THURSDAY, OCTOBER 3, 1912.

THE SPECIFIC TREATMENT OF TUBERCULOSIS.

The Treatment of Tuberculosis by means of the Immune Substances (I.K.) Therapy. An introduction to Carl Spengler's work on Immunity and Tuberculosis. By Walter H. Fearis. With a Foreword by Dr. Carl Spengler. Pp. xx + 206. (London: John Murray, 1912.) Price 6*s.* net.

THOSE who turn to this book for an account of Spengler's work and records will, we are afraid, be sorely disappointed. The opinions of an enthusiastic admirer of Dr. Carl Spengler, his school, and its work are here in abundance, but any detailed description of much that is peculiar to Spengler's method is wanting.

We are told, however, that in man tuberculous infection is a symbiotic infection, and that with rare exceptions two antagonistic types of tubercle bacilli are found:—(1) *Typus humanus brevis*, Koch; (2) *humano-longus*, Spengler, this latter differing from the *Typus bovinus* only in that it branches more and forms pigment, that it is less acid-fast, is more sensitive to the action of distilled water, is more highly pathogenic to cattle, rabbits, guinea-pigs, and adult human beings, and that there are differences between the two as regards certain optical properties. It is interesting to note that Spengler believes that although the two types, *bovinus* and *humano-longus*, are morphologically identical, their pathogenic action is markedly different; still, he rejects experiments on animals as being of little or no value in helping to distinguish between the different types.

It is insisted that the toxins of the true bovine bacillus are antagonistic to those formed by Koch's *Bacillus brevis* and the converse, and also that whilst the toxins of the true bovine bacillus act as vaccins towards man, those of Koch's *Bacillus brevis*, with rare exceptions, act as toxins towards man. Whatever may ultimately be accepted as to this and other points, the arguments as here put forward are scarcely convincing. Much of the latter part of the book is devoted to an attempt to prove that Dr. Carl Spengler was chiefly responsible for the development of Koch's tuberculin treatment, and that, following this up, he has devised a method for the production of an immunity in which are combined both active and passive elements.

This method depends on the production of certain immune substances or antibodies in the sheep or rabbit, whence, apparently, they can be transferred to the human subject, these immune bodies sometimes being used along with tuberculin, but, in certain cases, alone. Bacteriological methods of examining sputum, &c., of determining the amount of antitoxic substance in the "I.K.," special methods of inoculation, dry, subcutaneous, intramuscular, and the like, are described, and a series of directions for treatment are given, the most important of which (noted after long descriptions of systematic treatment) appears to be—watch the condition of the patient, and then inject just as may be thought fit. A rapid precipitation method used in determining the approximate immunity value of a sample of blood is mentioned, and figures bearing on these values are given, but nowhere is anything said about the method itself.

From this, and from other features of the book, one cannot help feeling that the work before us is the outcome of observations and discussion amongst a set of enthusiastic workers at a subject concerning which the author, at least, is content to accept everything that is put before him, whether he understands it fully or not. This somewhat serious statement is made after due consideration, though it may be that the author is so full of the methods here suggested that he is unaware of the ignorance of many of us "outsiders" of what, in the circle in which he moves, is common knowledge. Nowhere is this more marked than in connection with the reports of different physicians who are recorded as giving evidence for and against "I.K." treatment. There may be a very great field for this treatment, and this book may stimulate those interested to a further study of Carl Spengler's methods, but in it are collected such a mixture of elementary details and imperfect accounts of very difficult and complicated questions that it will certainly fail in its main object, *i.e.*, to be "of real practical value to the physicians who may desire to administer this treatment."

In an introductory note Dr. Carl Spengler writes: "Obgleich mir das vorliegende Buch nur in seiner Disposition bekannt ist. . . ." This is well for Dr. Spengler if he be a fairly modest man, but whether it is equally good for the book is another matter, and we suggest that in the larger work that is promised by the author an attempt should be made to cut out a number of the "Carl" Spenglers, "I.K.'s," and the almost endless repetitions by which the pages of this book will appear, to most readers, to be disfigured. Indeed, many will be so irritated by this constant repetition and reiteration that there will be great risk of any real merit in the work being overlooked.

Finally, in giving explanations, statistics, and comparative results, the author appears to be under the impression that if he makes a statement sufficiently frequently it must ultimately be accepted by any reasonable individual. May we make the suggestion that when the larger work appears it should contain more accurate accounts of the really fundamental differences between Spengler's work and that of his contemporaries, that full descriptions of all special methods be given, and that, in order to make room for many things that are here taken for granted, much irrelevant matter and repetition should be omitted?

SCIENCE OF TANNING.

The Puering, Bating, and Drenching of Skins. By J. T. Wood. Pp. xv+300. (London: E. and F. N. Spon, Ltd.; New York: Spon and Chamberlain, 1912.) Price 12*s.* 6*d.* net.

THE author in his preface claims that this volume is merely a collection of notes he has made during the past twenty years on the practical and scientific aspect of the puering, bating, and drenching of skins. "Puering" and "bating" are two processes commonly used in the manufacture of light and fancy leather from various skins. They consist of steeping the skins prior to tanning in a fermenting solution of excrement—in the case of "puering," dog excrement is used; in "bating," hen or pigeon manure. Subsequent to either of these processes the skins are "drenched," in which process they are placed in a fermenting solution of bran, which, by reason of its acid nature, swells the skins prior to tanning. The original of the words puering and bating is French—*puer*, to stink; *bête*, animal. The aim of scientific technologists is to substitute these two disgusting processes by cleaner materials which can be scientifically controlled. Puering and bating of skins reduce them in thickness, take out the lime and grease, and make them soft and velvety. Mr. Wood has put together his notes upon these subjects in such a way as to make this volume indispensable both to leather trades chemists and to those who wish specially to study the subject. It is, in short, a text-book bringing together in handy form all that has been done and all that is known of this, one of the most complicated processes in connection with leather manufacture.

In the first chapter the author gives an outline of the practical processes of puering and bating. This chapter deals more with the practical side, although scientific data are given in the form of analyses and analytical results connected with practical trials. The author describes also the use of Sand's electrometric apparatus for the controlling of puer and bate liquors.

In subsequent chapters the author deals with the physics and chemistry of bating. These chapters are probably beyond the ken of the average leather manufacturer, as the author deals with the measurement of the hydrogen-ion concentration, the conductivity of puer liquors, and also describes a new apparatus for measuring the degree of falling, illustrating the work of the instrument by curves.

Chapter iv. deals with the bacteriology of the bate, and here the author excels and gives a fund of information which will be most valuable to all branches of the leather industry. The author gives microphotographs of many of the active bacteria of the puer and bate, some of which have been isolated and named by himself.

The remaining chapters contain a number of Mr. Wood's original papers which have been contributed to various learned societies from time to time. A further chapter deals with artificial bates which from time to time have been suggested, some of which are being used with satisfactory results. Lastly, Mr. Wood has collected in convenient form a *résumé* of all the patents and the bibliography of the subject.

A special portion of the book deals with drenching, one of the subsequent processes to puering or bating, and one which must be treated quite apart. Various analyses and bacteriological investigations are fully described.

The book is one which all interested in the scientific side of the leather trade must possess. To the practical leather manufacturer the book may be a disappointment, as the author does not deal with the old practical difficulties.

Mr. Wood describes his book in the concluding chapter as follows:—

"Limited in extent, imperfect in execution, and in parts only suggestive in character, this little book may perhaps serve as a foundation on which students of the science of tanning may raise the superstructure of their own experience and eventually perfect the processes touched upon, so that the use of such filthy materials may be entirely avoided."

This is another example of Mr. Wood's modesty. The book goes further than he claims. It is indeed refreshing to find someone brave enough to publish the results of his years of study of this, one of the least understood and most complicated processes connected with the manufacture of leather.

Needless to add, the printing, illustrations, and the general get-up of the book leave nothing to be desired. J. G. P.

THREE BOOKS ON AGRICULTURE.

(1) *Fertilisers and Crops, or, The Science and Practice of Plant-Feeding.* By Dr. L. L. Van Slyke. Pp. xiv+734. (New York: Orange Junn Company; London: Kegan Paul and Co., Ltd., 1912.) Price 2.50 dollars.

(2) *Farm Dairying.* By Laura Rose. Pp. 303. (London: T. Werner Laurie, n.d.) Price 6*s.* net.

(3) *Fungoid Diseases of Agricultural Plants.* By Prof. Jakob Eriksson. Translated from the Swedish by Anna Molander. Pp. xv+208. (London: Baillière, Tindall and Cox, 1912.) Price 7*s.* 6*d.* net.

(1) THE system of soil depletion as practised in the United States of America and in our colonies is beginning to receive serious consideration from the agricultural economist. The continuous growth of grain crops and the failure to make any adequate returns of plant food to the soil soon lead not only to a lack of food reserve, but also to the loss of those organic compounds which are of such importance in the production of crops in dry regions. This in itself is deplorable enough, but even where manure is to be had much of its fertilising value is wasted. Dr. van Slyke puts forward the interesting computation that the annual loss caused by the careless treatment of the manure produced by the different farm animals in the States is equivalent in value to an annual wheat crop in that country, or to 700,000,000 dollars.

With a view to minimise this and similar losses caused by haphazard use of artificial manures, this book has been written, and is designed to meet the requirements of farmers and classes in agricultural colleges and high schools. The treatment is such as to lay a foundation in the general principles relating to soil fertility and plant nutrition, and to stimulate a desire on the part of the reader to know more about the subjects discussed. In this way it would serve as an introduction to special treatises on agricultural chemistry, soil physics, plant physiology, soil bacteriology, &c.

The four parts of the book each contain a number of chapters under the heading of factors of soil fertility, sources and composition of materials used as fertilisers, factors in the selection of fertilising materials, and the practical use of fertilisers in the growing of individual crops. The last part is distinctly valuable from the grower's point of view.

The book is copiously illustrated and is to be warmly recommended for anyone interested in the production of farm and garden crops.

(2) The second publication would appear to be intended for a large and general class of readers, viz., the members of farm households. The subject matter is divided into fifty-two chapters, and deals in a brief manner with many questions, not perhaps vital, but incidental to success and comfort in farming. The book contains advice on the general arrangements of farm buildings, the care and feeding of the cow, butter- and cheese-making, milk-testing, and the treatment of the common diseases of cattle. In perusing this book one cannot help feeling that much of the space occupied by minor issues might well have been devoted, with much advantage, to a more detailed treatment of farm operations; for instance, the mixing of limewash is given as much prominence as the discussion of feeding rations. The book is well illustrated and might possibly conduce to a better understanding of farm and dairy work.

(3) Prof. Eriksson's work will be welcomed by agriculturists and horticulturists as a valuable contribution to our literature on the subject. It is intended, primarily, as a practical guide for planters and to enable them to recognise, prevent and battle with diseases often occurring in practice. Bacterial and fungal diseases of common farm and garden crops are admirably described and preventive and remedial measures are treated in detail. A special chapter deals with unexplored diseases, whilst a useful appendix of diseases, arranged according to the host plant, is included.

TOPOGRAPHY AND GEOGRAPHY.

(1) *The Land of Goshen and the Exodus.* By Sir Hanbury Brown, K.C.M.G. Second edition. Pp. 92+2 maps. (London: Edward Stanford, 1912.) Price 3*s.* net.

(2) *Rambles in the Pyrenees and the Adjacent Districts, Gascony, Pays de Foix and Roussillon.* By F. Hamilton Jackson. Pp. xii+419. (London: John Murray, 1912.) Price 21*s.* net.

(3) *The Oxford Country.* Its Attractions and Associations described by several authors. Collected and arranged by R. T. Günther. Pp. xvi+319. (London: John Murray, 1912.) Price 7*s.* 6*d.* net.

(4) *Man and his Conquest of Nature.* By Dr. M. I. Newbigin. Pp. viii+183. (London: A. and C. Black, 1912.) Price 2*s.* (Black's School Geography Series.)

