère's and allied laws. It is printed by the Pester Lloyd Gesellschaft.

In the *Physical Review* for July and August, Messrs. E. F. Nichols and G. F. Hull describe experiments for determining the pressure due to radiation. In order to obtain results free from the effects due to the disturbing action of gases, (1) use was made of the most perfect reflecting surfaces to receive the radiation; (2) the action of a beam of constant intensity was studied in gases at different pressures; (3) the apparatus was arranged as a torsion balance, in such a way that the disturbing actions could in large measure be reversed; and (4) ballistic observations were made. It appears that the radiation pressure depends only on the intensity of radiation, and is independent of the wave-length, thus confirming the Maxwell-Bartoli theory within the probable errors of observation.

East African chamæleons form the subject of an illustrated article by Mr. J. L. Monk in the September number of the *Zoologist*, to which serial Mr. W. W. Fowler contributes a note on what he believes to be an unknown warbler recently observed nesting in Oxfordshire.

In the August number of the *Victorian Naturalist* Mr. W. Hopkins raises the question whether eels in Australia do not breed in fresh water. Among other facts, it is stated that in a swamp which had been dry for some months swarms of young eels made their appearance after the first rains.

In the *American Naturalist* for July Dr. C. R. Eastman records a lung-fish with a cutting type of dentition from the Permian strata of Texas. Possibly the divergence from the normal form may be correlated with a change from marine to brackish water conditions, of which there are indications in the Permian; but in any case it is very remarkable in view of the singularly uniform type of dentition presented by the lung-fishes throughout their history. The new species is named *Sagenodus pertenuis*.

The *Proceedings* of the Philadelphia Academy for June contain a description of a new species of Pleurotomaria from Japan. The shell resembles that of *P. beyrichi* in general form and characters, and if perfect would measure about 3 inches in height. To the same issue Mr. J. P. Moore contributes a long article on polychætous worms from Japan, Kamchatka, and Bering Sea, in the course of which many new forms are named and described; while in the section for July Messrs. Eigenmann and Kennedy have notes on fishes from Paraguay, accompanied by a synopsis of the American representatives of the cichlid group.

One of the most remarkable phenomena connected with Mont Pelée, in Martinique, is a gigantic plug of solidified lava which has been thrust up from the summit of the new cone of the volcano. This cone has been built up in the ancient crater-basin (the Étang Sec) to a height of 1600 feet or more, and it is now dominated by the ascending obelisk of lava, of which, through the courtesy of Prof. Angelo Heilprin, we are able to give a picture. The appearance of this mass of rock (as he tells us) was made known by Prof. Lacroix, and it calls to mind some of the pyramidated summits among the South American volcanoes. When first observed it must have been 1000 feet in height, and where implanted it has a thickness of some 300 to 350 feet. The plug has lost 180 feet, but when the photograph was taken (on June 13) it added 800 or 900 feet to the mountain, making the altitude more than 5000 feet. The obelisk terminates in a needle summit, a true *aiguille*. It is

Fig. 1.—The Ascending Obelisk of Mont Pelée. Photograph by Prof. Angelo Heilprin, June 13, 1903, taken from the rim of the crater.

gently curved in the direction of St. Pierre, and on this face it is cavernous and slaggy, giving evidence that explosions have torn away portions of the lava. On the opposite side, the surface is more solid in appearance, and there it is smoothed and even polished, with grooves and striæ, like a slickensided surface—the result, evidently, of attrition when the mass was extruded. No doubt the lava was so rapidly solidified that it was unable to flow away, moving upwards, and receiving accretions to its mass from below. Prof. Heilprin observed that the growth during a period of four days measured six metres. Previously a growth of ten metres in eight days had been recorded by M. Giraud. The volcano was too active to permit of a descent into the crater-hollow; steam and sulphur-puffs were issuing, and avalanches of rock were disrupted from the obelisk. Pelée, as remarked by Prof. Heilprin (*Science*, August 7) was still "ugly."

A new map of the world on an equal area projection has been published by Messrs. Darbishire and Stanford, Ltd., Oxford, price 6*d*. net. British possessions are coloured red,

and the principal areas where corn, rice, and other food stuffs are at present grown are indicated by shading.

MESSRS. WATTS AND CO. have published for the Rationalist Press Association, Ltd., a carefully revised, popular edition of "Supernatural Religion. An Inquiry into the Reality of Divine Revelation." The new edition runs to 920 pages, and is issued at 6s. net.

DR. ADOLF MARCUSE, Privat-docent at the University of Berlin, having taken charge of the section of geographical surveying in the "Geographischen Jahrbuch," edited by Prof. Wagner, asks astronomers, geographers, and explorers to send him papers or other publications containing results of which notice should be taken.

AT the request of teachers of chemistry in secondary schools, Messrs. J. and A. Churchill have published separately, at 2s. 6d. net, the chapters on general chemistry contained in the "Elementary Practical Chemistry" of Dr. Clowes and Mr. J. B. Coleman. In its present form the book provides a really good course of experimental chemistry, in which the broad principles of the science are gradually presented to the student.

DR. F. BASHWORTH has prepared a pamphlet of thirty pages, published by the Cambridge University Press, containing "A Historical Sketch of the Experimental Determination of the Resistance of the Air to the Motion of Projectiles." The pamphlet gives a general survey of the author's experiments and results, which have extended over many years, and for which he devised his chronograph, and shows their relationship to other investigations.

A NEW edition of Dr. Alfred Russel Wallace's book, "The Wonderful Century. The Age of New Ideas in Science and Invention," has been published by Messrs. Swan Sonnenschein and Co., Ltd. The book has been revised and largely rewritten. Among the most important changes may be mentioned the addition of a chapter on electricity, of four chapters on astronomy, and the omission of the long chapter on the vaccination question which was included in former editions. In its new form the book provides an excellent survey of the development of science during the nineteenth century.

THIS year's issue of "Chemical Handicraft," the illustrated catalogue of chemical apparatus and reagents manufactured and sold by Messrs. John J. Griffin and Sons, Ltd., is attractively arranged and very complete. Among new apparatus we notice vessels of quartz glass scheduled on pp. 45–6. These vessels may be treated in the blowpipe flame without previous warming, and, whilst hot, be plunged into cold water without being fractured. Teachers of chemistry should find this catalogue of assistance in ordering the apparatus necessary for their laboratories and lecture-rooms.

WE have received copies of the first three *publications de circonstance* of the Conseil Permanent International pour l'Exploration de la Mer, published by MM. Høst & Fils, of Copenhagen. The first booklet is a preliminary communication, by Dr. C. G. Joh. Petersen, on how to distinguish between mature and immature plaice throughout the year; the second, by M. Martin Knudsen, deals with the standard-water used in the hydrographical research until July, 1903. The third is a larger book of 107 pages, and includes ten compendious monographs on the literature of the ten principal food fishes of the North Sea, illustrated by ten plates, and preceded by a useful index.

THE Tuesday evening popular science lectures at the Royal Victoria Hall, Waterloo Bridge Road, have been the means of creating scientific interest and activity among many people who have attended them. Many men of science have given their services as lecturers at the hall, and have helped to make known the work that is being carried on there. An appeal is now being made for subscriptions to assist the committee to meet the expenditure of 3000*l.* for alterations which had to be undertaken in order to make the building fireproof to the satisfaction of the London County Council. Donations should be sent to Miss Emma Cons, honorary secretary, Royal Victoria Hall, London, S.E.

THE additions to the Zoological Society's Gardens during the past week include two Sacred Baboons (*Papio hamadryas*), two Variegated Jackals (*Canis variegatus*), two Spotted Hyænas (*Hyaena crocuta*), a Striped Hyæna (*Hyaena striata*), a Lion (*Felis leo*), a Leopard (*Felis pardus*), an Abyssinian Duiker (*Cephalophus abyssinicus*), three Somali Ostriches (*Struthio molybdophanes*) from Somaliland, presented by Mr. William Northrup McMillan; a Diana Monkey (*Cercopithecus diana*) from West Africa, presented by Mr. A. G. Turner; two Pig-tailed Monkeys (*Macacus nemestrinus*) from Java, presented by Mr. — Eussens; an Otter (*Lutra vulgaris*), British, presented by Miss Boughey; two Gold-fronted Finches (*Metoponia pusilla*) from India, presented by Mr. H. C. Harper; two Black Salamanders (*Salamandra atra*) from Switzerland, presented by Mr. W. C. Worsdell; three Indian Chevrotains (*Tragulus meminna*), nine Starred Tortoises (*Testudo elegans*) from India, a Mayotte Lemur (*Lemur mayottensis*), a Fringed Gecko (*Uroplates fimbriatus*), six Green Geckos (*Phelsuma madagascariensis*), twelve Blackish Sternotheres (*Sternothoerus nigricans*), a Sharp-nosed Snake (*Lioheterodon madagascariensis*) from Madagascar, four Angulated Tortoises (*Chersina angulata*) from South Africa, fourteen Stink-pot Terrapins (*Cinosternum odoratum*), two Prickly Trionyx (*Trionyx spinifer*) from North America, a Spiny-tailed Mastigure (*Uromastix acanthinurus*) from North Africa, three Cuban Snakes (*Liophis andrae*) from Cuba, a Merrem's Snake (*Rhadinoea merremi*) from Brazil, deposited.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN OCTOBER:—

Oct. 5. 13h. 48m. to 17h. 0m. Transit of Jupiter's Sat. III. (Ganymede).
6. Partial eclipse of the moon.
5h. 32m. Moon rises obscured by the penumbra.
6h. 7m. Last contact with the penumbra.
10. 8h. 18m. to 9h. 11m. Moon occults α Tauri (Aldebaran, Mag. 1·1).
15. Venus. Illuminated portion of disc = 0·188, of Mars = 0·907.
18. 9h. 41m. Minimum of Algol (β Persei).
,, 15h. 0m. Mercury at greatest elongation (18° 13′ W.).
,, 19h. 0m. Mercury in conjunction with moon, Mercury 1° 57′ N.
19–22. Epoch of Orionid meteoric shower (Radiant 91° + 15°).
21. 6h. 30m. Minimum of Algol (β Persei).
22. Saturn. Polar diameter = 15″·7. Minor axis outer ring = 13″·62.
24. 3h. Mars in conjunction with Uranus, Mars 1° 13′ S.
,, 12h. Venus at greatest brilliancy.
31. 7h. Jupiter in conjunction with moon, Jupiter 3° 39′ S.

REPORT OF THE PARIS OBSERVATORY FOR 1902.—In his report of the Paris Observatory for 1902, M. M. Lœwy, the director, describes in detail the various important series of observations made at that observatory.

In announcing that the last two volumes of the "Catalogue de l'Observatoire de Paris" are ready for publication, M. Lœwy gives a detailed account of the circumstances which led to the inception and prosecution of the work necessary for the publication of such a complete stellar catalogue.

For the determination of the latitude of the Paris Observatory, 6530 measures of the absolute polar distances of fundamental stars were made with the large meridian circle during the year, and, in accordance with Sir David Gill's proposals, 5063 observations of reference stars for the astrographic chart were made.

The observations for the redetermination of the difference of longitude between Paris and Greenwich were completed, and the concordance between the observations of the Paris and Greenwich observers in the first series, which has been completely reduced, is very striking.

504 photographs of the moon for the "Atlas Photographique de la Lune," of which the sixth section has been published, were taken with the large equatorial coudé. A 6-inch grating, for use with the smaller equatorial coudé, has been ordered from America, and when this is received it is proposed to carry out, systematically, similar researches in solar physics to those which are already prosecuted in England and America.

In connection with the "International Astrographic Chart and Catalogue" fifty-six plates for the chart and twelve for the catalogue were secured; the printing of the catalogue for zone +24° was completed, and it contains the positions of 64,264 stars, whilst the publication of zone +23° was commenced and the section 0h. 4m. to 6h. 20m. completed. Altogether the positions of 21,855 stars were completely measured for the catalogue, and the magnitudes of 35,630 stars belonging to zone +23° were determined during 1902.

THE RIGIDITY OF PIERS FOR MERIDIAN CIRCLES.—In No. 3902 of the *Astronomische Nachrichten*, Prof. G. W. Hough, of the Dearborn Observatory (U.S.A.), discusses in detail the relative merits of brick and stone piers as supports for meridian circles. It will perhaps be remembered that in the last report of the superintendent of the United States Naval Observatory it was stated that since the substitution of a brick pier for the marble pier that was formerly used, the previously reported changes in azimuth of the 6-inch Repsold meridian circle had entirely disappeared. The experience of Prof. Hough is opposed to the principle contained in that statement, viz. that brick piers are superior to stone for this purpose.

By a table of comparative expansions he shows that those of granite, sandstone, &c., approximate more nearly than that of brick to the expansion of iron, and therefore, with iron fastenings, a stone pier will ensure a greater rigidity of the instrument in regard to the pier; from the same table it is seen that brass fastenings are far more likely to produce lack of rigidity than those made of iron.

RECENT PAPERS ON METEORITES.

THROUGH the courtesy of Prof. Henry A. Ward, of Rochester, New York, we are able to reproduce for our readers a photograph which gives a good idea of the form and dimensions of the large mass of meteoric iron lying at a place called Ranchito, near Bacubirito, in the province of Sinaloa, Mexico. The existence of the mass was made known to the scientific world by Prof. Barcena more than a quarter of a century ago, and, later, its dimensions were recorded by Prof. Castillo; but until after the visit of Prof. Ward there had been no published information as to the particulars of the occurrence. Prof. Ward, who is greatly interested in meteorites, travelled from the city of Mexico to Bacubirito, an extremely long, arduous, and expensive journey, for the special purpose of examining the meteorite *in situ*. It was found by him to be lying at the place specified, but to have only one end projecting from the ground. Twenty-eight labourers were employed by him to excavate round the mass and make it possible to determine the complete form. After two days' work not only had this been done but, through removal of the support from one side, the large mass had been made to turn itself over. It is 13 feet 1 inch long, 6 feet 2 inches wide, and 5 feet 4 inches thick. Its irregularity of form and the character of the surface are manifest from Fig. 1. The mass is estimated to weigh

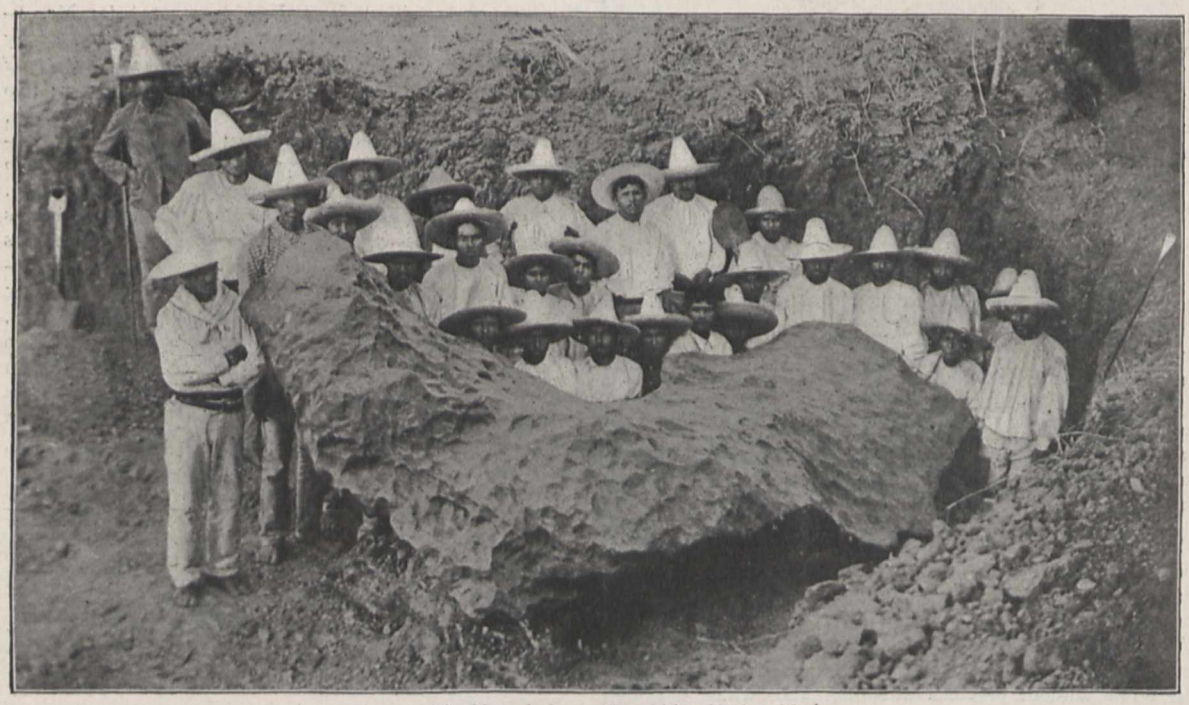

FIG. 1.—The Meteoric Iron of Bacubirito, Sinaloa, Mexico.

50 tons (the specific gravity having been determined to be 7·69), and it is probably at least as large as the big mass brought some years ago from Greenland to the United States by Lieutenant Peary. After these two, the next largest known meteorite in the world is that of Chupaderos, which has lately been removed to the city of Mexico and found to weigh 15⅔ tons. A polished face of the Bacubirito iron, when etched, shows very distinct Widmanstätten figures. According to a chemical analysis made by Prof. Whitfield the percentage of nickel (and cobalt) is 7·2. The time of fall of the mass is unknown. The meteorite is described by Prof. Ward in the *Proceedings* of the Rochester Academy of Science (vol. iv. p. 67, 1902).

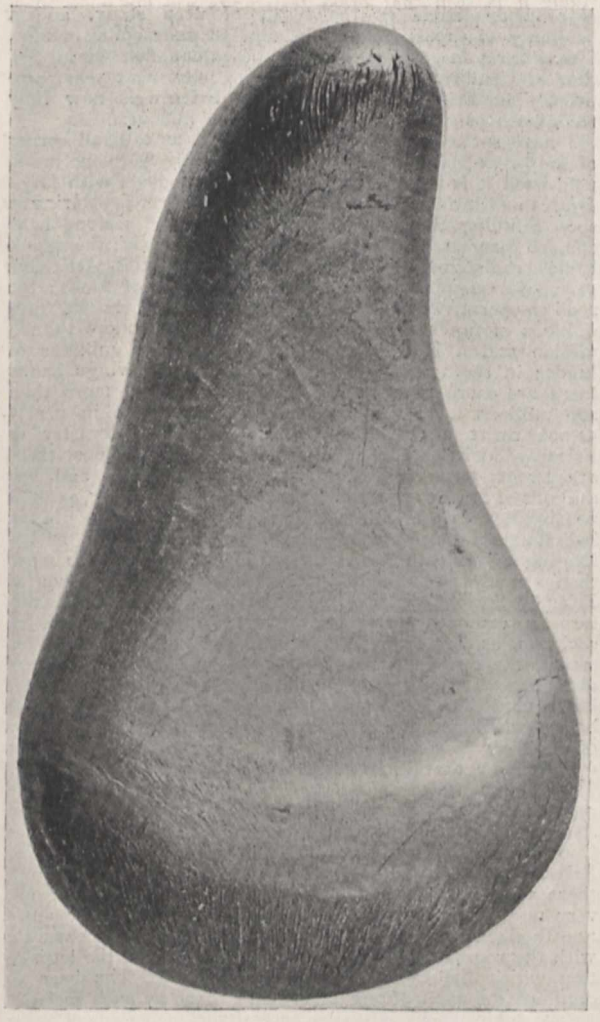

FIG. 2.—The Boogaldi meteorite, N.S.W. Showing "drip" from the underside, tail end. Length 5 inches, width 3 inches; weight 2057·5 grms. Sp. gr. 7·85.

In the *Journal* and *Proceedings* of the Royal Society of New South Wales, vol. xxxvi. pp. 341–359, Prof. Archibald Liversidge, F.R.S., of Sydney, gives descriptions of four meteorites, all from New South Wales, one of them a meteoric iron, the other three meteoric stones. The meteoric iron, though not actually observed to fall, was found shortly after that event; it was noticed in January, 1900, that the ground had been torn up on a hard ridge near Boogaldi Post Office; the furrow was followed, and a small pear-shaped mass of iron was found slightly embedded in the ground; it had come from the north-west, and its path must have been inclined at only a small angle to the horizon. It weighed 4½ lb., and has a specific gravity of 7·8. The surface is formed by a skin of fused oxide, which has been arranged in waves with transverse furrows by the motion through the air (Fig. 3); part of the fused oxide has accumulated at the thin end of the meteorite, and part of it has doubtless been blown off at that part (Fig. 2). A polished section, when etched, shows well-marked Widmanstätten figures; only one or two specks of troilite are visible on the etched face. Chemical analysis of the metallic sawdust obtained on cutting the meteorite shows that the nickel and cobalt amount to 8·5 per cent. In addition to the chemical elements normally present in meteorites, Prof. Liversidge found small quantities of arsenic, gold, and either platinum or some other member of the platinum group.

The places of fall of the meteoric stones were (1) Barratta, near Deniliquin; (2) Gilgoin, near Brewarrina; (3) Eli Elwah, near Hay; the falls were not actually observed. The stones are all remarkable for their size. In the case of Barratta, about 2 cwt. had been found on a previous occasion many years ago; two other stones have lately been found weighing 31½ lb. and 48 lb. respectively. The Gilgoin stones weigh 67½ lb. and 74¾ lb., and the Eli Elwah stone 35½ lb. All these stones have a chondritic structure; the specific gravities range from 3·39 to 3·86. The paper is illustrated with no fewer than twelve plates.

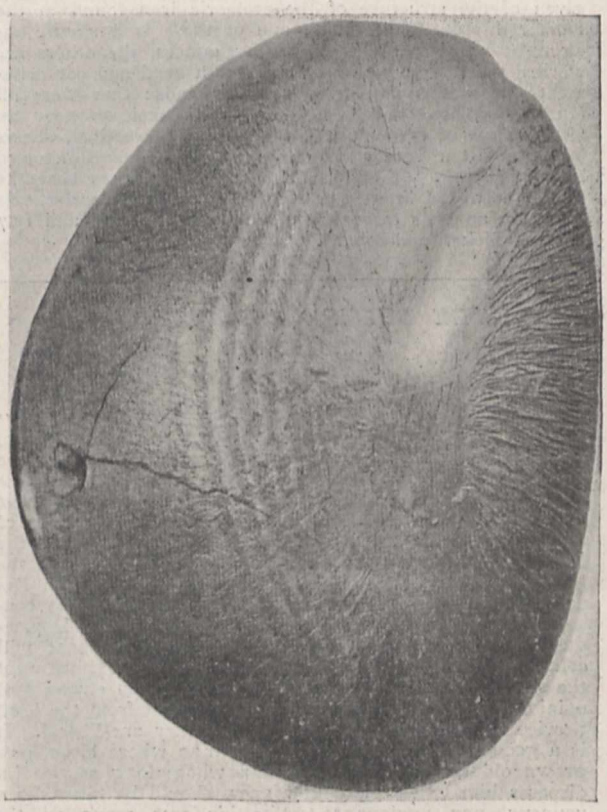

FIG. 3.—The Boogaldi meteorite, N.S.W. Showing waves formed in the fluid skin at the forward end; the right hand side was the lower one during flight. Enlarged two diameters.

In the *Publications* of the Field Columbian Museum (Geological Series, vol. i. pp. 283–315) Dr. O. C. Farrington gives an account of various meteorites. The first of them is from Long Island, Phillips County, Kansas, of the structure of which Dr. Weinschenk gave a minute description several years ago. The meteorite, which belongs to the chondritic kind, was not observed to fall, and must have been in the ground some time before it was found. Fragments having a total weight of 1244 lb. have been recovered; it is therefore the largest meteoric stone which has yet been met with. The larger fragments can be closely fitted together, and the original form of the mass is thus reproduced. The directive character of the pittings and furrows is very suggestive of the exterior of the Goalpara stone.