(1) SIR HANBURY BROWN takes the opportunity of this second edition of his study of the journey of the Israelites from Egypt to deal with some of the criticisms met with by the first edition. The subject is one which has received attention from a number of writers in

various aspects, such as the direction of the exact route followed, and the explanation of the various events which preceded and accompanied the journey, and bear on their face in the original narrative an appearance of the supernatural; for some of these natural explanations are afforded, as in the case of the passage over the Red Sea, without imposing any strain upon the received text. The short volume carries the journey as far as Elim, and the discussion is illustrated with two maps, which are noteworthy as indicating the author's view of the further northward extension of the Arabian Gulf at the time of the Exodus.

(2) Mr. Hamilton Jackson has produced a beautiful volume on a fascinating region. He deals with the Pyrenean lands from a general descriptive point of view, but his main interest, which is that of architecture, obtains the greatest share of attention, not only in his text, but more especially in the fine illustrations which come both from his own pen and from photographs by Mr. J. C. Ashton, which are excellent, and excellently reproduced. The French Pyrenean country is one of which travellers from this country know less than it deserves. Some of its monuments of antiquity, such as the city of Carcasonne and the church of St. Bertrand de Comminges, are unsurpassed in interest elsewhere in Europe, and of these and many others the author supplies full descriptions.

(3) It was a happy idea to bring together a collection, by various authors, of articles which have appeared from time to time in *The Oxford Magazine* and elsewhere, on the country neighbouring to Oxford, its geology, natural history, archæology, and the like. The territory, within a radius (let us say) of twenty miles of Oxford, is one which includes a remarkable variety of types of English rural scenery, such as the fresh charm of the Thames above Oxford and its more mature beauties below, the bolder scenery of the hills south of White Horse Vale, or the curious fen-like expanse of Otmoor. This country succeeds in exerting its charm over a good proportion of the sons of Oxford, among whom many well-known names appear as authors in this volume. Among writers who discuss scientific studies of one sort or another may be mentioned Prof. Poulton, Prof. Warde Fowler, Dr. Aplin, and Mr. Claridge Druce; while no less notable are the names of those who deal with other aspects of the country. The volume has been excellently arranged by Mr. R. T. Günther, who contributes a chapter on the Rollright Stones.

(4) Dr. Newbigin has already in her "Modern Geography" shown herself to be a student of that subject along the lines indicated chiefly by the name of "human geography," an important department which is receiving continually growing attention as an educational topic. In the present volume she deals mainly with the economic aspect in this department, showing how certain regions are suited, whether well or ill, by their climatic and physical conditions, for the cultivation of plants of economic value; how the distribution of minerals affects human settlement, and also how the products of the sea have done so. She deals skilfully with the inter-relation of these considerations in their effect upon the density of settlement and upon conditions of life. The book is suited for teachers and more advanced students; it has none of the less attractive characteristics of the school-book.

OUR BOOKSHELF.

Ueber die Einwirkung von Wasser und Natronlauge auf Baumwollecellulose. By Dr. Ing. Michael Robinoff. Pp. ii+94. (Berlin: Gebrüder Borntraeger, 1912.) Price 3.60 marks.

THIS is an account of investigations of cotton cellulose in regard chiefly to constitutional modifications determined by treatment with water, and with alkaline solutions (NaOH) under widely varied conditions of action. The author's work further confirms the diagnostic value of the reactions of cellulose with cupric oxide (alkaline solution), viz., (*a*) the reaction of combination, or fixation of CuO; (*b*) reduction.

These have been brought into prominence by Prof. C. G. Schwalbe, and are adopted, together with a special terminology, by a number of workers in Germany. The quantitative results are expressed as coefficients in terms of Cu per cent. cellulose, but under descriptive terms, such as "Cellulosezahl," "Korrigierte Cellulosezahl," which are not happily selected.

The results recorded are of considerable empirical value, and the author keeps with evident intention to a strictly empirical interpretation, particularly pointing out the bearings of the constitutional modifications resulting from the action of water at temperatures 100° to 150° C., dilute solutions of sodium hydrate (1-5 per cent. NaOH) at similar temperatures, more concentrated solutions in the cold (mercerisation reactions), upon the various treatments of cellulose textiles incidental to "bleaching" and lustre-finishing.

By means of the careful systematic application of the reactions in question, he is enabled to establish constitutional modifications of cotton cellulose resulting from treatments of such feeble chemical intensity as (1) contact with highly dilute acids in the cold, and (2) the papermakers' beating processes, in the convincing form of self-consistent numbers. He is thus able to confirm the general statements in the leading text-books, that cellulose responds to all and any chemical treatment, however feeble, by constitutional changes, and, as a particular case, that the beating preparation of the fibrous celluloses is in effect a hydration process.

The Main Drainage of Towns. By F. Noel Taylor. Pp. xi+313; illustrated. London: Charles Griffin and Co., Ltd., 1912.) Price 12*s.* 6*d.* net.

DESPITE the fact that this book is entitled "Main Drainage of Towns," the author has attempted the almost impossible task of dealing, in the course of 295 pages, not only with matters strictly pertaining to main drainage work, but also with questions of house drainage, the theoretical side of sewage disposal, sewage disposal works, &c.

It is therefore scarcely surprising to find that the author has not been successful in his treatment of the whole of the above subjects, particularly as throughout the work there is unmistakable evidence of the lack of that careful revision of the text so essential to the production of a scientific work of value.

In justice to the author, it should be stated that he has collected a great deal of useful information in regard to main drainage work, together with a large number of plans, tables, &c., which must have entailed considerable labour. On the other hand, the value of the book is very seriously impaired by the careless way in which it is written, the errors in composition being in many cases so serious as to render the meaning of the text obscure.

Careful perusal of the chapters relating to the theory of sewage disposal, sewage disposal works, &c., clearly indicates that the author would have been well advised to have left this part of the subject alone, especially in view of the various excellent text-books already available on the subject of sewage purification.

The book contains sufficient material for the production of a useful work on the subject of main drainage providing the matter is carefully edited, but as published it certainly cannot be recommended. E. A.

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.]*

A Tribe of White Eskimos.

CONSIDERABLE interest has been aroused by the announcement made by M. Vilhjalmar Stefansson (see NATURE of August 22, p. 644), communicated to the Press through Reuter on September 10, that he had discovered a tribe—or, to be more accurate, thirteen tribes—of white Eskimos living in the neighbourhood of Coronation Gulf and Victoria Island. It is stated that ten of these tribes had never heard of white people—other than themselves. Consequently, it cannot be assumed that this fair complexion is derived from the intercourse, so frequent in recent times, between Eskimos and the men of whaling ships. The telegraphed account states that "M. Stefansson believes the white Eskimos are descendants of the colony which set out from Norway to Greenland some time after the discovery of that island. Ethnologically, the white Eskimos bear not a single trace of the Mongolian type, differing in the shape of the skull and general features, colour of eyes, and texture of hair, which in many cases is red. They spoke Eskimo, though the explorer thought he detected some Norse words. They probably numbered two thousand. Many of them had perfectly blue eyes and blonde eyebrows."

It is, of course, quite possible that a newspaper correspondent may have given a very free rendering of the statements made to him by M. Stefansson. But, in any case, it is important to bear in mind that a description of a race of fair-complexioned Eskimos, living on the shores of Davis Straits, was printed in Europe in 1658. This account occurs in De Poincy's "Histoire Naturelle & Morale des Iles Antilles de l'Amérique," which was published at Rotterdam in that year, and contains a chapter (xviii.) incorporating the narrative of Nicolas Tunes, captain of a Flushing vessel, just returned from Davis Straits at the time when De Poincy was occupied with a description of the narwhal—a subject which led him into a long digression on the hunters of the northern narwhal. De Poincy indicates the locality in question in the following terms, here translated from his somewhat archaic French:—"The captain, from whom we have received this narrative, having set out from Zealand at the end of the spring of 1656, with the intention of discovering some new source of trade in those northern lands, arrived at the end of June in Davis Straits, whence, having entered a river which begins at 64° 10′ N. lat., he sailed to the seventy-second degree, where the land about to be described is situated."

A very full description is given of the natives, but only the following sentences need be quoted here:—"As regards the inhabitants, our travellers report having seen two kinds, who live together on the most friendly terms. Of these, one kind is described as very tall, well-built, of rather fair complexion, and very swift of foot. The others are very much smaller, of an olive complexion, and tolerably well-proportioned, except that their legs are short and thick. The former kind delight in hunting, for which they are suited by their agility and natural disposition, whereas the latter occupy themselves in fishing. All of them have very white, compact teeth, black hair, animated eyes, and the features of the face so well made that they present no notable deformity. Moreover, they are all so vigorous and of such a strong constitution that several of them who have passed their hundredth year are still lively and robust."

In the small, olive-complexioned, short-legged people here described, there is no difficulty in recognising true Eskimos. Those of the tall, comparatively fair type may easily have been the descendants of the Norse colonists, intermingled, it may be, with Eskimos. It is believed by many—for example, by Dr. Nansen ("In Northern Mists," London, 1911, vol. ii., p. 103)—that the early Norsemen in Greenland were not exterminated by the Eskimos, but were gradually absorbed by them through successive intermarriages. Admitting this, it would seem that the fusion of the two races was still only partial in 1656. Tunes and his comrades speak of black hair as common to both types, but that need not mean much. If black hair was not common among tenth-century Norsemen, there would have been no distinction in Harald's designation of *haar-fager*.

However, the point is that an expedition of the year 1656 reported a tall, light-complexioned caste of natives living on the shores of Davis Straits at the same time as others of genuine Eskimo type. It is quite possible that the former, still retaining their individuality, may have migrated westward to Victoria Land. DAVID MACRITCHIE.

4 Archibald Place, Edinburgh, September 23.

Antiquity of Neolithic Man.

THE letter of Mr. J. Sinel, in NATURE of September 19, on the submerged forest bed in Jersey, deals with several questions of great interest in relation to the submerged forest on the south-western coast of Wales. I hope to publish shortly an account of this forest-bed (so far as it is seen in Pembrokeshire) and the deposits associated with it, but in the meantime I may state that I have found worked flints—flakes and cores—in two localities on the Pembrokeshire coast in positions which correspond with that of the stratum of blue clay below the forest-bed at St. Heliers. These flints were clearly worked by men who inhabited the woodland, now submerged, before the trees fell into decay and formed the peaty mass of trunks, branches, leaves, &c., overlying the true root-bed of the "submerged forest." One locality near Amroth, in Carmarthen Bay, yielded cores and flakes in abundance; the circumstances indicate the existence of a chipping-floor or implement-factory on this part of the submerged land-surface, which now, during spring tides, is covered by not less than 20 ft. of water. In the patch of submerged forest recently exposed at Freshwater West, in southern Pembrokeshire (see NATURE, March 28, 1912), a few small flint implements were also found.

Both at Amroth and Freshwater West the flints occurred below the peaty layer in a thin blue slime or clayey silt, which rests in turn upon clayey rubble largely composed of material derived from older superficial deposits. There is evidence that the forest trees in Pembrokeshire are rooted either in unquestionable glacial Boulder Clay or in a clayey drift allied to the glacial deposits. There appears, therefore, an interesting agreement in the character of the substratum of the submerged forest in Jersey and on the Pembrokeshire coast, and the agreement further extends to the composition of the peat. All the plants (with others) mentioned by Mr. Sinel occur in the peat near Amroth and the remains of beetles are fairly common.

A point of difference, which may be more apparent than real, between the two localities, is the occurrence, according to Mr. Sinel, of blue "marine" clay below the peat at St. Heliers. In Pembrokeshire the blue slime, whence the flints were obtained, has yielded no evidence of marine origin; it appears rather to resemble an old marsh silt which developed into swampy soil, but it is quite possibly only the estuarine fringe of a marine clay which is now wholly submerged. The deposits, it may be, would be similar if compared at corresponding levels.

The geological horizon of the worked flints of the Pembrokeshire submerged land-surface appears identical with that of the Neolithic implements from St. Heliers. One of the most important questions that arises is whether these implements are so distinctively Neolithic in character as to exclude the possibility that they may belong to an earlier period. Two implements from the Pembrokeshire submerged forest were submitted to Mr. Reginald Smith, of the British Museum, but they were not found sufficiently characteristic in form to be dated according to modern detailed classifications of implements.

The term "Neolithic" is frequently applied to any surface finds of implements which are unabraded and not obviously of the familiar heavy Palæolithic forms. But while on the one hand many so-called "Neolithic" implements belong to the later prehistoric ages of Bronze and Iron, on the other hand some surface sites yield implements closely resembling Late Palæolithic types. This is so, for instance, in South Pembrokeshire, where recently I have obtained from several chipping-floors on the high ground bordering the coast a number of small implements, amongst which Mr. Reginald Smith has recognised several scrapers, probably of Late Palæolithic (Aurignacian) types. But some of these early forms occur on sites which have yielded also typical Neolithic tools (with ground edges) and pottery, and, moreover, it is not yet possible to show that they are older than the submerged forest.

I join with Mr. Sinel in expressing the hope that other records of implements from the submerged forest may be obtained, but further I should like to suggest that it is of great importance that all finds should be compared with the series of implements in our national collections in order that their age may be definitely ascertained.

A. L. LEACH.

Giltar, Shooter's Hill, London.

Human Jaw of Palæolithic Age from Kent's Cavern.

PROF. A. KEITH, in discussing the paper read at Dundee by Prof. Boyd Dawkins for Dr. Duckworth on the fragment of a jaw of Palæolithic age from Kent's Cavern, is reported by *The Times* to have said that "the whole thing was ridiculous and was not even scientific, for the specimen had not been shown in the position in which it had been found."

The specimen in question is in the museum of the Torquay Natural History Society. Its position has been defined in the late Mr. W. Pengelly's reports to the British Association, and more particularly in his Cavern Note-book and Diary, which are at present, with all his other records of Kent's Cavern, in the possession of his elder daughter, Mrs. Louis Maxwell.

By the kindness of Mrs. Maxwell, I have had the opportunity of examining the diary, and have also had a look at the specimen now in its place in the museum. The actual record of the fragment is as follows:—"Thursday, January 3 [1867]. To the Cavern. The objects found to-day were as below:—"No. 1930. In granular stalagmite. 7th Parallel, including part of a Human Jaw, a Flint Flake, a well-rolled Flint pebble from which a chip had been broken."

In the British Association's Third Cavern Report, 1867, the further fact is stated, viz. that the object was found "about 30 feet from the Northern Entrance to the Cavern and deeply imbedded in Granular Stalagmite 20 inches thick."

The position of the jaw in the cavern is thus ascertainable to a few feet, and its depth in the stalagmite to a few inches. But it tells its own tale. It is practically a specimen of the characteristic granular stalagmite, which seems to have been of Palæolithic age throughout. Pengelly mentions [Fifth Report] how cave bear, hyæna, and rhinoceros were met with not only in the granular stalagmitic floor, but quite at its upper surface (Trans. Devon Assoc., v., xvi., p. 250). Indeed, Pengelly records the occurrence of a tooth of rhinoceros found in another part of the cavern (No. 4090, found May 27, 1869), "which was not only in quite the upper part of the stalagmite, but instead of being completely covered, projected above its surface" (Trans Devon Assoc., vol. xvi., p. 207).

Having known Kent's Cavern long before the British Association exploration, and having been instructed therein by Mr. Pengelly for cave research elsewhere, I trust you will permit me to bear this testimony to the accuracy and detail of Pengelly's Kent's Cavern records.

I may mention that in 1884 Pengelly collected the whole of the sixteen Kent's Cavern reports in a single paper to the Devonshire Association. Not only is this paper much more convenient for reference than the reports scattered over sixteen years of the British Association, but occasional notes review the early

evidence. For instance, with reference to the jaw under discussion Pengelly adds the remark, "Nothing of the kind was subsequently met with in or under the Granular Stalagmite" (*loc. cit.*, p. 221).

A. R. HUNT.

Torquay, September 16.

MR. HUNT is under a misapprehension regarding my criticism of Prof. Boyd Dawkins's communication at the Anthropological Section of the British Association at Dundee. In making the important announcement that the remains of Neanderthal man had been discovered in England, Prof. Dawkins exhibited merely a rough sketch of a fragment of a human jaw—not the actual specimen itself. So far as the sketch went it showed none of the usual Neanderthal characters. Further, he was unable to say from which stratum of the floor of Kent's Cavern the original specimen had been derived. My criticism of "ridiculous" and "unscientific" applies merely to the fact that the meeting was asked to accept the discovery of Neanderthal man in England on a specimen which was absent and of uncertain origin. From Mr. Hunt's communication it is clear that the exact origin of the specimen could have been ascertained. I firmly believe that the remains of Neanderthal man will be discovered in England—it may be that Dr. Duckworth is right regarding the specimen from Kent's Cavern—but the discovery cannot be accepted unless the evidence is produced.

A. KEITH.

EXPERIMENTAL RESEARCHES ON VARIATIONS IN THE COLOURING OF LEPIDOPTERA.[1]

THIS is a very comprehensive treatise by Dr. Pictet, a former treatise by whom on a cognate subject was reviewed in NATURE in 1905 (vol. lxxii., p. 632). It begins with a *résumé* of previous researches by various authors, classified under several heads, and proceeds to describe the author's own researches and the conclusions he draws from them. Many of the details are highly interesting, and his observations upon them are of much weight.

Lepidoptera, Dr. Pictet tells us, with few exceptions, vary in only two directions, melanism and albinism; the law laid down by Oberthur may be thus summed up: Any part of the wing of a butterfly can become separately darker or lighter than it is normally; in the former case, whatever its colour (except green) it can darken sufficiently to become brown, and even of so deep a brown as to have the appearance of blackness, leading in all the parts so darkened to melanism; in the latter case these same parts can become lighter, sufficiently to become tawny (*fauve*), yellow, and even of a yellow so pale as to appear white, leading, in like manner, to albinism.

The dark markings of the wing can spread or be displaced, or merge in neighbouring parts, or mask them more or less completely, or they can contract, become partly effaced, or even disappear, giving place to the light markings of the ground colour (*fond*). In other cases certain markings may become darker, and others lighter, or the general colour may become darker or lighter without altering the pattern. Opposite exciting causes, *e.g.* heat and cold, may produce the same result, this being caused, not by the special quality of the abnormal factor, but by the fact of the passing of the individual from a normal environment to that which does not suit it.

Among the exciting causes M. Pictet includes, but apparently with some doubt, electricity and mechanical vibration (*trépidation*)—the last, I believe, has been abandoned.

As regards the mechanism of variation, this has its principal seat in the scales, all of which, whether red, yellow, white, brown, or black, as well as the blue and violet ones, are striated on the surface so as to be capable of displaying the optical colours, and most of which are more or less filled with pigment in a granular form. The optical effect is related to the quantity of pigment in the scale, the intensity of the iridescence growing in inverse proportion to the pigment. In many cases the basal part of a scale is less filled with pigment than the distal part. Where the colours of the wing are light, the scales generally contain less pigment than where the colours are darker. There are, however, white pigment scales, as in the Pierids.

There are various ways in which melanism may be caused:—(1) The contained pigment may be greater in quantity; (2) it may be more strongly oxidised, which darkens it; (3) where there are both light and dark scales the latter may increase in number; (4) the scales may become so numerous as to overlap each other, and thus reinforce the darkness; (5) the scales may be enlarged, which increases the overlapping; (6) dark hairs may increase in number—like the scales, these are susceptible of change in their colouring matter; (7) one face of the wing may appear darker if, owing to the small quantity of pigment in its scales, the darker opposite face of the wing shows. Converse considerations apply to the causation of albinism; as regards (5), a very frequent cause, the scales may so diminish in size that instead of overlapping they scarcely touch, and leave empty spaces; they may diminish in size on both sides of the wing, which thus becomes transparent. (6) They may curl up at the sides, producing similar consequences to those numbered (4) and (5).

There is a very interesting chapter on cases where the optical and the pigmentary effects are combined. Green in the Pierids is not caused by green pigment, but by a mixture of yellow and black scales having *reflets bleus*; and in *V. io* the violet and green is caused by red and yellow scales mixed with white scales having *reflets bleus*.

The cause of variation may be generally stated thus. An individual which in the course of its ontogeny makes less pigment than its congeners, albinises; inversely, it melanises if it makes more pigment than is normal; the quantity of pigment

[1] "Recherches Expérimentales sur les Mécanismes du Mélanisme et l'Albinisme chez les Lépidoptères." By Dr. Arnold Pictet. Mémoires de la Société de Physique et d'Histoire naturelle de Genève, vol. xxxvii. Pp. 111–278+5 plates. (Genève: George & Cie.; Paris: G. Fischbacher, 1912.)

is much more important than chemical modification of it.

The author states that his researches confirm in some measure a fact which seems general among animals, viz. that melanism is a sign of vigour and health; albinism, on the contrary, of the enfeebling of the organism. In melanism we have great abundance of pigment, increase in the size of scales and sometimes in their number, usually greater size, the females generally with voluminous abdomen, full of eggs; among Bombyces a great increase in pilosity. In albinism, on the other hand, we have the opposite state of things; the scales also frequently deformed, curled, and atrophied, the wings often failing to develop, the abdomen slender, with few eggs or none; in the Bombyces little pilosity.

The author refers to Standfuss's hypothesis that this enfeebling may begin in the larva, and to his own experiments supporting this. Caterpillars ill-nourished, having been supplied with leaves they could ill bite into, produced imagines struck with albinism, supporting the view that albinism is a sort of anæmia of the organism. These modifications increase in succeeding generations subjected to similar conditions, but at the end of four generations the caterpillars adjust themselves to the leaves they found difficult, and then recover their vigour, size, and habitual colour. There are certain characters which exposure to abnormal conditions does not seem able to modify, such characters as are common to a group or genus, for instance, the discoidal spot of *L. quercus*, and the discoidal V. of *Ocneria dispar*.

Dr. Pictet's valuable researches certainly cannot be considered to exhaust the subject of the cause of variation in the colouring of lepidoptera. In the case of seasonally dimorphic species, for example, experiments seem to have shown that the difference in colouring is dependent more on the differential life habit of the spring and summer emergences than on mere exposure to environment or change of environment. With many lepidoptera long duration in the pupal stage, such as is produced by a low temperature, usually causes darkness, but in *A. levana* cooling the summer pupa for many months results in an imago so much brighter than the nearly black imago which comes from a pupal life in a summer temperature of five or six days that it looks quite a different species. F. MERRIFIELD.

THE SENSITIVENESS OF SELENIUM TO LIGHT OF DIFFERENT COLOURS.

SOME curious facts about the behaviour of the selenium cell are mentioned in a recent paper by A. H. Pfund.[1] The possibility of using these cells for ordinary photometric processes has often been discussed, but there are certain irregularities in their behaviour which set a limit to their usefulness.

One obvious difficulty lies in the fact that the rays of light to which the eye is most sensitive are not necessarily those which have the most effect on selenium. Pfund brings this out by reproducing—what has seldom been published before—a curve showing the distribution of sensitiveness of this material throughout the spectrum of a Nernst filament. The energy-maximum in this spectrum lies far out in the infra-red; the maximum luminosity to the eye (at moderate illuminations) is situated in the yellow-green. The maximum sensitiveness of selenium, however, is located in the red, and the shape of the curve is also distinctly different from the luminosity curve for the eye, so that inconsistent results would evidently be obtained if one tried to compare the light from various illuminants (having radically different energy-curves) by means of the selenium cell. But it may be mentioned that, according to a recent number of *The Illuminating Engineer*, such cells have a possible sphere for purely comparative measurements of one and the same illuminant; for example, they have been used for studying the fluctuations in daylight and the variation in illumination in the course of an eclipse.