Chemically, the meteorite is remarkable for its high percentage (6·3) of chromium sesquioxide. Dr. Farrington suggests that a small portion may be present as a constituent of the olivine, and the rest as part of the chromite. The author next enters into a discussion of the relations of the various meteoric stones which have been found in Ness County and other parts of north-western Kansas; he infers that Prairie Dog Creek, Long Island, Oakley, Jerome, and Franklinville belong to distinct falls, and that Wellmanville may be part of the Franklinville fall, and Kansada part of either the Franklinville or the Jerome meteorite. Another meteorite described is one from Los Reyes, forty miles from Toluca; this is an iron, and its characters are similar to those of other masses found nearer Toluca; there is no reason to believe that the mass has been transported by man from the latter locality. The Los Reyes mass may belong either to a distinct fall or indicate a wide spreading of the Toluca shower. In the same paper an account is given of the structure of the meteoric iron found in the Hopewell Mounds of Ohio; one of these is a small, unwrought mass weighing about five ounces, the others are worked specimens, namely, a part of a head and ear ornament, some celts, and a number of beads; they were all found associated with a single human skeleton near an altar of one of the mounds; the iron, when etched, shows Widmanstätten figures, which have been bent and distorted by hammering. Finally, Dr. Farrington states that the tænite extracted from the Kenton County meteorite was found on analysis to consist of 80·3 parts of iron and 19·7 parts of nickel (and cobalt).

THE BRITISH ASSOCIATION.

SECTION F.

ECONOMIC SCIENCE AND STATISTICS.

OPENING ADDRESS BY EDWARD W. BRABROOK, C.B., F.S.A., V.P.S.S., PRESIDENT OF THE SECTION.

IT is a coincidence, which has great interest for me personally, that the honour of being President of this Section has fallen to me in the last year of my engagement in the public service. I am now in the sixty-fifth year of my age and the thirty-fifth of my connection with the Registry of Friendly Societies, and in a few months the guillotine of the Order in Council will fall, and the Department and its present head will be severed. The consequences are not so tragic as they sound, for the Department will at once find a new head, and the old head will contrive to maintain a separate existence. I therefore meet the stroke of fate with cheerfulness; for I am strongly of opinion that the arrangements for retirement from the Civil Service of the country are as wise as they are liberal. It is a good thing that the place of a man whose ideas have grown old and become fixed, and whose long service indisposes him to entertain new ones, should be taken by a younger man anxious to make his own mark on the administration of his department. Again, the prospect of promotion opened up by the limited term of service of the older men is a distinct inducement to able and ambitious young men to devote themselves to their country's service. I have lately had occasion to give minute and careful attention to one branch of this important question, and the study of the whole subject which has thus been rendered necessary has strongly confirmed the conviction I previously entertained that the system of retirement which now prevails greatly tends to promote the efficiency of the Civil Service and the interests of the country. I do not apologise for saying this much on a subject into which I was led by an observation that concerns me personally, for the means of securing efficiency in the public service is an important economic question.

The coincidence to which I refer tempts me to choose as the principal subject of the Address which I am permitted and enjoined to deliver to the Section on this occasion that small corner of the great field of Economics in which I have been a day labourer for so long, and I am not able to resist the temptation. My piece of allotment ground, if I may so call it, is that which is devoted to the cultivation of thrift, or of economy in the popular rather than the scientific sense. The temptation is strengthened by the circumstance that that subject has rarely been treated by my predecessors. Sir Robert Giffen in his Address of 1887 referred to it, and Sir Charles Fremantle in 1892 treated it at somewhat greater length. In old times, when the Chair of this Section was more frequently occupied by the practical statesman than by the professed economist, there were passing allusions to it by Henry Fawcett in 1872, William Edward Forster in 1873, and Sir Richard Temple in 1884; but in more recent years the accomplished economists who have presided over this Section, notably my immediate predecessor, have delivered luminous and memorable Addresses on the broad principles of Economics, the application and potency of its doctrines, and their serviceableness to mankind, with a comprehensiveness of view that is only attainable as the result of deep study, and a brilliancy of exposition that belongs to philosophic insight. I may here, in passing, express the satisfaction we all feel that at Cambridge, where we are to meet next year, proficiency in Economics and Political Science is now fully recognised as qualifying for academical honours.

I have spoken of the subject of Thrift as a small corner of the great field of Economics; and relatively to the broad field itself it is so; but it is a subject that deals with large figures and intimately affects large numbers of people. The 2000 Building Societies in Great Britain and Ireland have 600,000 members and sixty-two millions of funds; the 28,000 bodies registered under the Friendly Societies Act have 12,000,000 members and forty-three millions of funds; the 2000 co-operative societies have 2,000,000 members and forty millions of funds; the 600 trade unions have more than a million and a half members and nearly five millions of funds; in the 13,000 Post Office and other savings banks there are more than 10,000,000 depositors and more than 200 millions invested; so that upon the whole in nearly 50,000 thrift organisations with which the Registry of Friendly Societies has, in one form or other, to deal there are twenty-seven millions of persons interested and 360 millions of money engaged. These figures, however, possess no significance other than that they are very big. Many individuals are necessarily counted more than once, as belonging to more than one society in one class, or to more than one class of societies. Some portion of the funds of Friendly Societies is invested in savings banks, and therefore is counted twice over. Some of the co-operative societies, as, for example, the wholesale societies, have for capital the contributions of other societies, which thus are also counted twice over. On the other hand, the aggregate, large as it is, is necessarily defective. It includes only bodies which are brought into relation with the Registry of Friendly Societies in one or other of the functions exercised by that department. It does not include, therefore, many co-operative and other bodies which are registered under the Companies Act, nor the Industrial Assurance Companies which are regulated by the Assurance Companies Act, nor does it include the great body of Friendly Societies which are not registered at all. Among these shop clubs hold a prominent position, and these are very numerous. The Royal Commissioners of thirty years ago thought that the unregistered were then commensurate with the registered bodies; and as one result of the legislation which the Commissioners recommended has been to diminish the applications for registry made by such societies as are subjected by it to the necessity of a periodical valuation of assets and liabilities, there seems no reason to think that unregistered societies are relatively now any fewer than they were then.

It would seem, then, that the figures we have cited are well within the mark, and that, used for the mere purpose of indicating the magnitude of the interests involved, they may be relied upon as not over-estimating it. The observation just made leads to the question, why should there be so many unregistered societies? Why, indeed, should there be any unregistered societies? The National Conference of Friendly Societies, which consists wholly of registered bodies, has just passed a resolution recommending the enactment of a law that all societies should be compelled to register. Why not? I think it will not be difficult to find the real answer to these questions. It was given as long ago as 1825 by a Committee of the House of Commons in these wise words:—"It is only in consideration of advantages conferred by law that any restrictive interference can be justified with voluntary associations established for lawful

and innocent purposes. It is for the individuals themselves to determine whether to adopt the provisions of the statute, which offers them at the same time regulation and privilege, or to remain perfectly unfettered by anything but their own will, and the common or more ancient law against fraud or embezzlement," which common or more ancient law was strengthened in 1868 by the Act known as Russell Gurney's Act. "For your Committee apprehend that although the Act of 1793 appears to begin by rendering lawful the institution of Friendly Societies, there neither was at that time nor is now any law or statute which deprives the King's subjects of the right of associating themselves for mutual support."

Upon this principle the Legislature has hitherto proceeded. Registration is voluntary. The subscriptions of the members are voluntary. The conditions of membership are such as the rules framed by the members themselves impose. They have full authority to alter those rules from time to time. Those conditions may, if the members so please, imply that the subscriptions are to be small and the benefits large. They may provide for investment of funds on any security they think fit so long as it is not personal security. They may provide for the periodical division of the funds so long as they make it clear that all claims existing at the time of division are first to be met. Up to this point the registered society and the unregistered are hardly distinguishable. What, then, are the obligations consequent upon registry? There is the making an annual return and the making a quinquennial valuation; but the action to be taken by the society upon the result of the valuation is wholly in the discretion of the members. The valuer may demonstrate beyond doubt that the society in order to save itself from disaster must increase the subscriptions of the members or diminish their benefits; but neither he nor the Registrar can enforce the recommendation. The society has its destinies wholly in its own hands. Then, again, the Act contains certain provisions for the protection of members. Individual members have the right to inspect the books of the society, to receive copies of its balance sheets and valuations, and so forth. A certain number of the members have the right to apply to the Registrar to appoint an inspector into the affairs of the society or to call a special meeting of the members. The inspector can only report—there is no action which the Registrar can take upon his report if the members disregard it. The special meeting will in no way differ from an ordinary meeting called by the society itself, except that it may choose its own chairman. The Registrar cannot in any way control its proceedings. Even these things he cannot do of his own motion without being set in action by a competent number of the members. If a society becomes insolvent, members may in like manner apply to him to wind it up: he may see that a readjustment of contributions and benefits would set the society on its legs again, and may suspend his award of dissolution to enable the society to make that readjustment, but he can do no more. If the society refuse to make it, he has no option but at the end of the period of suspension to issue the award. Here again he may have the fullest knowledge that a society is hopelessly insolvent, yet he can do nothing unless a competent number of the members call in his aid. I confess that I think the Legislature might have gone further in this respect and conferred upon the Registrar, or at any rate upon some public authority, the power to deal compulsorily with cases of hopeless insolvency, and if necessary to appoint a receiver, as such cases are not infrequently complicated with fraud carried on in circumstances which make it difficult for a competent number of the members to join in an application to the Registrar. However that may be, taking the legislation as it stands, it embodies to the fullest extent the principle laid down by the Committee of 1825.

The surrender of freedom which a Friendly Society is called upon to make in order to obtain the privileges of registry, which are not inconsiderable, is therefore exceedingly small; yet it is sufficient, as we have seen, to keep out of the registry office a large number of societies. It seems not improbable, looking back on the history of legislation on the subject—and the observation is a curious one—that unwillingness to register has been closely connected with actuarial considerations. Thus, in the year 1819, an Act was passed which provided, among other things, that the justices should not confirm any tables or rules connected with calculation until they had been approved by two persons at least known to be professional actuaries or persons skilled in calculation; but that was repealed in 1829. Again, in 1846 an Act was passed which provided, among other things, that every registered society should make a quinquennial valuation; but that was repealed in 1850 before a single quinquennial period had arrived. It was not until a quarter of a century after 1850 that this most salutary provision again found a place in the statute book, and the experience of the last twenty-eight years has shown how valuable it is, and how much it is to be regretted that the Act of 1846 was not allowed to remain in force. Again, the Act of 1850 provided for the discrimination of societies into two classes: those which were simply registered and those which were certified. These latter were to obtain the certificate of a qualified actuary that their tables of contribution were sufficient for the benefits they proposed to insure. Very few certified societies were established, and that Act was repealed in 1855. The experience of the Legislature has not been favourable therefore to endeavours to impose upon Friendly Societies by Act of Parliament conditions of actuarial soundness.