Perhaps the most curious point brought out in these researches is the dependence of the maximum sensitiveness of the selenium cell on the intensity of the stimulus. With a very bright light the maximum is in the red, near 0·7 μ. But as the illumination is weakened, this maximum becomes less definite, and ultimately, in a feeble light, another maximum point, situated about 0·57 μ, appears. Ruhmer makes two kinds of selenium cells. The "hard" type is most sensitive to strong light, but relatively insensitive to feeble stimuli, and has its maximum in the red. The "soft" type, on the contrary, is most sensitive to weak light, and has its maximum in the green. This explains the discrepancies between earlier observers, some of whom found selenium to be most sensitive to yellow light, while others thought that red had most effect.

Now the interesting point to observe here is that this behaviour of the selenium cell is curiously similar to that of the eye. It is a well-authenticated fact, demonstrated many years ago by Sir Wm. Abney, that whereas at strong illuminations the maximum luminosity occurs near 0·58 μ in the yellow, in weak light it shifts to the green, probably near 0·51–0·53 μ. This is known as the Purkinje effect. In very feeble light the eye seems almost insensitive to red, while green and blues appear an uncanny light grey. Formerly this singular effect was ascribed to a struggle for predominance between the minute light-perceptive organs on the retina known as the "rod" and "cones." But, according to a later theory, this is not necessarily so, for the accentuation of the red end of the spectrum with increasing stimuli is characteristic of all photo-chemical processes.

At all events the similarity between the eye and the selenium cell in this respect is very suggestive. At first sight this complicated behaviour of selenium would seem unfavourable to

[1] *Phys. Review*, xxxiv., No. 5, May, 1912.

its extended use in photometry. But in a sense it appears fortunate, since it suggests that one might conceivably prepare selenium in such a way as to follow out almost exactly the behaviour of the eye as regards the perception of luminous energy.

NOTES.

THE typhoon which recently visited Japan, isolated Tokyo telegraphically from September 22 to 24, and carried widespread devastation, is said to have been the severest experienced in half a century. Accounts so far are meagre, but according to reports already received the loss of life and damage to property afloat and on shore are appalling. The storm appears to have been most violent in the middle of the south coast. Typhoons are revolving storms of tropical origin that may occur in Far Eastern seas—the North Pacific or the China Seas—during any month of the year. In Japan and its neighbourhood they are, as a rule, confined to the months of June to September inclusive, and are most frequent in September. In general, all tropical revolving storms follow a parabolic track. The typhoons that visit Japan in September usually originate in the Pacific south-eastward of Formosa, move N.W. by W., recurve when abreast of that island, and then take the direction of the Japan Sea. Algué divides the tracks of typhoons in the Far East into two classes—those of the Pacific, which do not cross the meridian of 124 E., and those of the China Sea. A typhoon is said to travel rapidly when its rate of motion exceeds twelve nautical miles an hour; if its rate of motion be less than six miles an hour it is said to travel slowly. The September typhoons come under the former category.

DURING the recent meeting at Geneva of the fourteenth International Congress of Prehistoric Anthropology and Archæology, an important piece of work was carried out by the Committee for the Unification of Anthropometric Measurements. The committee (or commission) included representatives of most of the European countries, as well as of the United States of America, and the number amounted to about thirty. Dr. Duckworth (of the Cambridge Anthropological Laboratory) was one of the three secretaries appointed to prepare a report of the proceedings. The secretaries made out a report, which was adopted at the final meeting of the commission, and was confirmed at the concluding meeting of the congress. The official report will be published in French, but it is intended to issue translations in English and in German simultaneously, if possible, with the official version. The illustrations are to be uniform in all three publications. Dr. Duckworth is at present engaged (for the third year in succession) upon excavations at Gibraltar, but he will be pleased to give further information as to the above-mentioned report after his return to England early this month. Communications should be addressed to the Anthropological Laboratory, New Museums, Cambridge.

A CONFERENCE of members of the Museums Association and of others interested in similar work will be held on the afternoon of Thursday, November 7, at the Manchester Museum, for the purpose of discussing subjects of common interest to those concerned in the work of museums, art galleries, and kindred institutions.

THE Huxley lecture will be delivered at Charing Cross Hospital Medical College on Thursday, October 31, by Prof. Simon Flexner, of the New York Rockefeller Institute, on "Recent Advances in Science in relation to Practical Medicine." On the same day the extensive new laboratories of public health and bacteriology, recently formed by the school and taken over by the University of London as the public health and bacteriological departments of King's College, will be formally opened and handed over to the University.

ON the suggestion of Mr. Mark Sykes, M.P., Sir Tatton Sykes has kindly sent for exhibition in the Hull Museum the objects of prehistoric date in his possession. These include the contents of the famous Duggleby Howe burial mound, which contained flint and bone weapons and implements of exceptional interest; a prehistoric jet necklace containing several hundred beads; a fine series of prehistoric implements in flint, sandstone, bronze, &c., and some earthenware vases taken from British burials on the Yorkshire Wolds.

THE extensive collection of east Yorkshire and north Lincolnshire diatoms, made by the late R. H. Philip, of Hull, also the specimens which have been figured and described in the well-known work by Mills and Philip, together with his microscope, a fine collection of microscopical slides (including several made by Robt. Harrison, a former Hull microscopist), and his scientific books, have been presented by Mrs. Philip and family to the Hull Museum. The collection of slides contains more than 3000 specimens, and among the books are such important works as "Diatomées Marines de France," by MM. H. et M. Peragallo; "A Treatise on the Diatomaceæ," by Van Heurck; "Diatomaceæ Germaniæ," by H. von Schonfeldt; "British Desmidiaceæ," by W. West, and numerous other volumes dealing with microscopy.

THE British Fire Prevention Committee opened its autumn session on September 25 with two important series of official fire tests, namely, (1) a series of twenty tests with ordinary celluloid kinematograph films *versus* a non-inflammable celluloid film; and (2) an extensive series of some twenty-five fire tests as to the possibility of extinguishing petrol fires, celluloid fires, and similar outbreaks by the application of chemical foam. Reports upon the tests, which were witnessed by representatives of about thirty Government departments and other institutions, will be published by the committee later.

THE next meeting of the Australasian Association for the Advancement of Science is to be held at Melbourne in the University, from January 7 to 14, 1913, under the presidency of Prof. T. W. E. David, C.M.G., F.R.S., Sydney. The presidents of the various sections are as follows:—A, Astronomy, Mathematics, and Physics, Prof. H. S. Carslaw, Sydney; B, Chemistry,

Prof. C. Fawsitt, Sydney; C, Geology and Mineralogy, Mr. W. Howchin, Adelaide; D, Biology, Prof. H. B. Kirk, Wellington, N.Z.; E, Geography and History, Hon. Thos. M'Kenzie, Wellington, N.Z.; F, Ethnology and Anthropology, Dr. W. Ramsay-Smith, Adelaide; G1, Social and Statistical Science, Mr. R. M. Johnston, Hobart; G2, Agriculture, Mr. F. B. Guthrie, Department of Agriculture, N.S.W.; Subsection, Veterinary Science, Prof. Douglas Stewart, Sydney; H, Engineering and Architecture, Colonel W. L. Vernon, Sydney; I, Sanitary Science and Hygiene, Dr. T. H. A. Valintine, Wellington, N.Z.; J, Mental Science and Education, Sir J. Winthrop Hackett, K.C.M.G., Perth, W.A. In addition to the meetings of the sections, arrangements are in progress for evening lectures and entertainments, and for excursions to places of interest. Full particulars can be obtained from the permanent hon. secretary, Mr. J. H. Maiden, Botanic Gardens, Sydney. The hon. treasurer for the Melbourne meeting is Mr. G. H. Knibbs, C.M.G., Melbourne, and the general secretary Dr. T. S. Hall, University, Melbourne.

DR. W. E. GARFORTH has recently presented to the University of Leeds and placed in the geological department a large case containing specimens which show the structures of numerous seams of coal from Yorkshire, Lancashire, Staffordshire, and Australia. The lower part of the case contains coal-balls, or bullions, which are found in the Halifax Hard Bed of Yorkshire and its equivalent, the Bullion Mine, in Lancashire. The coal-balls are simply masses of vegetable material which were impregnated with calcium carbonate while the tissues were still in a fresh condition, and so preserved during the subsequent changes which the surrounding vegetable matter underwent in the process of its conversion into coal. Many of the microscopic sections of these coal-balls are of an extraordinary size, measuring 8 in. by 6 in., and show the structure of the plants most beautifully. The centre of the case is occupied by a series of models illustrating the structure of Lepidostrolius, the "fruit" of Lepidodendron and its allies, showing the position of the megasporangia and microsporangia. Perhaps the most interesting sections are those from coal seams in which explosions have occurred, such as those from No. 3 Bank Pit, Atherton, near Bolton. These were prepared with the view of ascertaining whether any connection could be traced between the microscopic structure of the coal and the character of the coal dust, and were the first sections to be prepared for that purpose. The whole of the sections were made by the Lomax Palæobotanical Co., Bolton, and the case was exhibited at the Franco-British Exhibition.

IN *L'Anthropologie* for June-July-August, MM. C. Maska, H. Obermaier, and H. Breuil describe a remarkable discovery of an ivory statuette of a mammoth found near the village of Prerau, not far from the battlefield of Austerlitz. This site has already supplied a vast number of remains of extinct animals and flint implements of the palæolithic period. The present figure measures 116 mm. in length and 96 mm. in breadth. It represents the animal with full details of head and trunk. It is referred to the Salutrian Age, and is thus much older than the carvings of the animal in the flat from La Madelaine, Combarelles, Font-le-Gaume, and Pindal in Spain, of which drawings for the purpose of comparison are supplied in the article. This is the finest representation hitherto found of this great beast which flourished for ages in the steppes and prairies of ancient Europe, and was hunted for food by its early races.

THE *National Geographic Magazine* for July devotes one of its usual well-illustrated articles to an exploration of the little-known parts of Panama by Mr. H. Pitter. The Guaymies, one of the aboriginal tribes, who were formerly under the influence of Roman Catholic missionaries, have now reverted to their ancient customs and manner of life. Among the Suna-Cunis, while some of the men have visited the United States and Nova Scotia, and have thus acquired some degree of culture, primitive habits are perpetuated among the women, who have not as yet been allowed a glimpse of the outer world. The article, as a whole, gives an instructive picture of the gradual acquirement of a new phase of culture in its varied forms.

IN the report of the Warrington Museum for the year ending June 30, the director and librarian records some progress in all departments, but no change in the programme, of that institution.

IN an article on type-specimens, published in the August number of *The Victorian Naturalist* (vol. xxix., p. 59), Mr. F. Chapman proposes the new term "tectotype" for specimens, fragmentary or otherwise, selected to illustrate the external or internal microscopic characters of a species or genus. Such a specimen may be the section of a tooth, a flake of a shell, a slice of a foraminifer, or a preparation from a fossilised leaf.

PROF. W. L. MCATEE commences a long article in the Proceedings of the Philadelphia Academy for June on the experimental method of testing the efficiency of warning and cryptic coloration in protecting animals from their enemies by the statement that the theories on this subject long preceded any knowledge of the food-preferences of insectivorous species sufficient to justify such speculations. At the conclusion he states that the behaviour of animals in captivity, as regards food, does not afford trustworthy indications of what they would do in the wild state when offered similar food, thereby showing that the results of such experiments do not indicate the parts the animals might play in natural selection. He therefore urges that the time expended in making such experiments might be better employed in collecting trustworthy data in regard to the food-habits of animals in the wild condition, as "the result would be truth, not imaginative inferences from abnormal behaviour."