If, however, the voluntary principle is abandoned, and all societies are to be compelled to register, it is obvious that there must be a recurrence to the policy of imposing such conditions. At present a registered society may be as unsound as it pleases, and so may an unregistered society. Unless registry is to imply something more than that, there can be no reason for any compulsion to register. For what does compulsion mean? It means prosecuting, fining, and sending to prison all persons who associate themselves together for the lawful and innocent purpose of mutual support in sickness and adversity without registration; and that, obviously, cannot reasonably be done unless abstinence from registration is shown to be a moral offence; that is to say, unless the conditions of registration are such that a registered society shall be necessarily a good one, and an unregistered society necessarily a bad one. We must begin, at any rate, by devising model tables and insisting that every society shall adopt them. Are they not ready to hand? Did not my lamented colleague, Mr. Sutton, prepare a Blue Book of 1350 pages full of them? That is true; but it is also true that in the brief introductory remarks which he addressed to me at the beginning of that report he observed, with great force, that the adoption of sufficient rates of contribution is not enough to secure the soundness of a society. Those rates are derived from the average experience of all classes of societies—some exercising careful supervision over claims for sick pay, others lax in their management—and it is upon care in the management, rather than upon sufficiency of rates, that the success of a Friendly Society mainly depends. If the members administer the affairs of their society with the same rigorous parsimony and watch over the claims for sick-pay with the same vigilance which a poor and prudent man is compelled to exercise in the administration of his own household affairs, the society will be more than solvent, even though they do not pay as high a contribution as the model tables exact. If they neglect these precautions, there is no model table which will rescue them from ultimate insolvency. In Mr. Sutton's happy phrase, it is the personal equation of the members and of their medical adviser that tells the most on the prosperity or the failure of a society. Your compulsory registration will impose unfair conditions on the well-managed societies, and will do nothing to prevent the inevitable collapse of those which are badly managed. Registration tells for a great deal while it is voluntary and free; but if you make it compulsory, and add to it conditions that you suppose will tend to soundness, you will inevitably do more harm than good. It is, of course, of vital importance that adequate rates of contribution should be charged for the benefits proposed to be ensured; but if these are imposed by authority, the management of the societies must also be undertaken by the same authority. It is a curious observation, which has been borne out by experience, that in poor societies the claims for sickness are relatively less than in rich ones. M. Bertillon, the eminent French statistician, has shrewdly remarked: "The truth is, that friendly societies, when they grant sick-pay, attach less weight to the text of their rules than to the state of their funds. If the society is rich, it grants relief

more freely than if it is poor. Thence, and thence only, it comes that the great English societies, which are often very old and generally rich, give more days' pay than the French societies, for example, which are bound to a rigorous economy." Without necessarily assenting to all that M. Bertillon says, it is easy to see that if the State were unwise enough to say that such-and-such rates would be sufficient, it would encourage laxity of management, and accept a responsibility that does not belong to it.

I may now proceed to show that the present voluntary system, unscientific as it may be supposed to be, works very well on the whole. Its most useful feature is the valuation, for a society which disregards the lessons of one valuation finds itself pulled up sharply by the results of a second. A deficiency that is frankly faced by an increase of contributions, a reduction of benefits, or a levy, or by all three together, will probably not only disappear, but be succeeded by a surplus; but a deficiency that is disregarded not only grows at compound interest, but increases by the continued operation of the causes which produced it. It is to be remembered that a valuation deficiency or surplus, as the case may be, in a Friendly Society is always hypothetical. It means this in the case of deficiency—if you go on as you are going and do not modify your contracts you will ultimately be in a deficiency of which this is the present value. In the case of surplus it means—if you go on as you are going and do not allow your prosperity to tempt you to recklessness you will probably have enough to meet all your engagements, and this much over together with its improvements at interest.

When Friendly Societies are considered in their economic aspect, they appear to be an excellent application of the principle of insurance to the wants of the industrial community. Sickness may come upon a working man at any time, and may disable him from work for an indefinite period. In such an event, if he had nothing to rely upon but his own savings accumulated while he was at work, they would before long be exhausted, and he would be left in distress. By combining with a number of others who are exposed to the same risk, he can fall back upon the contributions to the common fund which have been made by those who have escaped sickness. It is an essential part of every contract of insurance that the contributions of all who are exposed to an equal contingent risk are equal; but the benefits are only derivable by those of the number in whose experience the contingent risk becomes actual, and they receive more than they have paid, the deficiency being made up out of the contributions of those who have escaped the contingent risk.

This really seems too elementary a proposition to be worth stating, but it is the fact that the principle of insurance is so little understood that many members of Friendly Societies look upon themselves as having performed an altruistic and charitable act in joining a society when they have been fortunate enough not to make claims upon it through sickness. Several intelligent witnesses before Lord Rothschild's Committee on Old-age Pensions, representing large and well-managed societies, actually urged upon the Committee that the members of Friendly Societies were more deserving of old-age pensions than other people because they subscribed for the benefit of others and not of themselves.

Another economic point of view in which Friendly Societies call for consideration is that of their relation to the Poor Law. The old Act of 1793, which was the day of elaborate preambles to statutes, affirmed that the protection and encouragement of such societies would be likely to be attended with very beneficial effects by promoting the happiness of individuals, and at the same time diminishing the public burthens. The public burthen at which this was pointed was no doubt the Poor Law, which was then administered in a very different manner from that which has prevailed since the great reform of 1834, and one of the items of encouragement which the Legislature provided for the societies was that their members should not be liable to removal under the Poor Law until they had actually become chargeable to their respective parishes. This exemption was no doubt of great value at that time, when the law of settlement bore very severely upon the poor.

It appears to me that the proper relation of the Friendly Societies to the Poor Law is a negative one. The main object of the societies should be, as indeed it is, to keep their members independent of the Poor Law. They have done so with great success. The returns which have more than once been presented to Parliament of persons receiving relief who are or have been members of Friendly Societies have frequently been shown to be untrustworthy. The number of actual members of such societies who seek relief is small absolutely, and still smaller relatively to the population. It was therefore not without regret that I observed the passing of an Act in 1894 which empowered Boards of Guardians to grant relief out of the poor rates to members of Friendly Societies, and if they thought fit to exclude from consideration of the amount of relief to be granted the amount received by the applicant from his Friendly Society. That Act has just been followed in the natural course of events by a bill for taking away from the Guardians their discretion in the matter, and requiring them to grant full relief to the applicant in addition to the weekly sum, not exceeding five shillings, which he receives from his Friendly Society. In other words, they are to provide a pauper who is a member of a Friendly Society with a free income of five shillings a week more than they would grant as adequate relief to a pauper who was not a member of a Friendly Society, however deserving in other respects that pauper might be. Poor-law relief, instead of being a painful and deplorable necessity, is elevated into a reward of merit in the one case, in which that merit has been displayed by joining a society. A kind of old-age pension is provided for the member, but instead of being an old-age pension without the taint of pauperism, it is a condition of obtaining it that the man must become a pauper. This seems to me to be topsy-turvy legislation. The very bodies the aim and proud boast of which it should be that their members never are paupers have been contented to claim for their members the rank of privileged paupers.

The discussion of the subject of old-age pensions which has now been proceeding for the last twelve or thirteen years has had one good effect in bringing under the consideration of the Friendly Societies the practical methods by which they can obtain these pensions for themselves. The impression that some day and somehow the State would provide pensions for everybody, or at least for everybody who is thrifty, has had a bad effect; but the wiser members of the societies have seen that it would be a good thing to substitute for their present plan of continuing sick-pay to the end of life a plan of insuring a certain annuity after a given age. For this purpose they have had to overcome a natural reluctance on the part of the members to lock up their savings in the purchase of deferred annuities, and they have done so with some success, several thousands of persons having agreed to subscribe for these benefits. It is anticipated that the report of Mr. Alfred Watson on his investigations into the sickness experience of the Manchester Unity of Oddfellows will add force to this movement by showing how great a burden old-age sickness at present is, and how slight an additional sacrifice would secure a deferred annuity. It need hardly be said that it is more desirable that the members generally should do this for themselves than that they should get the State to do it for them.

Registered Friendly Societies are becoming more popular and more wealthy under the present system. The number of returns from societies and branches increased from 23,998 on December 31, 1891, to 26,431 on December 31, 1899, and 27,005 on December 31, 1901; the number of members from 4,203,601 to 5,217,261 in eight years, and to 5,479,882 in ten years; the amount of funds from 22,695,039*l.*, or 5*l.* 8*s.* per member, to 32,751,869*l.*, or 6*l.* 5*s.* 6*d.* per member, after eight years, and 35,572,740*l.*, or 6*l.* 9*s.* 9*d.* per member, after ten years. It is necessary to observe, however, that some of the numerical increase is due to greater completeness in the later returns. The increase in ratio is not affected by this. It may be worth noting that, on the average, the proportion of members under fifty years of age to those above that age is as 81 to 19; and that of the total aggregate receipts per annum, 73 per cent. goes in benefits, 11 per cent. in management, and 16 per cent. is added to capital. The average annual contribution per member is 1*l.* 1*s.* 6*d.*

Up to this point I have referred merely to the Friendly Society of the ordinary type, the sick club and burial fund. Societies of the collecting group, while registered under the

Friendly Societies Act, are also regulated by a separate Act, and it is convenient therefore to consider them apart. They insure burial money only. They are only 46 in number, having increased from 43 in 1891. They have as many as 6,678,005 members, an increase from 5,922,615 in 1899 and 3,875,215 in 1891; but among these each individual above the age of one year in every family is counted separately, and the majority, therefore, are young children. Their funds are 5,973,104*l.*, or 17*s.* 11*d.* per member, having increased from 5,207,686*l.*, or 17*s.* 7*d.* per member, since 1899, and from 2,713,214*l.*, or 14*s.* per member, since 1891. These societies therefore show progress like the others.

The collecting societies do a similar business to that of the Industrial Assurance Companies, of which the Prudential is the type. Their ostensible reason for existence is to answer that instinct of human nature which makes even the poorest desire that the burial of the dead should be attended with some degree of ceremony; but strong as that instinct may be, it does not prompt the poor to seek out the office of the society and pay their premiums there. They have to be solicited by canvassers and waited upon by an army of collectors at their own homes; and the maintenance of this army and the general cost of management absorb nearly half the contributions, so that the poor insurer pays double the net price for his insurance. There is reason to believe, moreover, that these societies are largely used for speculative insurances by persons who have no real insurable interest in the lives insured. So long ago as 1774 an Act was passed for the purpose of checking this sort of gambling in human life; but as it only makes the policy void, the insurer takes the risk of the society repudiating the contract, knowing that its doing so would discredit it and spoil its business.

A number of other classes of societies are capable of being registered under the Friendly Societies Act, such as cattle insurance societies, benevolent societies, working men's clubs, and societies for any purpose the registry of which the Treasury may specially authorise. The formation of cattle insurance societies on a large scale was contemplated by an Act of 1866, when the cattle plague was at its height; but in practice only small pig clubs and similar societies in Lincolnshire and the neighbouring counties have been registered under this head. Benevolent societies are defined as societies for any benevolent or charitable purpose, and might therefore comprise all the charitable institutions of the United Kingdom, but in fact the registered benevolent societies are few. Working men's clubs—frequently called working men's clubs and institutes—were first brought under the operation of the Friendly Societies Act of that day by Sir George Grey as Secretary of State in 1864, and were then societies for purposes of social intercourse, mutual helpfulness, mental and moral improvement, and rational recreation. They are still so defined by law; what they are in fact has been revealed by the provisions of the Licensing Act, 1902, as to the registration of clubs. Rules have been submitted to the Registry Office, and we have been advised that we have no discretion to refuse to register them as rules for carrying out the excellent purposes just defined, providing for the supply of intoxicating liquors to members and their friends at hours when the ordinary licensed houses are compulsorily closed, for keeping the club open every night until midnight, and on nights when there are balls until six o'clock in the morning, and for other incitements to intemperance. I hope that it will not be long before an enactment is passed that the registry of a club under the Licensing Act shall vacate its registry under the Friendly Societies Act. Such clubs have nothing to do with thrift or with insurance; they are rather instruments of extravagance, improvidence, and dissipation.

Some of the specially authorised purposes are also wide of the mark, which upon the *ejusdem generis* rule should, I think, be pointed with strictness in the direction of provident insurance; but there has always been a desire liberally to extend the benefits of the Friendly Societies Act with a view to the encouragement of societies having praiseworthy objects which for want of means or some other reason are not registered as companies. The large majority of specially authorised societies are Loan Societies, and though these may in some cases be fairly good investments for those who lend, they are of doubtful benefit to those who borrow. An exception must be made to this statement with respect to the Agricultural Credit Societies, many of which have been established in Ireland by the exertions of Sir Horace Plunkett, and have been pecuniarily assisted by the Congested Districts Board. It is a feature of these societies that they not only lend money to the small farmer, but see that he spends it on improvements to his farm; and also that there is no division of profit among the members.

The returns from all societies under the Friendly Societies Act other than Friendly Societies proper increased from 557 in 1891 to 1308 in 1899, and 1449 in 1901; the number of members from 241,446 in 1891 to 610,254 in 1899, and 649,491 in 1901; and the amount of funds from 594,808*l.* in 1891 to 1,528,064*l.* in 1899, and 1,686,656*l.* in 1901. Here, again, great allowance has to be made for the want of completeness in the returns of the earliest date.