IT is a well-known fact that in certain aquatic hemipterous insects belonging to the genera Zaitha and Serphus, the females—in Europe, Japan, the West Indies, and America—are in the habit of attaching their eggs to the backs of their apparently unwilling

partners, in such a manner as to form a complete coating. According to an article by Prof. J. F. Abbott in the September number of *The American Naturalist*, a somewhat analogous, although more remarkable, instance of abnormal "nursery arrangements" occurs in the case of a North American hemipterous insect (*Rhamphocorixa balanodis*) belonging to the family Corixidæ, which is related to the Notonectidæ, as represented by the well-known "water-boatman." In 1910 it was observed that many of the crayfish (*Cambarus immunis*) near Colombia, Mo., were more or less completely coated with the eggs of this insect, each egg being imbedded in a small cup fixed to the shell of the crayfish. Each crayfish carried hundreds of eggs, and as each female Rhamphocorixa lays comparatively few, several insects must have cooperated in investing the crayfish. It is suggested that the coating of eggs renders the crayfish less conspicuous than in its ordinary condition, just as crabs carrying colonies of algas, sponges, or sea-anemones probably profit in some manner by the investiture.

We have received from Dr. Friedrich König, of Krailling-Planegg, near Munich, a small pamphlet on the reconstruction of extinct vertebrate animals, with photographs of models which he has prepared in accordance with the principles he explains. He emphasises especially the important aid afforded by the new kinematograph films of wild animals in motion, and points out how much less hypothetical are restorations made with our present knowledge than those which were attempted some years ago. His pamphlet forms an interesting summary of the whole subject, its problems and difficulties, with full references to all the important literature. Among his own restorations that of Diplodocus is particularly striking, for he has tried to avoid the appearance of a sleek pachyderm by assuming the presence of a series of glands beneath the skin, which give the dorsal region of the body a segmented aspect.

In the September number of *The American Journal of Science* Prof. Roy L. Moodie publishes a detailed description of the remains of *Eobatrachus agilis* from the Upper Jurassic of Wyoming, U.S.A., and confirms the opinion of the late Prof. O. C. Marsh that they represent a true anourous amphibian. Prof. Moodie finds that the bones are closely similar to those of a modern toad, and he comments on the great interest of the discovery of so highly specialised an animal in rocks so ancient as those of the Jurassic period. He overlooks the fact, however, that a well-preserved skeleton of a frog, *Palaeobatrachus gaudryi*, is already known from the Upper Jurassic of northern Spain (L. M. Vidal, *Mem. Real Acad. Ciencias de Barcelona*, vol. iv., No. 18, 1902).

The Rev. M. Saderra Masó, the well-known student of the Philippine earthquakes, finds that most of the earthquakes in southern Luzon originate along three great fractures, two of which lie to the east and west of the island, and are roughly parallel to the coast-lines, while the third, and most important, traverses the Taal volcano (the seat of the disastrous eruption of 1911), and runs in a north-north-easterly direction, passing some miles to the east of Manila. The earthquakes which originate in the south-western part of this line are characterised by relatively long duration and rather slow undulations of large amplitude, while those which proceed from the north-eastern part of the fracture are more dangerous, owing to the rapidity of their vibrations. It is in the latter part of the fracture that the destructive earthquakes of Manila have for the most part originated.

All the available space in *Symons's Meteorological Magazine* for September is devoted by Dr. Mill to an account and preliminary map of the distribution of rain in East Anglia on August 26 and 27, which was altogether unprecedented for a cyclonic storm in that part of Great Britain. The relation of the track of the depression to the rain area was similar to that of the great Irish fall of August 24–26, 1905 ("British Rainfall," pp. [110]–[114]). On the morning of August 26 the Daily Weather Report issued by the Meteorological Office showed a depression off the North Foreland; by 6 p.m. it had moved northwards and deepened off the most easterly part of the Norfolk coast, and during the night turned to the right, across the North Sea. The storm seems to have been central close to Norwich, and the area of torrential rain lay in the north-east of Norfolk. The more important facts relating to the heavy rainfall are given in letters from several of Dr. Mill's staff of observers. Among these Mr. J. H. Willis, of Norwich, took the trouble to read his gauge twelve times between 4 a.m. of August 26 and 4 a.m. of August 27; he recorded 6·32 in. in the twelve hours to 4 p.m. of August 26, and a further inch exactly in the following twelve hours. Only 0·04 in. fell between 4 and 9 a.m. on August 27, making 7·36 in. in twenty-nine hours. Although the twenty-four hours in question do not count as a "rainfall day" (twenty-fours ending at 9 a.m.), and the amount does not compare with other falls, it has not been surpassed in the British Isles on more than two or three occasions. The remarkable amount of 8·09 in. was recorded at Brundall, five miles east of Norwich, for the two days. Dr. Mill computes that the county of Norfolk, with an area of 2044 square miles, had a general rainfall of probably 4·88 in., which would be equivalent to twice as much water as is contained in Windermere, the largest of the English lakes.

The Journal of the Franklin Institute for September contains an account of some experiments on the electrical precipitation of solid and liquid matter suspended in gases by Mr. W. W. Strong, of the department of industrial research of the University of Pittsburg. The suspended matter was obtained by blowing lime dust or the smoke produced by burning soft coal or the spray from a nozzle through which alcohol, ether, or toluol was forced, into the space between an earthed electrode and one connected to six different types of high-tension apparatus. The experiments show that the problem of precipitating smoke is identical with that of removing dust, and that the coronal discharge is much more effective than the brush discharge, especially with large velocities of the gas containing the suspended particles. With this type of

discharge the size of the precipitating chamber may be materially reduced. The ionic currents due to secondary ionisation appear to play a more important part in the process than has been supposed.

IN an interesting note in the *Gazzetta chimica italiana* (vol. xlii., ii., 85) by F. Calzolari, the relationship between solubility and electro-affinity is discussed with especial reference to the chlorates and perchlorates of the alkali-metals, potassium, rubidium, and cæsium. According to the electrochemical theory of Abegg and Bodländer, the solubility should diminish, in the case of these salts, as the atomic weight of the metal increases, so that the solubility of the rubidium salts should be intermediate between the solubilities of those of potassium and cæsium; actually, however, it was found that at 20° the solubility of the cæsium salts is intermediate between those of the potassium and rubidium compounds, whilst, owing to the crossing of the solubility curves at higher temperatures, the order of the arrangement is entirely different at different temperatures. The case is apparently similar with the nitrates. The solubility of these salts, which has been cited in favour of the theory of electro-affinity, is in reality not in accord with it.

The Biochemical Journal, vol. vi., part 3, contains an important paper by Messrs. E. S. Edie, W. H. Evans, B. Moore, G. C. E. Simpson, and A. Webster from the laboratories of biochemistry and tropical medicine of the University of Liverpool, on the question of the cause and curative treatment of beri-beri and polyneuritis. An alcoholic extract of ordinary yeast, after removal of the alcohol at a low temperature, is extremely active in curing the convulsions and lameness of birds suffering from polyneuritis. An organic base, to which the name *torulin* has been given, has been isolated from this extract; its nitrate has apparently the composition, $C_7H_{16}O_2N,HNO_3$, forms feathery crystals, and is not precipitated by basic lead acetate, although thrown down by phosphotungstic acid. The alcoholic yeast extract loses its activity on warming, and the active substance is apparently easily destroyed by heat. Experiments are in progress to ascertain whether birds can fully maintain their weight and activity on a diet of polished rice, which ordinarily produces neuritis, when taken in conjunction with small doses of torulin; or whether it will only prevent the onset of convulsions or nervous changes without being able to maintain full nutrition.

The Builder for September 27 gives some interesting particulars of ancient iron beams in India. At the Black Padoga of Orissa, Kanarak, there are some very large forged iron beams; the two largest members, as described by Mr. H. G. Graves, of Calcutta, are 35 ft. long by 8 in. square, and 25·5 ft. long by 11 in. square. The broken end of one of them indicates that the method of construction was by the welding up of billets. The age of the temple has been placed by some as early as the ninth, and by others as late as the thirteenth, century. Examination indicates that the small blooms were of 3 to 4 lb. in weight; in some places the blooms appear to have been welded together in strings to form short bars, which in turn were welded into place. No special care seems to have been taken to make the blooms break joint. The beams are nearly all of uniform size, and square in section from end to end. The designers do not appear to have understood the advantage of making the depth of the beam greater than the width. The beams could have been of but little structural value, although they constitute interesting examples of smiths' work.

COMMENTING on Sir W. H. White's address at the recent International Mathematical Congress, *Engineering* for September 27 states that it is not a little remarkable how little information mathematics is able to give us as to the strength of any engineering structure. In many cases, the service which mathematics renders is to furnish laws of comparison by which, without knowing the actual limits of the stresses, we can conclude that a structure which has successfully met certain conditions may be used as a basis for designing another similar structure, larger or smaller, to meet similar conditions. Perhaps the greatest service that mathematics can render to the engineer is in directing the course of a series of experiments and in analysing the results observed. There is unquestionably an immense mass of data uselessly pigeon-holed in the archives of manufacturing firms simply and solely because their technical staff are insufficiently equipped with mathematical knowledge to analyse these records effectively, and the art of the engineer and the profits of the manufacturer suffer in consequence.

MESSRS. JOHN BARTHOLOMEW AND CO., of the Geographical Institute, Edinburgh, have published two additional sheets to their "half-inch to mile" map of Scotland. One sheet deals with Berwick and Haddington, the other with Inverness and Spey. The familiar greens and browns associated with this excellent series of reduced survey maps serve admirably to bring out the build of the country depicted, and the points of the compass arranged to show the magnetic variation, with the annual decrease of the variation indicated, is a commendable feature which will be of great assistance to tourists using the map with a compass. The price of the sheet on paper is 1*s*. 6*d*., and on cloth 2*s*.

SEVERAL additions have recently been made to the "Home University Library of Modern Knowlege" and to "The People's Books." Messrs. Williams and Norgate have added to the former series, among other volumes, the following books: "The Human Body," by Prof. Arthur Keith, "Electricity," by Prof. Gisbert Kapp, and "The Making of the Earth," by Prof. J. W. Gregory, F.R.S. To "The People's Books" Messrs. T. C. and E. C. Jack have added, with others, the following volumes: "The Evolution of Living Organisms," by Mr. E. S. Goodrich, F.R.S.; "Embryology," by Dr. Gerald Leighton; "Practical Astronomy," by Mr. Hector Macpherson, Jun.; and "Aviation," by Mr. S. F. Walker. It may be hoped that the recent rapid growth of scientific literature for the general reader is an indication of a fuller understanding of the important part which science must take in the work and development of modern States.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES FOR OCTOBER :—

Oct. 3. 18h. om. Mercury in superior conjunction with the Sun.
4. 9h. 25m. Neptune in conjunction with the Moon (Neptune 5° 46′ S.).
9. 3h. om. Uranus stationary.
10. 2h. om. Sun eclipsed, invisible at Greenwich.
,, 11h. 36m. Mercury in conjunction with the Moon (Mercury 1° 35′ N.).
,, 17h. 10m. Mars in conjunction with the Moon (Mars 1° 44′ N.).
12. 4h. 6m. Venus in conjunction with the Moon (Venus 2° 52′ N.).
13. 16h. 51m. Mercury in conjunction with Mars (Mercury 0° 11′ S.).
14. 6h. 15m. Jupiter in conjunction with the Moon (Jupiter 5° 2′ N.).
17. 22h. 40m. Uranus in conjunction with the Moon (Uranus 4° 35′ N.).
19. 6h. om. Neptune at quadrature to the Sun.
22. 21h. om. Uranus at quadrature to the Sun.
27. 23h. 9m. Saturn in conjunction with the Moon (Saturn 6° 26′ S.).
31. 15h. 12m. Neptune in conjunction with the Moon (Neptune 5° 43′ S.).

GALE'S COMET 1912*a*.—Dr. Ebell's elements and an extended ephemeris for comet 1912*a* appear in No. 4602 of the *Astronomische Nachrichten*.

Ephemeris 12h. (M.T. Berlin).

1912	α (true) h. m.	δ (true) ° ′	log *r*	log Δ
Oct. 3 ...	15 24·0 ...	−3 34·3		
5 ...	15 28·6 ...	−1 10·7 ...	9·8616 ...	0·0301
7 ...	15 32·7 ...	+1 7·4		
9 ...	15 36·5 ...	+3 20·2 ...	9 8653 ...	0·0454
11 ...	15 40·0 ...	+5 27·5		
13 ...	15 43·1 ...	+7 29·6 ...	9·8740 ...	0·0600

The calculated magnitude remains about 5·0 until the middle of October, so that given a good clear horizon the comet should not be a difficult object for field glasses, or even the naked eye; during the current week it should be looked for almost due west. On October 5, at about 7.30 p.m., it will lie about halfway between β Libræ and α Serpentis, and will form the apex of an isosceles triangle, having the base, α Coronæ Arcturus, about two-thirds the length of the side. Its apparent path lies nearly along the line joining β Libræ to a point one-third the distance from α to ε Serpentis, a point which it will pass on October 11. As may be seen from the ephemeris, the comet's distance from the sun increases after October 5, and its distance from the earth is also increasing, so that it will not become any brighter; at perihelion passage, October 5, it will be some 67·5 million miles from the sun, and 99·4 million from the earth, while on October 13 these distances will be 69·5 and 106·7 million miles respectively. The orbit of this comet is peculiar by reason of its great inclination, 82°, to the ecliptic.

EPHEMERIS FOR TUTTLE'S COMET.—In No. 4602 of the *Astronomische Nachrichten*, M. N. Miličevič gives an ephemeris for Tuttle's comet, based on the elements, uncorrected for perturbations, published in No. 3552 of the same journal. According to this ephemeris, the comet should now be high up in Ursa Major (October 6, α=8h. 36m., δ=+76° 19′), and should travel southwards to α=10h. 8m., δ=70° 24·7′ on October 31. Its calculated distances from the sun and earth on October 6 are 153 and 123 millions of miles respectively. Discovered by Méchain in 1790, this comet was rediscovered by Tuttle in 1858, and, having a period of about 13·7 years, was seen again in 1871, 1885, and May, 1899, so that it should pass perihelion some time early next year.

THE LATITUDE OF THE KHEDIVIAL OBSERVATORY AT HELWAN.—Some interesting facts concerning latitude determinations are brought to light in a paper published by Messrs. Wade and Knox Shaw in Bulletin No. 6 of the Khedivial Observatory, Helwan. The observations discussed were made (1) because observations made in September, 1908, gave a value for the latitude 3″ lower than that formerly accepted, and (2) because the observations at other geodetic stations suggested a night-to-night variation, possibly due to some atmospheric variation such as the shifting of the refractive zenith. They were also intended to show whether any abnormal variation of latitude took place from month to month.

The instruments and observations are fully discussed, Talcott's method having been employed, and the final value for the latitude of the geodetic pillar is given as 29° 25′ 31·82″ N. ±0·11″. The authors conclude that there is no very definite evidence for a night-to-night variation, but there seems to be a variation from month to month; thus August, 1911, shows the largest residual, +0·92″, from the mean value, although the probable error of the determination is small. August, 1910, also gave an abnormal value, and during the period July, 1910, to August, 1911, the mean latitude actually varied from 31·6″ to 32·1″.

THE MANCHESTER ASTRONOMICAL SOCIETY.—The report of this society shows that a vigorous interest in astronomy is exhibited in the Manchester district, an interest which would be welcome in other centres. The membership for 1910–11 was 128, as compared with 98 in 1903–4, and the average attendance at the meetings was 72. Many interesting papers were read and discussed, the lecturers including Father Cortie and Mr. T. Thorp. On alternate Wednesdays the Godlee Observatory is open to members for practical work.

FORTHCOMING BOOKS OF SCIENCE.

AGRICULTURE.

A. and C. Black.—Ranching in the Canadian West, A. B. Stock. *Blackie and Son, Ltd.*—Woman's Place in Rural Economy, translated from the French of Paul de Vuyst. *C. Griffin and Co., Ltd.*—A Manual of Practical Agricultural Bacteriology, Prof. F. Lohnis, translated by W. Stevenson and J. H. Smith, illustrated: The Laboratory Book of Dairy Analysis, H. D. Richmond, new edition, illustrated. *T. Werner Laurie, Ltd.*—Farm Dairying, L. Rose. *Longmans and Co.*—English Farming Past and Present, R. E. Prothero. *Macmillan and Co., Ltd.*—The Beginner in Poultry, C. S. Valentine, illustrated; Sheep Farming, J. A. Craig and F. R. Marshall; Forage Crops for the South, S. M. Tracy, illustrated. *John Murray.*—Practical Agricultural Chemistry, Dr. S. J. N. Auld and D. R. Edwardes-Ker, illustrated. *John Wiley and Sons (New York).*—Dairy Technology, Prof. C. Larsen and W. White.

ANTHROPOLOGY.

The Cambridge University Press.—The Civilization of Ancient Mexico, L. Spence. *Gustav Fischer (Jena).*—Der Derfflinger Hügel bei Kalbsrieth (Grossherzogtum Sachsen), A. Möller. *Macmillan and Co., Ltd.*—The Golden Bough: a Study in Magic and Religion, Prof. J. G. Frazer, third edition, revised and enlarged: Part vi., The Scapegoat;

Part vii., Balder the Beautiful; Marriage Ceremonies in Morocco, Prof. E. Westermarck; The Pagan Tribes of Borneo: a Description of their Physical, Moral and Intellectual Condition, with some Discussion of their Ethnic Relations, Dr. C. Hose and Dr. W. M'Dougall, F.R.S., 2 vols., illustrated. *Seeley, Service and Co., Ltd.*—Among Congo Cannibals: the Experiences, Impressions, and Adventures during a Thirty Years' Sojourn among the Boloki and other Congo Tribes, with a Description of their Curious Customs, Habits, and Religion, J. H. Weeks, illustrated.

BIOLOGY.

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Oshanin (Heteroptera, Homoptera-Auchenorhyncha und Psylloideæ); Résultats des Campagnes Scientifiques d'Albert I., Prince de Monaco, Fasc. xxxv., Poissons des camp. 1901–10, E. Zugmayer, illustrated; Fasc. xxxvi., Géphyriens des camp. 1898–1910, G. P. Sluiter, with coloured plate; Das Tierreich, edited by F. E. Schulze: Lief. 34, Amathusiidae, H. Stichel; Lief. 35, Rhabdocoela, L. v. Graff; Lief. 36, Pteropoda, J. J. Tesch; Verhandlungen des V. Internationalen Ornithologen-Kongress, Berlin, 1910, edited by H. Shalow, illustrated; Zoologischer Jahresbericht für 1911; Chromotaxia seu Nomenclator Colorum Polyglottus ad usum Botanicorum et Zoologorum, Prof. P. A. Saccardo, new edition, illustrated; Die Fauna der Deutschen-Kolonien, Reihe v., Heft 3, Drs. G. Aulmann and W. La Baume, illustrated; Ornis Romaniae, Die Vogelwelt Rumaniens, R. v. Dombrowski; Die sanitärisch-pathologische Bedeutung der Insecten u. verwandten Gliedertiere, namentlich als Krankheitserreger u. 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MEDICAL SCIENCE.

Edward Arnold.—Malingering, Sir J. Collie. *Baillière, Tindall and Cox.*—Aids to Public Health, Dr. D. Sommerville; Food Inspector's Encyclopædia, A. H. Walker; Veterinary Toxicology, Dr. G. D. Lander. *A. and C. Black.*—A Short Manual of Diseases of the Nervous System, E. Bramwell, Part i., Method of Examination of the Nervous System, the Significance of Important Physical Signs and Symptoms, Part ii., The Diseases of the Nervous System, illustrated; Diseases and Injuries of the Eye, Dr. W. G. Sym,

illustrated; Post-mortem Technique and Practical Pathology, Dr. J. Miller, illustrated.—*The Cambridge University Press.*—Bibliography of Medicine and related Sciences (Bio-chemistry, Biology, Cytology, &c.). *J. and A. Churchill.*—Digestion and Metabolism, the Physiological and Pathological Chemistry of Nutrition, Dr. A. E. Taylor; Meat Hygiene, with special consideration of Ante-mortem and Post-mortem Inspection of Food-producing Animals, Dr. R. Edelmann, translated by J. R. Mohler and A. Eichhorn, illustrated; On Alcoholism, Dr. F. Hare; On Fatty Foods, their Practical Examination, E. R. Bolton and C. Revis, illustrated. *Constable and Co., Ltd.*—Cancer of the Breast Clinically Observed, the late C. H. Leaf. *Gustav Fischer (Jena).*—Versuche zur Immunisierung gegen Trypanosomen, H. Braun and E. Teichmann; Jahresbericht über die Ergebnisse der Tuberkuloseforschung 1911, Dr. F. Köhler; Medizinisch-biologische Familienforschungen innerhalb eines 2232-köpfigen Bauerngeschlechts in Schweden (Provinz Blekinge), Dr. H. Lundborg, text and atlas, illustrated; Lehrbuch der Zahnkrankheiten, Dr. B. Mayrhofer, illustrated; Die Rezeptsammlung des Scribonius Largus, Dr. W. Schonack; Zur Morphologie der Nierensekretion unter physiologischen und pathologischen Bedingungen, Dr. T. Suzuki, illustrated; Verhandlungen der Deutschen Otologischen Gesellschaft auf der xxi. Versammlung in Hannover am 23 und 24 Mai, 1912, edited by Dr. R. Panse, illustrated. *C. Griffin and Co., Ltd.*—A Handbook of Hygiene, Lt.-Col. A. M. Davies and Col. Melville, new edition, illustrated; A Medical and Surgical Help: for Shipmasters and Officers in the Merchant Navy, W. J. Smith, new edition by Dr. A. Chaplin, illustrated; Clinical Medicine, Dr. J. S. Bury, edited by Drs. J. S. Bury and A. Ramsbottom, illustrated. *T. C. and E. C. Jack.*—Hynotism, Dr. A. Hutchison. *H. K. Lewis.*—Ionisation, Dr. H. L. Jones; A Short Account of the Royal Society of Medicine, S Paget; Medical Electricity: a Practical Handbook for Students and Practitioners, Dr. H. L. Jones, new edition, illustrated. *Macmillan and Co., Ltd.*—Human Physiology, Prof. L. Luciani, translated by F. A. Welby, edited by Dr. M. Camis, in four volumes, illustrated, vol ii.; Diseases of the Liver, Gall-Bladder and Bile-Ducts, Dr. H. D. Rolleston, new edition, illustrated; The Care of the Body, Prof. R. S. Woodworth; The Kallikak Family: a Study in Heredity, H. H. Goddard, illustrated; Stuttering and Lisping, Dr. E. W. Scripture, illustrated. *Julius Springer (Berlin).*—Lehrbuch der Muskel- und Gelenkmechanik, Prof. H. Strasser, ii. Band., Spezieller Teil i., illustrated. *The University Tutorial Press, Ltd.*—Physical Training and Hygiene for Certificated Students. *T. Fisher Unwin.*—Hypnotism and Disease: a Plea for Rational Psychotherapy, Dr. H. C. Miller.

METALLURGY.

C. Griffin and Co., Ltd.—The Mineralogy of the Rarer Metals: a Handbook for Prospectors, E. Cahen and W. O. Wootton; The Sampling and Assay of the Precious Metals: Comprising Gold, Silver and Platinum, in Ores, Bullion and Products, E. A. Smith, illustrated; The Microscopic Analysis of Metals in Theory and Practice, F. Osmond and J. E. Stead, F.R.S., with a chapter on the Metallography of the Deformation of Iron and Steel, and an Appendix on the Theory of the Iron-Carbon System, revised, corrected and re-written by L. P. Sidney.

TECHNOLOGY.