Allied to Friendly Societies, but having special regulations under other Acts, are shop clubs and workmen's compensation schemes. In a vast number of large industrial establishments the men have their own sick club, sometimes assisted by the employer; and in a few the employer makes it a condition of employment that every workman shall join the club. Where this is done it is now enacted, not only that the club shall comply with the requirements of the Friendly Societies Act as to registry, but also with other conditions of more stringency. As yet only a few clubs have been able to satisfy all the requirements of the Shop Clubs Act, 1902. The workmen's compensation schemes provide an alternative to the general scheme of compensation to injured workmen contained in the Act of 1897, and have enabled the employers and workmen in several large industries to enter into mutual arrangements by which the workman gains an equivalent to the compensation which the Act would give him, and enters into partnership with the employer for obtaining other benefits. According to the returns, these schemes have hitherto resulted very favourably to the workmen, and it seems a pity there are not more of them.

The sentiment of which I have spoken, that it is desirable to extend the benefits of the Friendly Societies Acts to societies for good objects, even though those objects may not be purposes of provident insurance, is expressed in the statute of 1834, which allowed of "any purpose which is not illegal," and in that of 1846, in which the definition of a Friendly Society was made to include the frugal investment of the savings of the members for better enabling them to purchase food, firing, clothes, or other necessaries, or the tools, implements, or materials of their trade or calling, or to provide for the education of their children or kindred. Under these Acts the Rochdale Equitable Pioneers and a number of other Co-operative Societies were registered, and in 1852 an Act was passed specially dealing with these bodies under the name of Industrial and Provident Societies. They were made corporate bodies by an Act of 1862, and are now regulated by the Industrial and Provident Societies Act, 1893. The societies that may be registered under that Act are societies for carrying on any industries, businesses, or trades specified in or authorised by their rules, whether wholesale or retail, and including dealings of any description with land.

This definition indicates pretty clearly the manner in which Co-operative Societies have worked out their own evolution. The expression "Industries" denotes the productive form of society, a form which has always embodied the ideal of co-operation when the combined labour of the members should be engaged in the production of commodities. The expression "Businesses" indicates the recognition of the Legislature that Co-operative Societies ought to cover a wider range than was allowed by the words "labour, trade, or handicraft" in the Act of 1876, and includes banking, assurance, and the like. The expression "Trades" denotes the distributive form of society, a form in which co-operation has gained its greatest successes. The permission to carry on these functions "wholesale" as well as retail points to the system of super-association, or co-operation between societies, which has attained phenomenal proportions in the co-operative wholesale societies of Manchester and of Glasgow, and exists in a smaller degree of development in other societies. The authorising of "dealings of any description with land" relates not merely to a considerable number of land societies, but is also an indication of the great extent to which societies for other purposes have applied their profits and

some of their capital to the excellent work of providing homes for their members. It is also to be observed that many societies are both distributive and productive.

What have these societies done for their members? They have reduced the price of the necessaries of life and have thus enabled persons of limited means to enjoy some of its luxuries; they have provided a remunerative investment for small savings; they have done much to put an end to the practice of giving and taking long credit; they have done as much as in them lies to ensure the purity of commodities; they have discountenanced (though, perhaps, not with all the success that might have been hoped for) the practice of taking commissions and commercial bribery generally; they have raised the standard of comfort and have helped many members to obtain the coveted possession of a house of their own; they have devoted a share of their profits to educational purposes with excellent results. Some of the productive societies, by the practice of giving a bonus to labour, have improved the economic position of the workman and contributed to the efficiency of his work. On the other hand, co-operative societies generally have not been so successful as was expected in realising some of the aspirations of the founders of co-operation; commercial failure has not been unknown among them; losses have occurred, though the simple organisation of the societies has made it easy to deal with them by adjustments of the capital account; they have not always had the best of managers, and have sometimes failed to give their confidence where it was deserved, and given it where it was not. In many places they have had to contend with opposition from the traders to whose business and profits their success was unfavourable. Taking all things into consideration, the progress they have made is surprising.

Comparing the returns for the United Kingdom for the years ending December 31, 1891, and December 31, 1901, the increase in number of societies was from 1597 to 2175; in number of members from 1,136,907 to 1,929,628; in amount of funds from 16,545,138*l.* to 40,824,660*l.*

It has been observed that the Co-operative Societies are largely undertaking the work of providing houses for their members; and to that it may be added that the Friendly Societies are more and more tending to adopt the practice of lending money to members on mortgage as one of the most remunerative forms of investment open to them. The Building Societies, which were established for that purpose only, are still carrying on the same work, and the combined operation of all three ought to produce a material effect on the prosperity and well-being of the industrial population. Building Societies alone advance as much as 9,000,000*l.* a year on mortgage.

Building Societies have passed through a crisis. The incorporated societies reached their highest point of prosperity in 1887, when their capital amounted to fifty-four millions; by 1894 it had fallen to below forty-three millions. The Building Societies Act, 1894, required of societies a fuller disclosure of the real state of their affairs than had previously been called for. The result was to show that, apart from the special scandal caused by the fraudulent proceedings of the Liberator Society, there were hitherto undisclosed elements of weakness in the management of Building Societies that justified the withdrawal of the public confidence that had been reposed in them. The properties in possession before the passing of the Act of 1894 were not less than 7,500,000*l.*; they are now less than 3,000,000*l.* This points to the fact that the early prosperity of Building Societies had led to the establishment of more societies than the public demand called for, with the consequences that societies competed against each other, and that in the stress of competition and the anxiety to do business they accepted unsatisfactory securities, which must lead to loss upon realisation. From this point of view the effect of the Act of 1894 has been wholly salutary. Year after year the societies have reduced their properties in possession. The evils which they dreaded from the disclosure of the facts have not arisen. At this day it may be said that the societies as a whole have regained the position they held in public confidence, for the members now know the worst. They know, too, that where the blight of properties in possession still infests the business the managers are resolutely endeavouring to diminish its effect.

I need hardly repeat what has so often been said of the economic value of a sound Building Society. The man who by its means gets a stake in the country mounts many steps on the social ladder. When he has paid off the mortgage on his own dwelling-house, and so liberated himself from the obligation to pay principal and interest, either in the form of repayment annuity or of rent, what is to prevent him from buying in the same manner, as an investment, another house with the income thus set free, and so on?

There are still sixty-eight Building Societies which remain under the operation of the Act of 1836, having been established before 1856, and not having availed themselves of the option of taking upon themselves the responsibilities and the privileges of the Acts of 1874 and subsequent years. One society (the Birkbeck) stands by itself, as, although its business as a Building Society is considerable—the new advances granted on mortgage last year having been for 120,000*l.*—its main operations are those of a deposit bank, and it keeps the far greater part of its funds in investments on liquid securities. The other societies are pursuing the even tenor of their way, just as they have done for the last fifty years, and show on the average an increase of business from year to year. But the great body of Building Societies are those which are incorporated under the Acts of 1874 to 1894, exceeding 2000 in number. They have so far recovered from the effects of the depression that their assets are now forty-eight millions, being midway between the low-water mark of 1894 and the high-water mark of 1887. That and the fact that they have in about seven years reduced their properties in possession by about 60 per cent. leads to the inference that they are now, speaking generally, in a fairly healthy condition, and that many years of usefulness are still to be expected for them.

The Friendly Societies Registry also registers and receives returns from trade unions. These useful and necessary bodies have, I think, been rather cruelly treated, not only in past days, but also in more recent times. Without going back to the bad old times when six poor agricultural labourers were sentenced to seven years' transportation for forming a trade union, or even to the time when they were refused the protection of the law for the funds they had accumulated, because, forsooth, they were for an illegal purpose, it will be sufficient to mark the unexpected change that has been worked in their position since the Act of 1871 purported to render them legal. Registry under that Act authorised the trustees of a trade union to hold land not exceeding one acre, vested the property of the union in them, authorised them to sue and be sued on behalf of the union, limited their liability, made the treasurers and officers accountable to them or to the members, and enabled them to take summary proceedings against any person misapplying their funds. But it did not create the unions corporate bodies, and did not enable any Court to entertain legal proceedings for enforcing their contracts with their members, recovering contributions due from a member, or recovering from the union benefits due to a member or other person, or for enforcing any agreement between one trade union and another, even where any such contracts or agreements were secured by bond. It was commonly thought that the effect of all this would be that the unions, having none of the privileges of incorporation, would escape the liabilities which affect corporate bodies; and so much was this the general opinion that the Duke of Devonshire and other members of the Royal Commission on Labour made a minority report in which they suggested that the law in this respect should be altered.

It has recently been determined that, although unions are not corporate bodies, they are responsible for the acts of their agents as much as if they were. I do not presume to question the propriety of this decision as a matter of law, nor even to say that it is a decision which is contrary to equity; but only to point out that its result upon the individual member of a trade union, who gave no mandate to its agents to do any illegal or injurious act, but handed over his savings to the trustees of the union, relying on the stringency of the provisions of the Act as to misapplication of funds, is very serious and was unexpected. The contributions of workmen to their trade union represent an amount of self-sacrifice and self-denial that is not readily gauged or measured or understood by persons in easier circumstances of life. Their object, which is primarily to provide the sinews of war in any conflict that may be necessary to secure their material welfare, and secondarily to provide sick and funeral and pension and out-of-work

benefits against the ordinary ills of life, is one that ought to appeal most strongly to the sympathies of the economist. If it is the fact that trade unions make mistakes, as most people do, those mistakes will be much fewer and less mischievous when full legislative recognition and protection are afforded them than they were under the old *régime* of suspicion and repression.

Loan Societies under the Act of 1840 are societies for lending sums of money not exceeding 15*l.* to the industrious classes upon terms of a deduction of interest at the time of granting the loan and a corresponding weekly repayment fixed to commence at such a time that the rate of interest earned by the society shall be about 12 per cent. per annum; another instance of the experience which always faces the poor man that he has to pay for any small accommodation he wants a higher relative price than the man has who wants more. These societies are of two types: the Friends of Labour Loan Societies, existing mainly in the metropolis, having two classes of members, investing and borrowing, but limiting the subscriptions of the one class to the 15*l.*, which is the statutory limit of the loans to the other class; and what may be called the proprietary loan societies, existing mainly in Yorkshire, making their loans to non-members, and consisting of a small number of persons who contribute the whole of the capital, the holding of each proprietor sometimes amounting to several hundreds of pounds.

The Registry of Friendly Societies has for one of its functions that of granting to societies which are exclusively for purposes of science, literature, and the fine arts certificates exempting them from local rating. Though there can be no question that these certificates are of great value to many excellent institutions, such as public libraries, picture galleries, museums, and scientific and learned societies, which would find the liability to pay rates, in these days when rates have increased and are increasing so largely, a serious deduction from the scanty means at their command for maintaining their useful operations, yet I have very grave doubts whether on economic grounds any such exemption from rates is capable of being defended. The benevolent people who subscribe to maintain these buildings for the public good increase the burden upon the small ratepayer to the extent to which they fail to contribute their share. The Act of 1843 has more than once been scheduled in Bills for repealing exemptions from rating, but those Bills have not been passed, and the Act is still in force.