Edward Arnold.—Electroplating, W. R. Barclay and C. H. Hainsworth, illustrated. *Cassell and Co., Ltd.*—Cassell's Reinforced Concrete, edited by B. E. Jones, illustrated; Wireless Telegraphy: and How to Make the Apparatus, edited by the Editor of *Work*, illustrated; Motor-cars and Their Story, F. A. Talbot, illustrated. *Constable and Co., Ltd.*—Materials used in Sizing, W. F. A. Ermen; Seasonal Trades, A. Freeman; Mineral and Aerated Waters, C. A. Mitchell; Testing of Electrical Machinery J. H. Morecroft and F. W. Hehre; The Practical Mechanic's Handbook, F. E. Smith; Bells, Telephones, &c., J. B. Redfern and J. Savin; Toll Telephone Practice, J. B. Theiss and G. A. Joy. *C. Griffin and Co., Ltd.*—Briquetting: Coal, Shale, &c., Ores, Furnace Products, Metal Swarf, &c., G. Franke, translated and edited by F. Lantsberry, 2 vols., illustrated; A Handbook for Buyers and Sellers in the Cotton Trade, H. B. Heylin; Painters' Colours, Oils, and Varnishes, G. H. Hurst, revised by N. Heaton, new edition, illustrated. *Crosby Lockwood and Son.*—Stone Quarrying and the Preparation of Stone for the Market, A. Greenwell and Dr. J. V. Elsden; The Art of Modern Fretcutting, J. Makinson, illustrated. *Longmans and Co.*—Advanced Textile Design, W. Watson; Textile Design and Colour Elementary Weaves and Figured Fabrics, W. Watson. *George Routledge and Sons, Ltd.*—The Broadway Textbooks of Technology, edited by G. U. Yule and C. Hamilton, illustrated, Introductory Volume on Organisation and Teaching; Preliminary Technical Course, First Year; Building Construction, First Year; Geometry for Builders, First Year; Science for Builders, First Year; Machine Construction, First Year; Mechanics for Engineers, First Year; Practical Mathematics and Geometry, First Year; Mechanics for Textile Students, First Year; Safety Lamps and Testing for Mine Gases; Elementary Electrical Engineering, First Year; Telephotography, C. F. Lan-Davis, illustrated. *The University Tutorial Press, Ltd.*—Manual Training, A. H. Jenkins. *Whittaker and Co.*—The Baudôt Printing Telegraph System, H. W. Pendry, illustrated; Magneto and Electric Ignition, W. Hibbert, illustrated; Wireless Telegraphy and Telephony, W. J. White, illustrated; Practical Sheet and Plate Metal Work, E. A. Atkins.

MISCELLANEOUS.

Edward Arnold.—Questions of the Day in Philosophy and Psychology, Dr. H. L. Stewart. *A. and C. Black.*—Forged Egyptian Antiquities, T. G. Wakeling, illustrated. *Blackie and Son, Ltd.*—Safety in Coal Mines, Prof. D. Burns; Tillage, Trade, and Invention, G. T. Warner. *R. Friedländer und Sohn (Berlin).*—Jade, a Study of Chinese Archæology and Religion, B. Laufer, illustrated. *C. Griffin and Co., Ltd.*—The Official Year-Book of the Scientific and Learned Societies of Great Britain and Ireland, compiled from Official Sources, twenty-eighth annual issue. *Harper and Brothers.*—Rough Stone Monuments and their Builders, T. E. Peet. *Henry Holt and Co. (New York).*—Leading American Inventors, G. Iles, illustrated. *T. C. and E. C. Jack.*—Psychology, Dr. H. J. Watt; The Meaning of Philosophy, Prof. A. E. Taylor; Kant's Philosophy, A. D. Lindsay. *Longmans and Co.*—The Aviation World Who's Who and Industrial Directory, third issue, 1912; Introduction to Experimental Education, Dr. R. R. Rusk. *Macmillan and Co., Ltd.*—Statistics, the late Sir Robert Giffen, edited by H. Higgs, C.B. *Methuen and Co., Ltd.*—The Ancient History of the Near East from the Earliest Period to the Persian Invasion of Greece, H. R. Hall, illustrated; Survivals and Tendencies: being Sundry Sociological Interpretations and Forecasts, V. V. Branford; The Malthusian Limit: a Theory of a Possible Static Condition for the Human Race, E. Isaacson. *Seeley, Service and Co., Ltd.*—Heroes of Science, C. R. Gibson, illustrated.

CLIMATOLOGICAL OBSERVATIONS.

A VALUABLE instalment has been added to the long series of meteorological observations taken at the Radcliffe Observatory, Oxford, by the publication of a volume containing the results for the five years 1906–1910. In its main features the volume is arranged on the same lines as before, the principal exceptions being the omission of (1) the readings of the underground platinum-resistance thermometers, which will be dealt with in a separate paper, and (2) the results obtained from the photographic recording instruments, but the records are continued at present. The tables exhibit very clearly the mean daily, monthly, and annual results for the various elements. The wind velocity is deduced with the old factor 3, but to reduce this to the new factor 2·2 it is only necessary to multiply the quantities by 0·733. From a special table prepared by Dr. Rambaut for the thirty years 1881–1910, the mean yearly horizontal motion of the air is 108,000 miles; it shows an apparent periodic annual variation, with an amplitude of about 3·8 miles an hour, the maximum occurring in March and the minimum in September.

The report recently issued by the Survey Department of Egypt upon the rains of the Nile basin and the flood of 1910 claims that the decade which has just passed ranks as the most important in the study of the Nile from the hydrographical and meteorological points of view. The investigations during that period are chiefly due to the instigation and personal efforts of Sir W. Garstin and to the discussion of his data by various men of science. Among the principal results of this work are:—(1) A proper appreciation of the enormous loss of water in marshy regions. (2) The regulating effect of the trough wherever a rapid tributary joins a more sluggish one. (3) A more precise knowledge of the relative parts played by the different tributaries. (4) The importance of the contribution returned to the river from underground sources. During 1910 there was a general or partial failure of rain in the first half of the year, but during the critical months, July to September, there was heavy rain in Abyssinia and round the Bahr el Jebel, and this condition persisted into the last quarter. The low stage preceding the flood was very satisfactory and water was plentiful. The flood started well in April, but was subject subsequently to several fluctuations; from November 1 the fall was rapid, but the river remained above its normal level.

In our "Notes" column of April 25 we made a brief reference to a report on the climate of Tripoli by Dr. Philip Eredia, based on direct observations between 1892 and 1911. He has now supplemented that useful paper by one on the diurnal range of temperature, based on readings of a self-recording thermometer since September, 1905 (*Rendiconti R. Accad. Lincei*, July, 1912). The tables contain, *inter alia*, ten-day and monthly means for every even hour (2h., 4h., &c.). These show that the highest mean values occur about 2h. p.m., and differ little from those at other hours near that time, except in the decades of the extreme months; the lowest readings generally occur near sunrise, as is usually the case. The mean daily extremes occur early in February (11·4° C.) and about the middle of August (26·5°), giving a mean range of 15° C., which differs little from that of the coastal towns of southern Italy. The peculiarities exhibited by the hourly means in the various months are well shown by thermo-isopleths.

We have received Nos. 7–9 of the *Finländische hydrographisch-biologische Untersuchungen* in the gulfs of Bothnia and Finland and the northern part of the Baltic Sea during the years 1900–1910. These very valuable observations and results, including sea-temperature at various depths, salinity, wind direction and force, and other data at lightships, lighthouses, and other fixed stations, as well as during expeditions to sea, have been discussed by Dr. Rolf Witting, director of the investigations, and translated into German by Mrs. Ellen Witting. The principal results are also shown graphically by a number of coloured plates. We note that the author is of opinion that more importance should be given to detailed observations at fixed stations in supplementing the observations made in the open sea than has hitherto been the case. The discussion covers too wide a range to allow of our entering into further details here, but we may mention that one of the chapters contains an interesting historical account of the development of our knowledge of the hydrography of the Baltic prior to the commencement of the international exploration of the ocean.

THE BRITISH ASSOCIATION AT DUNDEE.

SECTION I.

PHYSIOLOGY.

OPENING ADDRESS BY LEONARD HILL, M.B., F.R.S., PRESIDENT OF THE SECTION.

LAST year the distinguished president of this section raised us to the contemplation of the workings of the soul. I ask you to accompany me in the consideration of nothing higher than a stuffy room. Everyone thinks that he suffers in an ill-ventilated room owing to some change in the chemical quality of the air, be it want of oxygen, or excess of carbon dioxide, the addition of some exhaled organic poison, or the destruction of some subtle property by passage of the air over steam-coils, or other heating or conducting apparatus. We hear of "devitalised" or "dead" air, and of "tinned" or "potted" air of the battleship. The good effects of open-air treatment, sea and mountain air, are no less generally ascribed to the chemical purity of the air. In reality the health-giving properties are those of temperature, light, movement, and relative moisture of the surrounding atmosphere, and leaving on one side those gross chemical impurities which arise in mines and in some manufacturing processes, and the question of bacterial infection, the alterations in chemical composition of the air in buildings where people crowd together and suffer from the effects of ill-ventilation have nothing to do with the causation of these effects.

Satisfied with the maintenance of a specious standard of chemical purity, the public has acquiesced in the elevation of sky-scrapers and the sinking of cavernous places of business. Many have thus become cave-dwellers, confined for most of their waking and sleeping hours in windless places, artificially lit, monotonously warmed. The sun is cut off by the shadow of tall buildings and by smoke—the sun, the energiser of the world, the giver of all things which bring joy to the heart of man, the fitting object of worship of our forefathers.

The ventilating and heating engineer hitherto has followed a great illusion in thinking that the main objects to be attained in our dwellings and places of business are chemical purity of the air and a uniform draughtless summer temperature.

Life is the reaction of the living substance to the ceaseless play of the environment. Biotic energy arises from the transformation of those other forms of energy—heat, light, sound, &c.—which beat upon the transformer—the living substance (B. Moore). Thus, when all the avenues of sense are closed, the central nervous system is no longer aroused and con-

sciousness lapses. The boy paralysed in almost all his avenues of sense fell asleep whenever his remaining eye was closed. The patient who lost one labyrinth by disease, and, to escape unendurable vertigo, had the other removed by operation, was quite unable to guide his movements or realise his position in the dark. Rising from bed one night, he collapsed on the floor and remained there helpless until succour arrived.

A sense organ is not stimulated unless there is a change of rate in the transference of energy; and this to be effectual must occur in most cases with considerable quickness. If a weak agent is to stimulate, its application must be abrupt (Sherrington). Thus the slow changes of barometric pressure on the body-surface originate no skin sensations, though such changes of pressure if applied suddenly, are much above the threshold value for touch. A touch excited by constant mechanical pressure of slight intensity fades quickly below the threshold of sensation. Thus the almost unbearable discomfort which a child feels on putting on for the first time a "natural" wool vest fades away, and is no longer noticed with continual wear. Thomas à Beckett soon must have become oblivious to his hair-shirt, and even to its harbingers. It is not the wind which God tempers to the shorn lamb, but the skin of the lamb to the wind. The inflow of sensations keeps us active and alive and all the organs working in their appointed functions. The cutaneous sensations are of the highest importance. The salt and sand of wind-driven sea air particularly act on the skin and through it brace the whole body. The changing play of wind, of light, cold, and warmth stimulate the activity and health of mind and body. Monotony of sedentary occupation and of an over-warm still atmosphere endured for long working hours destroys vigour and happiness and brings about the atrophy of disuse. We hear a great deal of the degeneration of the race brought about by city life, but observation shows us that a drayman, navvy, or policeman can live in London, or other big city, strong and vigorous, and no less so than in the country. The brain-worker, too, can keep himself perfectly fit if his hours of sedentary employment are not too long and he balances these by open-air exercise. The horses stabled, worked, and fed in London are as fine as any in the world; they do not live in windless rooms heated by radiators.