There only remains to consider the case of Savings Banks, which are brought in connection with the Registry of Friendly Societies by the Acts which confer upon that office exclusive and final jurisdiction in the settlement of disputes, and effectually oust the jurisdiction of the Courts of Law. Under these Acts many thousands of disputes have been settled by my predecessors, my colleagues, and myself, and at the present time an average of three appointments every week during the busy time of the year has to be made to hear the parties. We see much of the seamy side of life in these cases—many family and other quarrels of a sordid character are brought to light—and it has been noted as a curious fact that persons guilty of fraud or embezzlement seem frequently, but most unwisely, to select the Savings Bank as the securest receptacle for their ill-gotten gains. On the other hand many pathetic and touching instances of thrift and self-sacrifice have been brought under our notice, and much evidence has been accumulated as to the great value to the poor of these excellent institutions. As compared with the several self-governing bodies to which I have already directed attention, the Savings Bank may not unfairly be described as the elementary form of organisation for thrift. The depositor entrusts his money to it for mere safe custody and accumulation, and has no voice in the application of it or control over its managers. All he asks is that he may run no risk of losing it. Savings Banks are of three classes: the 230 Trustee Savings Banks of the old type which still remain, and have to their credit an undiminished amount of funds, though there were at one time more than twice as many banks; the Post Office Savings Bank, which is one of the many monuments still extant to the financial genius of Mr. Gladstone, and not less to the administrative skill of the public servants who settled the lines upon which it works, and which has increased the savings of the people more than threefold by bringing almost to every man's door the opportunity of making deposits. I hope that it may meet in its new and splendid home at West Kensington with a continuance and increase of the marvellous success which has hitherto attended it. Thirdly, there are the Railway Savings Banks, which have collected from the workmen employed and from their families nearly five million pounds. It is right to observe that they give a rate of interest exceeding by about 1 per cent. that given by the Trustee and Post Office Savings Banks. It is also to be borne in mind that the deposits in Savings Banks are not drawn wholly from the industrial population, but that many, especially women and children, belonging to other classes make use of the banks. Indeed, the Postmaster-General, in an approximate estimate made some years ago, calculated that women and children constituted 56 per cent. of the whole number of depositors. School Savings Banks and Penny Savings Banks are also to be mentioned as feeders of the ordinary Savings Banks, and as greatly increasing the opportunities of saving afforded to the young, and instilling into them valuable lessons of thrift.

Such is the story the department I am about to leave has to tell of the free and spontaneous efforts of the industrial population to better their condition by means of thrift and economy. It is, I venture to think, one which speaks well for the general body of that population and has great promise for the future of the country. In times of depression, as well as in times of prosperity, the gradual increase of the funds of these various bodies has been maintained; the members have not been compelled by the one, nor tempted by the other, to relax their efforts and their sacrifices.

I ask forgiveness for having detained you so long on so small a branch of the great subjects with which this Section has to deal, and which will be well illustrated in the important papers and discussions that are set down on its programme. The course of events has given to one group of subjects, that has often been considered in this Section, a new and unexpected prominence; and we await with keen interest the teaching which economic science has to offer on the questions of the day.

SECTION H.

ANTHROPOLOGY.

OPENING ADDRESS BY PROF. JOHNSON SYMINGTON, M.D., F.R.S., F.R.S.E., PRESIDENT OF THE SECTION.

IT is now nearly twenty years since Anthropology attained to the dignity of being awarded a special and independent Section in this Association, and I believe it is generally admitted that during this period the valuable nature of many of the contributions, the vigour of the discussions, and the large attendance of members have amply justified the establishment and continued existence of this Section.

While the multifarious and diverse nature of the subjects which are grouped under the term Anthropology gives a variety and a breadth to our proceedings, which are very refreshing in this age of minute specialism, I feel that it adds very considerably to the difficulty of selecting a subject for a Presidential Address which will prove of general interest.

A survey of the recent advances in our knowledge of the many important questions which come within the scope of this Section would cover too wide a field for the time at my disposal, while a critical examination of the various problems that still await solution might expose me to the temptation of pronouncing opinions on subjects regarding which I could not speak with any real knowledge or experience. To avoid such risks I have decided to limit my remarks to a subject which comes within the range of my own special studies, and to invite your attention to a consideration of some problems arising from the variations in the development of the skull and the brain.

Since the institution of this Section the development, growth, and racial peculiarities of both skull and brain, and the relation of these two organs to each other, have attracted an ever-increasing amount of attention. The introduction of new and improved methods for the study of the structure of the brain and the activity of an able

band of experimenters have revolutionised our knowledge of the anatomy and physiology of the higher nerve centres.

The value of the results thus obtained is greatly enhanced by the consciousness that they bear the promise of still greater advances in the near future. If the results obtained by the craniologist have been less marked, this arises mainly from the nature of the subject, and is certainly not due to any lack of energy on their part. Our craniological collections are continually increasing, and the various prehistoric skull-caps from the Neanderthal to the Trinil still form the basis of interesting and valuable memoirs.

While the additions to our general knowledge of cerebral anatomy and physiology have been so striking, those aspects of these subjects which are of special anthropological interest have made comparatively slight progress, and cannot compare in extent and importance with the advantages based upon a study of fossil and recent crania. These facts admit of a ready explanation. Brains of anthropological interest are usually difficult to procure and to keep, and require the use of special and complicated methods for their satisfactory examination, while skulls of the leading races of mankind are readily collected, preserved, and studied. Hence it follows that the crania in our anthropological collections are as numerous, well preserved, and varied as the brains are few in number and defective, both in their state of preservation and representative character. It may reasonably be anticipated that improved methods of preservation and the growing recognition on the part of anthropologists, museum curators, and collectors of the importance of a study of the brain itself will to some extent at least remedy these defects; but so far as prehistoric man is concerned, we can never hope to have any direct evidence of the condition of his higher nerve centres, and must depend for an estimate of his cerebral development upon those more or less perfect skulls which fortunately have resisted for so many ages the corroding hand of time.

I presume we will all admit that the main value of a good collection of human skulls depends upon the light which they can be made to throw upon the relative development of the brains of different races. Such collections possess few, if any, brains taken from these or corresponding skulls, and we are thus dependent upon the study of the skulls alone for an estimate of brain development.

Vigorous attacks have not unfrequently been made upon the craniometric systems at present in general use, and the elaborate tables, compiled with so much trouble, giving the circumference, diameters, and corresponding indices of various parts of the skull, are held to afford but little information as to the real nature of skull variations, however useful they may be for purposes of classification. While by no means prepared to express entire agreement with these critics, I must admit that craniologists as a whole have concentrated their attention mainly on the external contour of the skull, and have paid comparatively little attention to the form of the cranial cavity. The outer surface of the cranium presents features which are due to other factors than brain development, and an examination of the cranial cavity not only gives us important information as to brain form, but by affording a comparison between the external and internal surfaces of the cranial wall it gives a valuable clue to the real significance of the external configuration. Beyond determining its capacity we can do but little towards an exact investigation of the cranial cavity without making a section of the skull. Forty years ago Prof. Huxley, in his work "On the Evidence of Man's Place in Nature," showed the importance of a comparison of the basal with the vaulted portion of the skull, and maintained that until it should become "an opprobrium to an ethnological collection to possess a single skull which is not bisected longitudinally" there would be "no safe basis for that ethnological craniology which aspires to give the anatomical characters of the crania of the different races of mankind." Prof. Cleland and Sir William Turner have also insisted upon this method of examination, and only two years ago Prof. D. J. Cunningham, in his Presidential Address to this Section, quoted, with approval, the forcible language of Huxley. The curators of craniological collections appear, however, to possess an invincible objection to any such treatment of the specimens under their care. Even in the Hunterian Museum in London, where Huxley himself worked at this subject, among several thousands of skulls, scarcely any have been bisected longitudinally, or had the cranial cavity exposed by a section in any other direction. The method advocated so strongly by Huxley is not only essential to a thorough study of the relations of basi-cranial axis to the vault of the cranium and to the facial portion of the skull, but also permits of casts being taken of the cranial cavity; a procedure which, I would venture to suggest, has been too much neglected by craniologists.

Every student of anatomy is familiar with the finger-like depressions on the inner surface of the cranial wall, which are described as the impress of the cerebral convolutions; but their exact distribution and the degree to which they are developed according to age, sex, race, &c., still remain to be definitely determined. Indeed, there appears to be a considerable difference of opinion as to the degree of approximation of the outer surface of the brain to the inner surface of the cranial wall. Thus the brain is frequently described as lying upon a water-bed, or as swimming in the cerebro-spinal fluid, while Hyrtle speaks of this fluid as a "ligamentum suspensorium" for the brain. Such descriptions are misleading when applied to the relation of the cerebral convolutions to the skull. There are, it is true, certain parts of the brain which are surrounded and separated from the skull by a considerable amount of fluid. These, however, are mainly the lower portions, such as the medulla oblongata and pons Varolii, which may be regarded as prolongations of the spinal cord into the cranial cavity. As they contain the centres controlling the action of the circulatory and respiratory organs, they are the most vital parts of the central nervous system, and hence need special protection. They are not, however, concerned with the regulation of complicated voluntary movements, the reception and storage of sensory impressions from lower centres, and the activity of the various mental processes. These functions we must associate with the higher parts of the brain, and especially with the convolutions of the cerebral hemispheres.

If a cast be taken of the cranial cavity and compared with the brain which had previously been carefully hardened *in situ* before removal, it will be found that the cast not only corresponds in its general form to that of the brain, but shows a considerable number of the cerebral fissures and convolutions. This moulding of the inner surface of the skull to the adjacent portions of the cerebral hemispheres is usually much more marked at the base and sides than over the vault. Since the specific gravity of the brain tissue is higher than that of the cerebro-spinal fluid, the cerebrum tends to sink towards the base and the fluid to accumulate over the vault; hence probably these differences admit of a simple mechanical explanation. Except under abnormal conditions, the amount of cerebro-spinal fluid between the skull and the cerebral convolutions is so small that from a cast of the cranial cavity we can obtain not only a good picture of the general shape and size of the higher parts of the brain, but also various details as to the convolutionary pattern. This method has been applied with marked success to the determination of the characters of the brain in various fossil lemurs by Dr. Forsyth Major and Prof. R. Burckhardt, and Prof. Gustav Schwalbe has made a large series of such casts from his craniological collection in Strassburg. The interesting observations by Schwalbe[1] on the arrangement of the "impressiones digitatæ" and "juga cerebralia," and their relation to the cerebral convolutions in man, the apes, and various other mammals, have directed special attention to a very interesting field of inquiry. As is well known, the marked prominence at the base of the human skull, separating the anterior from the middle fossa, fits into the deep cleft between the frontal and temporal lobes of the brain, and Schwalbe has shown that this ridge is continued—of course in a much less marked form—along the inner surface of the lateral wall of the skull, so that a cast of the cranial cavity presents a shallow but easily recognised groove corresponding to the portion of the Sylvian fissure of the brain separating the frontal and parietal lobes from the temporal lobe. Further, there is a distinct depression for the lodgment of the inferior frontal convolution, and a cast of the middle cranial fossa shows the three external temporal convolutions.

We must now turn to the consideration of the relations

1 "Ueber die Beziehungen zwischen Innenform und Aussenform des Schädels," *Deutsches Archiv für klinische Medicin*, 1902.

of the outer surface of the cranium to its inner surface and to the brain. This question has engaged the attention of experts as well as the "man in the street" since the time of Gall and Spurzheim, and one might naturally suppose that the last word had been said on the subject. This, however, is far from being the case. All anatomists are agreed that the essential function of the cranium is to form a box for the support and protection of the brain, and it is generally conceded that during the processes of development and growth the form of the cranium is modified in response to the stimulus transmitted to it by the brain. In fact it is brain growth that determines the form of the cranium, and not the skull that moulds the brain into shape. This belief, however, need not be accepted without some reservations. Even the brain may be conceived as being influenced by its immediate environment. There are probably periods of development when the form of the brain is modified by the resistance offered by its coverings, and there are certainly stages when the brain does not fully occupy the cranial cavity.

At an early period in the phylogeny of the vertebrate skull the structure of the greater part of the cranial wall changes from membranous tissue into cartilage, the portion persisting as membrane being situated near the median dorsal line. In the higher vertebrates the rapid and early expansion of the dorsal part of the fore-brain is so marked that the cartilaginous growth fails to keep pace with it, and more and more of the dorsal wall of the cranium remains membranous, and subsequently ossifies to form membrane bones. Cartilage, though constituting a firmer support to the brain than membrane, does not possess the same capacity of rapid growth and expansion. The head of a young child is relatively large, and its skull is distinguished from that of an adult by the small size of the cartilaginous base of the cranium as compared with the membranous vault. The appearance of top-heaviness in the young skull is gradually obliterated as age advances by the cartilage continuing slowly to grow after the vault has practically ceased to enlarge. These changes in the shape of the cranium are associated with corresponding alterations in that of the brain, and it appears to me that we have here an illustration of how the conditions of skull growth may modify the general form of the brain.

Whatever may be the precise influences that determine skull and brain growth, there can be no doubt but that within certain limits the external form of the cranium serves as a trustworthy guide to the shape of the brain. Statements such as those by Dr. J. Deniker ("The Races of Man," p. 53) "that the inequalities of the external table of the cranial walls have no relation whatever with the irregularities of the inner table, and still less have anything in common with the configuration of the various parts of the brain," are of too general and sweeping a character. Indeed, various observers have drawn attention to the fact that in certain regions the outer surface of the skull possesses elevations and depressions which closely correspond to definite fissures and convolutions of the brain. Many years ago Sir William Turner, who was a pioneer in cranio-cerebral topography, found that the prominence on the outer surface of the parietal bone, known to anatomists as the parietal eminence, was situated directly superficial to a convolution of the parietal lobe of the brain, which he consequently very appropriately named "the convolution of the parietal eminence." Quite recently Prof. G. Schwalbe has shown that the position of the third or inferior frontal convolution is indicated by a prominence on the surface of the cranium in the anterior part of the temple. This area of the brain is of special interest to all students of cerebral anatomy and physiology, since it was the discovery by the illustrious French anthropologist and physician, M. Broca, that the left inferior frontal convolution was the centre for speech, that laid the scientific foundation of our present knowledge of localisation of function in the cerebral cortex. This convolution is well known to be much more highly developed in man than in the anthropoid apes, and the presence of a human cranial speech-bump is usually easily demonstrated. The faculty of speech, however, is such a complicated cerebral function that I would warn the "new" phrenologist to be cautious in estimating the loquacity of his friends by the degree of prominence of this part of the skull, more particularly as there are other and more trustworthy methods of observation by which he can estimate this capacity.

In addition to the prominences on the outer surface of the cranium, corresponding to the convolutions of the parietal eminence and the left inferior frontal convolution, the majority of skulls possess a shallow groove marking the position of the Sylvian point and the course of the horizontal limb of the Sylvian fissure. Below these two other shallow oblique grooves indicate the line of the cerebral fissures which divide the outer surface of the temporal lobe into its three convolutions, termed superior, middle, and inferior. Most of these cranial surface markings are partially obscured in the living body by the temporal muscle, but they are of interest as showing that in certain places there is a close correspondence in form between the external surface of the brain and that of the skull. There are, however, distinct limitations in the degree to which the various cerebral fissures and convolutions impress the inner surface of the cranial wall, or are represented by inequalities on its outer aspect. Thus over the vault of the cranium the position of the fissure of Rolando and the shape of the cerebral convolutions in the so-called motor area, which lie in relation to this fissure, cannot usually be detected from a cast of the cranial cavity, and are not indicated by depressions or elevations on the surface of the skull, so that the surgeons in planning the seats of operations necessary to expose the various motor centres have to rely mainly upon certain linear and angular measurements made from points frequently remote from these centres.

The cranium is not merely a box developed for the support and protection of the brain, and more or less accurately moulded in conformity with the growth of this organ. Its antero-lateral portions afford attachments to the muscles of mastication and support the jaws and teeth, while its posterior part is liable to vary according to the degree of development of the muscles of the nape of the neck. Next to the brain the most important factor in determining cranial form is the condition of the organs of mastication —muscles, jaws, and teeth. There is strong evidence in favour of the view that the evolution of man from microcephaly to macrocephaly has been associated with the passage from a macrodontic to a microdontic condition. The modifications in the form of the cranium due to the influence of the organs of mastication have been exerted almost entirely upon its external table; hence external measurements of the cranium, as guides to the shape of the cranial cavity and indications of brain development, while fairly trustworthy in the higher races, become less and less so as we examine the skulls of the lower races, of prehistoric man, and of the anthropoid apes.

One of the most important measurements of the cranium is that which determines the relation between its length and breadth and thus divides skulls into long or short, together with an intermediate group neither distinctly dolichocephalic nor brachycephalic. These measurements are expressed by an index in which the length is taken as 100. If the proportion of breadth to length is eighty or upwards, the skull is brachycephalic; if between seventy-five and eighty, mesaticephalic; and below seventy-five, dolichocephalic. Such a measurement is not so simple a matter as it might appear at first sight, and craniologists may themselves be classified into groups according as they have selected the nasion, or depression at the root of the nose, the glabella, or prominence above this depression, and the ophryon, a spot just above this prominence, as the anterior point from which to measure the length. In a young child this measurement would practically be the same whichever of these three points was chosen, and each point would be about the same distance from the brain. With the appearance of the teeth of the second dentition and the enlargement of the jaws the frontal bone in the region of the eyebrows and just above the root of the nose thickens, and its outer table bulges forwards so that it is now no longer parallel with the inner table. Between these tables air cavities gradually extend from the nose, forming the frontal sinuses. Although the existence and significance of these spaces and their influence on the prominence of the eyebrows were the subject of a fierce controversy more than half a century ago between the phrenologists and their opponents, it is only recently that their variations have been carefully investigated.

The frontal sinuses are usually supposed to vary according to the degree of prominence of the glabella and the supra-orbital arches. This, however, is not the case. Thus Schwalbe[1] has figured a skull in which the sinuses do not project as high as the top of the glabella and supra-orbital prominences, and another in which they extend considerably above these projections. Further, Dr. Logan Turner ("The Accessory Sinuses of the Nose," 1901), who has made an extensive investigation into these cavities, has shown that in the aboriginal Australian, in which this region of the skull is unusually prominent, the frontal sinuses are frequently either absent or rudimentary. The ophryon has been selected by some craniologists as the anterior point from which to measure the length of the skull, under the impression that the frontal sinuses do not usually reach above the glabella. Dr. Logan Turner, however, found that out of 174 skulls in which the frontal sinuses were present in 130 the sinuses extended above the ophryon. In seventy-one skulls the depth of the sinus at the level of the ophryon varied from 2 mm. to 16 mm., the average being 5·2 mm., while in the same series of skulls the depth at the glabella varied from 3 mm. to 18 mm., with an average depth of 8·5 mm. It thus appears that the selection of the ophryon in preference to the glabella, as giving a more accurate clue to the length of the brain, is based upon erroneous assumptions, and that neither point can be relied upon in the determination of the anterior limit of the cranial cavity.

The difficulties of estimating the extent of the cranial cavity by external measurements and the fallacies that may result from a reliance upon this method are especially marked in the case of the study of the prehistoric human calvaria, such as the Neanderthal and the Trinil and the skulls of the anthropoid apes.

Statistics are popularly supposed to be capable of proving almost anything, and certainly if you allow craniologists to select their own points from which to measure the length and breadth of the cranium, they will furnish you with tables of measurements showing that one and the same skull is dolichocephalic, mesaticephalic, and brachycephalic. Let us take as an illustration an extreme case, such as the skull of an adult male gorilla. Its glabella and supra-orbital arches will be found to project forwards, its zygomatic arches outwards, and its transverse occipital crests backwards, far beyond the anterior, lateral, and posterior limits of the cranial cavity. These outgrowths are obviously correlated with the enormous development of the muscles of mastication and those of the back of the neck. In a specimen in my possession the greatest length of the cranium, *i.e.* from glabella to external occipital protuberance, is 195 mm., and the greatest breadth, taken between the outer surfaces of the zygomatic processes of the temporal bone, is 172 mm., giving the marked brachycephalic index of 88·21. The zygomatic processes, however, may reasonably be objected to as indicating the true breadth, and the side wall of the cranium just above the line where the root of this process springs from the squamous portion of the temporal bone will certainly be much nearer the cranial cavity. Measured in this situation the breadth of the cranium is 118 mm., which gives a length-breadth index 60·51, and thus represents the skull as decidedly dolichocephalic. The transverse occipital crests and the point where these meet in the middle line to form the external occipital protuberance are much more prominent in the male than in the female gorilla, and the estimate of the length of the cranium in this male gorilla may be reduced to 160 mm. by selecting the base of the protuberance in place of its posterior extremity as the posterior end measurement. This raises the index to 73·75, and places the skull near the mesaticephalic group. At the anterior part of the skull the prominent glabella is separated from the inner table of the skull by large air sinuses, so that on a median section of the skull the distance from the glabella to the nearest part of the cranial cavity is 36 mm. We have here, therefore, another outgrowth of the cranial wall which in an examination of the external surface of the skull obscures the extent of the cranial cavity. Accordingly the glabella cannot be selected as the anterior point from which to measure the length of the cranium, and must, like the zygomatic arches and occipital protuberance, be excluded from our calculations if we desire to determine a true length-breadth index. The difficulty, however, is to select a definite point on the surface of the cranium to represent its anterior end, which will be free from the objections justly urged against the glabella. Schwalbe suggests the hinder end of the supra-glabellar fossa, which he states often corresponds to the beginning of a more or less distinctly marked frontal crest. I have found this point either difficult to determine or too far back. Thus in my male gorilla the posterior end of this fossa formed by the meeting of the two temporal ridges was 56 mm. behind the glabella, and only 24 mm. from the bregma, while in the female gorilla the temporal ridges do not meet, but there is a low median frontal ridge, which may be considered as bounding posteriorly the supra-glabellar fossa. This point is 22 mm. from the glabella, and between 50 mm. and 60 mm. in front of the bregma.

I would suggest a spot in the median line of the supra-glabellar fossa which is crossed by a transverse line uniting the posterior borders of the external angular processes of the frontal bone. I admit this plan is not free from objections, but it possesses the advantages of being available for both male and female skulls. In my male skull the selection of this point diminishes the length of the cranium by 25 mm., thus reducing it to 137 mm. The breadth being calculated at 114 mm., the index is 83 21, and hence distinctly brachycephalic. The length of the cranial cavity is 118 mm. and the breadth 96 mm., and the length-breadth index is thus the brachycephalic one of 81·36.

I have given these somewhat detailed references to the measurements of this gorilla's skull because they show in a very clear and obvious manner that from an external examination of the skull one might easily be misled as to the size and form of the cranial cavity, and that, in order to determine from external measurements the proportions of the cranial cavity, skull outgrowths due to other factors than brain growth must be rigorously excluded. Further, these details will serve to emphasise the interesting fact that the gorilla's skull is decidedly brachycephalic. This character is by no means restricted to the gorilla, for it has been clearly proved by Virchow, Schwalbe, and others that all the anthropoid apes are markedly round-headed. Ever since the introduction by the illustrious Swedish anthropologist Anders Retzius of a classification of skulls according to the proportions between their length and breadth great attention has been paid to this peculiarity in different races of mankind. It has been generally held that brachycephaly indicates a higher type of skull than dolichocephaly, and that the increase in the size of the brain in the higher races has tended to produce a brachycephalic skull. When the cranial walls are subject to excessive internal pressure, as in hydrocephalus, the skull tends to become distinctly brachycephalic, as a given extent of wall gives a greater internal cavity in a spherical than an oval form. In estimating the value of this theory as to the evolutionary line upon which the skull has travelled, it is obvious that the brachycephalic character of the skulls of all the anthropoid apes is a fact which requires consideration.

Although an adult male gorilla such as I have selected presents in an extreme degree outgrowths from the cranial wall masking the true form of the cranial cavity, the same condition, though to a less marked extent, is met with in the human subject. Further, it is interesting to note that the length of the skull is more liable to be increased by such growths than the breadth, since they occur especially over the lower part of the forehead and to a less degree at the back of the skull, while the side walls of the cranium in the region of its greatest breadth generally remain thin.

Few if any fossils have attracted an equal amount of attention or given rise to such keen controversies as the "Neanderthal" and the "Trinil" skull-caps. According to some authorities both these skull-caps are undoubtedly human, while others hold that the "Neanderthal" belongs to an extinct species of the genus Homo, and the "Trinil" is the remains of an extinct genus—*Pithecanthropus erectus* of Dubois—intermediate between man and the anthropoids. One of the most obvious and easily recognised peculiarities of these skull-caps is the very marked prominence of the supra-orbital arches. The glabella-occipital length of the

[1] "Studien über *Pithecanthropus erectus*," *Zeitschrift für Morphologie und Anthropologie*, Bd. i. 1899.

Neanderthal is 204 mm., and the greatest transverse diameter, which is over the parietal region, is 152 mm.—an index of 74·51—while the much smaller Trinil calvaria, with a length of 181 mm. and a breadth of 130 mm., has an index of 71·8. Both these skulls are therefore slightly dolichocephalic. Schwalbe has corrected these figures by making reductions in their lengths on account of the frontal "outworks," so that he estimates the true length-breadth index of the Neanderthal as 80 and that of the Trinil as 75·5. These indices, thus raised about 5 per cent., are considered to represent approximately the length-breadth index of the cranial cavity. A comparison of the external and internal measurements of many recent skulls with prominent glabellæ would, I suspect, show a greater difference than that calculated by Schwalbe for the Neanderthal and Trinil specimens. In a male skull, probably an aboriginal Australian, with a cranial capacity of 1227 c.cm. I found that the glabella-occipital length was 189 mm., and the transverse diameter at the parieto-squamous suture 127 mm., which gives an index of 67 20 and makes the skull decidedly dolichocephalic. The length of the cranial cavity, however, was 157 mm. and the breadth 121 mm. (an index of 77·07 and a difference of nearly 10 per cent.), so that while from external measurements the skull is distinctly dolichocephalic, the proportions of its cavity are such that it is mesaticephalic. It is probable that many skulls owe their dolichocephalic reputation simply to the prominence of the glabella and supra-orbital ridges. An excessive development of these structures is also liable to give the erroneous impression of a retreating forehead. In the Australian skull just mentioned the thickness of the cranial wall at the glabella was 22 mm.; from this level upwards it gradually thinned until 45 mm. above the glabella it was only 6 mm. thick. When the bisected skull was placed in the horizontal position the anterior surface of the frontal bone sloped from the glabella upwards and distinctly backwards, while the posterior or cerebral surface was inclined upwards and forwards. In fact, the cranial cavity in this region was separated from the lower part of the forehead by a wedge-shaped area having its apex upwards and its base below at the glabella.

The cranial wall opposite the glabella is not appreciably thicker in the Neanderthal calvaria than in the Australian skull to which I have already referred, and the form of the cranial cavity is not more masked by this prominence in the Neanderthal than in many of the existing races.

Although the Neanderthal skull is by no means complete, the base of the cranium and the face bones being absent, still those parts of the cranial wall are preserved that are specially related to the portion of the brain which subserves all the higher mental processes. It includes the frontal, parietal, and upper part of the occipital bones, with parts of the roof of the orbits in front, and of the squamous division of the temporal bones at the sides. On its inner or cranial aspect there are markings by which the boundaries between the cerebrum and the cerebellum can be determined. In a profile view of such a specimen an inio-glabellar line can be drawn which will correspond very closely to the lower boundary of the cerebrum, and indicate a horizontal plane above which the vaulted portion of the skull must have contained nearly the whole of the cerebrum.

Schwalbe[1] has devised a series of measurements to illustrate what he regards as essential differences between the Neanderthal skull-cap and the corresponding portion of the human skull. From the inio-glabellar line another is drawn at right angles to the highest part of the vault, and by comparing the length of these two lines we can determine the length-height index. According to Schwalbe this is 40·4 in the Neanderthal, while the minimum in the human skull is 52. He further shows that the frontal portion of the vault, as represented by a glabella-bregmatic line, forms a smaller angle with the base or inio-glabellar line, and that a vertical line from the posterior end of the frontal bone (bregma) cuts the inio-glabellar further back than in the human subject. Prof. King, of Galway, attached special importance to the shape and proportions of the parietal bones, and more particularly to the fact that their mesial borders are shorter than the lower or temporal, whereas the reverse is the case in recent man. This feature is obviously related to the defective expansion of the Neanderthal vault, and Prof. Schwalbe also attributes considerable significance to this peculiarity.

Another distinctive feature of the Neanderthal skull is the relation of the orbits to the cranial wall. Schwalbe shows that its brain-case takes a much smaller share in the formation of the roof of the orbit than it does in recent man, and King pointed out that a line from the anterior inferior angle of the external orbital process of the frontal bone, drawn at right angles to the inio-glabellar line, passed in the Neanderthal in front of the cranial cavity, whereas in man such a line would have a considerable portion of the frontal part of the brain-case anterior to it.

From the combined results of these and other measurements Schwalbe arrives at the very important and interesting conclusion that the Neanderthal skull possesses a number of important peculiarities which differentiate it from the skulls of existing man, and show an approximation towards those of the anthropoid apes. He maintains that in recognising with King[1] and Cope[2] the Neanderthal skull as belonging to a distinct species, *Homo Neanderthalensis*, he is only following the usual practice of zoologists and palæontologists by whom specific characters are frequently founded upon much less marked differences. He maintains that as the Neanderthal skull stands in many of its characters nearer to the higher anthropoids than to recent man, if the Neanderthal type is to be included under the term *Homo sapiens*, then this species ought to be still more extended, so as to embrace the anthropoids.

It is interesting to turn from a perusal of these opinions recently advanced by Schwalbe to consider the grounds on which Huxley and Turner, about forty years ago, opposed the view, which was then being advocated, that the characters of the Neanderthal skull were so distinct from those of any of the existing races as to justify the recognition of a new species of the genus Homo. Huxley, while admitting that it was "the most pithecoid of human skulls," yet holds that it "is by no means so isolated as it appears to be at first, but forms in reality the extreme term of a series leading gradually from it to the highest and best developed of human crania." He states that "it is closely approached by certain Australian skulls, and even more nearly by the skulls of certain ancient people who inhabited Denmark during the stone period." Turner's[3] observations led him to adopt a similar view to that advanced by Huxley. He compared the Neanderthal calvaria with savage and British crania in the Anatomical Museum of the University of Edinburgh, and found amongst them specimens closely corresponding to the Neanderthal type.

While yielding to no one in my admiration for the thoroughness and ability with which Schwalbe has conducted his elaborate and extensive investigations on this question, I must confess that in my opinion he has not sufficiently recognised the significance of the large cranial capacity of the Neanderthal skull in determining the zoological position of its owner, or made sufficient allowance for the great variations in form which skulls undoubtedly human may present.

The length and breadth of the Neanderthal calvaria are distinctly greater than in many living races, and compensate for its defect in height, so that it was capable of lodging a brain fully equal in volume to that of many existing savage races and at least double that of any anthropoid ape.

A number of the characters upon which Schwalbe relies in differentiating the Neanderthal skull-cap are due to an appreciable extent to the great development of the glabella and supra-orbital arches. Now these processes are well known to present very striking variations in existing human races. They are usually supposed to be developed as buttresses for the purpose of affording support to the large upper jaw and enable it to resist the pressure of the lower jaw due to the contraction of the powerful muscles of mastication. These processes, however, are usually feebly marked in the microcephalic, prognathous, and macrodont negro skull, and may be well developed in the macrocephalic and orthognathous skulls of some of the higher races. Indeed, their variations are too great and their significance

[1] "Ueber die specifischen Merkmale des Neanderthalschädels," *Verhandl. der anatomischen Gesellschaft in Bonn*, 1901

[1] "The Reputed Fossil Man of the Neanderthal," *Journal of Science*, 1864.

[2] "The Genealogy of Man," *The American Naturalist*, vol. xxvii. 1893.

[3] "The Fossil Skull Controversy," *Journal of Science*, 1864.

too obscure for them to form a basis for the creation of a new species of man. Both Huxley and Turner have shown that the low vault of the Neanderthal calvaria can be closely paralleled by specimens of existing races.

If the characters of the Neanderthal calvaria are so distinctive as to justify the recognition of a new species, a new genus ought to be made for the Trinil skull-cap. In nearly every respect it is distinctly lower in type than the Neanderthal, and yet many of the anatomists who have expressed their opinion on the subject maintain that the Trinil specimen is distinctly human.

Important and interesting as are the facts which may be ascertained from a study of a series of skulls regarding the size and form of the brain, it is evident that there are distinct limits to the knowledge to be obtained from this source. Much additional information as to racial characters would undoubtedly be gained had we collections of brains at all corresponding in number and variety with the skulls in our museums. We know that as a rule the brains of the less civilised races are smaller, and the convolutions and fissures simpler, than those of the more cultured nations, beyond this but little more than that definitely determined.

As the results of investigations in human and comparative anatomy, physiology, and pathology, we know that definite areas of the cerebral cortex are connected with the action of definite groups of muscles, and that the nervous impulses starting from the organs of smell, sight, hearing, and common sensibility reach defined cortical fields. All these, however, do not cover more than a third of the convoluted surface of the brain, and the remaining two-thirds are still to a large extent a *terra incognita* so far as their precise function is concerned. Is there a definite localisation of special mental qualities or moral tendencies, and if so where are they situated? These are problems of extreme difficulty, but their interest and importance are difficult to exaggerate. In the solution of this problem anthropologists are bound to take an active and important part. When they have collected information as to the relative development of the various parts of the higher brain in all classes of mankind with the same thoroughness with which they have investigated the racial peculiarities of the skull, the question will be within a measurable distance of solution.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

DR. DAVID HEPBURN has been appointed professor of anatomy at the University College of South Wales and Monmouthshire, and Dr. T. J. Jehu professor of geology in the University of St. Andrews.

THE distribution of medals and prizes to the students of the Royal College of Science will take place in the lecture theatre of the Victoria and Albert Museum, South Kensington, at 2.30 p.m. on October 8, when an address will be delivered by Prof. Farmer, F.R.S.

EIGHTEEN lectures, open to the public without payment or ticket, will be given at University College, London, during October by professors in the faculties of arts and laws and of science. On October 7 a lecture on "Architectural Evolution," introductory to the work of the School of Architecture, will be given by Prof. F. M. Simpson. Sir William Ramsay will lecture on the gases of the atmosphere, and their connection with radium and its emanations, on October 6.

THE "Education Directory," just published by the Education Committee of the Oxfordshire County Council, shows that the committee has ordered a special survey of the educational conditions of the area over which it has control. Until this inquiry has been held the committee has decided that the higher education of the county shall be carried forward on the lines previously laid down by the Technical Instruction Committee, only modified in so far as last year's Act gives wider powers to the Education Committee.

THE research, statistical and biometric laboratory of University College, London, under Prof. Karl Pearson, offers good opportunities for post-graduate students and research workers in many fields of inquiry. The aim of the department is to give exact training in both observation and computation. Lectures are provided in both elementary and advanced statistics, and the general theory of statistics is so developed as to be of service not only to "biometricians," but to those who propose in the future to deal with social, economic or vital statistics. The training thus gained is far more profitable than any mere examination curriculum for those professions which require powers of careful observation, of original thought, or of accurate computation.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, September 21.—M. Albert Gaudry in the chair.—Parthenogenesis by carbonic acid obtained with eggs after the emission of the polar globules, by M. Yves **Delage.** It has been shown in previous work by the author that the eggs of the sea urchin are absolutely refractory to the action of carbonic acid. The effect of heat alone, or of shaking alone, gave also negative results, but moderate shaking at 30° C. in presence of carbonic acid was successful in producing the desired result, segmentation taking place in about 60 per cent. of the eggs.—On the production of sugar in the blood during the passage of the latter through the lungs, by MM. R. **Lépine** and **Boulud.** From the experiments described the authors conclude that, during the passage of the blood through the lungs, there is not only a glycolytic, but also a glycogenic process, hitherto unnoticed.—On monodrome functions and differential equations, by M. Edm. **Maillet.**—On the properties and constitution of the manganese steels, by M. Léon **Guillet.** The metallographic and mechanical tests are in perfect agreement with each other, and show that there is great similarity between nickel and manganese steels.—The diagnosis of biliary calculi by preliminary radiography, by MM. **Mauclaire** and **Infroit.**—The germination of orchids, by M. Nöel **Bernard.**

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