The hardy men of the north were evolved to stand the vagaries of climate—cold and warmth—a starved or full belly have been their changing lot. The full belly and the warm sun have expanded them in lazy comfort; the cold and the starvation have braced them to action. Modern civilisation has withdrawn many of us from the struggle with the rigours of nature: we seek for and mostly obtain the comfort of a full belly and expand all the time in the warm atmosphere afforded us by clothes, wind-protected dwellings, and artificial heat—particularly so in the winter, when the health of the business man deteriorates. Cold is not comfortable, neither is hunger; therefore we are led to ascribe many of our ills to exposure to cold, and seek to make ourselves strong by what is termed good living. I maintain that the bracing effect of cold is of supreme importance to health and happiness, that we become soft and flabby and less resistant to the attacks of infecting bacteria in the winter, not because of the cold, but because of our excessive precautions to preserve ourselves from cold; that the prime cause of "cold" or "chill" is not really exposure to cold, but to the overheated and confined air of rooms, factories, and meeting-places. Seven hundred and eleven survivors were saved from the *Titanic* after hours of exposure to cold. Many were insufficiently clad and others wet to the skin. Only one died after reaching the *Carpathia*, and he three hours after being picked up. Those who died perished from actual cooling of the body. Exposure to cold did not cause in the survivors the diseases commonly attributed to cold.

Conditions of city and factory life diminish the physical and nervous energy, and reduce many from the vigorous health and perfectness of bodily functions which a wild animal possesses to a more secure, but poorer and far less happy, form of existence. The ill-chosen diet, the monotony and sedentary nature of daily work, the windless uniformity of atmosphere, above all, the neglect of vigorous muscular exercise in the open air and exposure to the winds and light of heaven—all these, together with the difficulties in the way of living a normal sexual life, go to make the pale, undeveloped, neurotic, and joyless citizen. Nurture in unnatural surroundings, not nature's birth-mark, moulds the criminal and the wastrel. The environment of childhood and youth is at fault rather than the stock; the children who are taken away and trained to be sailors, those sent to agricultural pursuits in the Colonies, those who become soldiers, may develop a physique and bodily health and vigour in striking contrast to their brothers who become clerks, shop assistants, and compositors.

Too much stress cannot be put on the importance of muscular exercise in regard to health, beauty, and happiness. Each muscle fills with blood as it relaxes, and expels this blood on past the venous valves during contraction. Each muscle, together with the venous valves, forms a pump to the circulatory system. It is the function of the heart to deliver the blood to the capillaries, and the function of the muscles—visceral, respiratory, and skeletal—to bring it back to the heart. The circulation is contrived for a restless mobile animal; every vessel is arranged so that muscular movement furthers the flow of blood.

The pressure of the blood in the veins and arteries under the influence of gravity varies with every change of posture. The respiratory pump, too, has a profound influence on the circulation. Active exercise, such as is taken in a game of football, entails endless changes of posture, varying compressive actions—one with another struggling in the rough and tumble of the game—forcible contractions and relaxations of the muscles, and a vastly increased pulmonary ventilation; at the same time the heart's action is accelerated and augmented and the arterial supply controlled by the vasomotor system. The influence of gravity, which tends to cause the fluids of the body to sink into the lower parts, is counteracted; the liver is rhythmically squeezed like a sponge by the powerful respiratory movements, which not only pump the blood through the abdominal viscera but thoroughly massage these organs, and kneading these with the omentum clean the peritoneal cavity and prevent constipation. At the same time the surplus food metabolic products, such as sugar and fat, stored in the liver, are consumed in the production of energy, and the organs swept with a rapid stream of blood containing other products of muscular metabolism which are necessary to the interrelation of chemical action. The output of energy is increased very greatly; a resting man may expend two thousand calories per diem; one bicycling hard for most of the day expended eight thousand calories, of which only four thousand was covered by the food eaten.

Such figures show how fat is taken off from the body by exercise, for the other four thousand calories comes from the consumption of surplus food products stored in the tissues. While resting a man breathes some 7 litres of air, and uses 300 c.c. of oxygen per minute, against 140 litres and 3000 c.c. while doing very hard labour. The call of the muscles for oxygen

through such waste products as lactic acid impels the formation of red corpuscles and hæmoglobin. The products of muscular metabolism in other ways not yet fully defined modify the metabolism of the whole body.

Exposure to cold, cold baths, and cold winds has a like effect, accelerating the heart and increasing the heat production, the activity of the muscles, the output of energy, the pulmonary ventilation, and intake of oxygen and food. In contrast with the soft pot-bellied, over-fed city man the hard, wiry fisherman trained to endurance has no superfluity of fat or tissue fluid. His blood volume has a high relative value in proportion to the mass of his body. His superficial veins are confined between a taut skin and muscles, hard as in a racehorse trained to perfection. Thus the adequacy of the cutaneous circulation and loss of heat by radiation rather than by sweating is assured. His fat is of a higher melting point, hardened by exposure to cold. In him less blood is derived to other parts, such as adipose tissue, skin, and viscera. He uses up the oxygen in the arterial blood more completely and with greater efficiency; for the output of each unit of energy his heart has to circulate much less blood (Kreogh); his blood is sent in full volume by the well-balanced activity of his vasomotor system to the moving parts. Owing to the perfect coordination of his muscles, trained to the work, and the efficient action of his skin and cutaneous circulation—the radiator of the body—he performs the work with far greater economy and less fatigue. The untrained man may obtain 12 per cent. of his energy output as work, against 30 per cent., or perhaps even 50 per cent., obtained by the trained athlete. Hence the failure and risk suffered by the city man who rushes straight from his office to climb the Alps. On the other hand, the energetic man of business or brain worker is kept by his work in a state of nervous tension. He considers alternative lines of action, but scarcely moves. He may be intensely excited, but the natural muscular response does not follow. His heart is accelerated and his blood pressure raised, but neither muscular movements and accompanying changes of posture, nor the respiratory pump materially aid the circulation. The activity of his brain demands a rapid flow of blood, and his heart has to do the circulatory work, as he sits still or stands at his desk, against the influence of gravity. Hence a high blood pressure is maintained for long periods at a time by vaso-constriction of the arteries in the lower parts of the body and increased action of the heart; hence, perhaps, arise those degenerative changes in the circulatory system which affect some men tireless in their mental activity. We know that the bench-worker, who stands on one leg for long hours a day, may suffer from degeneration and varicosity of the veins in that leg. Long-continued high arterial pressure, with systolic and diastolic pressures approximately the same, entails a stretched arterial wall, and this must impede the circulation in the vaso-vasorum, the flow of tissue lymph in, and nutrition of, the wall. Since his sedentary occupation reduces the metabolism and heat production of his body very greatly, the business man requires a warmer atmosphere to work in. If the atmosphere is too warm it reduces his metabolism and pulmonary ventilation still further; thus he works in a vicious circle. Exhausting work causes the consumption of certain active principles, for example, adrenin, and the reparation of those must be from the food. To acquire certain of the rarer principles expended in the manifestation of nervous energy more food may have to be eaten by the sedentary worker than can be digested and metabolised. His digestive organs lack the kneading and massage, the rapid circulation and oxidation of foodstuffs which is given by muscular exercise. Hence arise the digestive and metabolic ailments so common to brain workers.

Mr. Robert Milne informs me that of the thousands of children who have passed through Barnardo's Homes—there are 9000 in the homes at any one time—not one after entering the institution and passing under its regimen and the care of his father, Dr. Milne, has developed appendicitis. Daily exercise and play, adequate rest, a regular, simple diet have ensured their immunity from this infection. It pays to keep a horse healthy and efficient; it no less pays to keep men healthy. I recently investigated the case of clerks employed in a great place of business, whose working hours are from 9 to 6 on three days, and 7 to 9 on the other three days of each week, and working such overtime, they make 1*l.* to 2*l.* a week; these clerks worked in a confined space—forty or fifty of them in 8200 cubic feet, lit with thirty electric lamps, cramped for room, and overheated in warm summer days. It is not with the chemical purity of the air of such an office that fault is to be found, for fans and large openings ensured this sufficiently. These clerks suffered from their long hours of monotonous and sedentary occupation, and from the artificial light, and the windless, overwarm and moist atmosphere. Many a girl cashier has worked from 8 to 8.30, and on Saturdays from 8 to 10, and then has had to balance her books and leave perhaps after midnight on Sunday morning. Her office is away in the background—confined, windless, artificially lit. The Shops Act has given a little relief from these hours. What, I ask, is the use of the State spending a million a year on sanatoria and tuberculin dispensaries, when those very conditions of work continue which lesson the immunity and increase the infection of the workers?

The jute industry in this town of Dundee is carried out almost wholly by female and boy labour. "The average wages for women are below 12*s.* in eight processes, and above 12*s.*, but under 18*s.*, for the remaining five processes." The infant mortality has been more than 170 per 1000. The Social Union of Dundee reported in 1905 that of 885 children born to 240 working mothers no fewer than 520, or 59 per cent., died—and almost all of them were under five years of age. The life of these mothers was divided between the jute factory and the one-roomed tenement. Looking such conditions squarely in the face, I say it would be more humane for the State to legalise the exposure of every other new-born infant on the hillside rather than allow children to be slowly done to death. The conditions, as given in the report, contravene those rights of motherhood which the meanest wild animal can claim.

Isolation hospitals, sputum-pots, and anti-spitting regulations will not stamp out tuberculosis. Such means are like shutting the door of the stable when the horse has escaped. Flügge has shown that tubercle bacilli are spread by the droplets of saliva which are carried out as an invisible spray when we speak, sing, cough, sneeze. Sputum-pots cannot control this. The saliva of cases of phthisis may teem with the bacilli. The tuberculin reaction tests carried out by Hamburger and Monti in Vienna show that 94 per cent. of all children aged eleven to fourteen have been infected with tubercle. In most the infection is a mere temporary indisposition. I believe that the conditions of exhausting work, and amusement in confined and overheated atmospheres, together with ill-regulated feeding, determine largely whether the infection, which almost none can escape, become serious or not. Karl Pearson suggests that the death statistics afford no proof of the utility of sanatoria or tuberculin dispensaries, for during the very years in which such treatment has been in vogue, the fall in

the mortality from tuberculosis has become less relatively to the fall in general mortality. He opines that the race is gradually becoming immune to tubercle, and hence the declination in the mortality curve is becoming flattened out—that nature is paramount as the determinant of tuberculosis, not nurture. From a statistical inquiry into the incidence of tuberculosis in husband and wife and parent and child, Pearson concludes that exposure to infection as in married couples is of little importance, while inborn immunity or diathesis is a chief determinant. Admitting the value of his critical inquiries and the importance of diathesis, I would point out that in the last few years the rush and excitement of modern city life has increased, together with the confinement of workers to sedentary occupations in artificially lit, warm, windless atmospheres. The same conditions pertain to places of amusement, eating-houses, tube railways, &c.

Central heating, gas-radiators, and other contrivances are now displacing the old open fire and chimney. This change greatly improves the economical consumption of coal and the light and cleanliness of the atmosphere. But in so far as it promotes monotonous, windless, warm atmospheres, it is wholly against the health and vigour of the nation. The open fire and wide chimney ensure ventilation, the indrawing of cold outside air, streaky air—restless currents at different temperatures, which strike the sensory nerves in the skin and prevent monotony and weariness of spirit. By the old open fires we were heated with radiant heat. The air in the rooms was drawn in cool and varied in temperature. The radiator and hot-air system give us a deadly uniformly heated air—the very conditions we find most unsupportable on a close summer's day.

In Labrador and Newfoundland, Dr. Wakefield tells me, the mortality of the fisherfolk from tuberculosis is very heavy. It is generally acknowledged to be four per 1000 of the population per annum, against 1·52 for England and Wales. Some of the Labrador doctors talk of seven and even eight per 1000 in certain districts. The general death-rate is a low one. The fishermen fish off shore, work for many hours a day in the fishing season, and live with their families on shore in one-roomed shanties. These shanties are built of wood, the crannies are "stogged" with moss, and the windows nailed up, so that ventilation is very imperfect. They are heated by stoves and kept at a very high temperature, *e.g.*, 80° F. Outside in the winter the temperature may be 30 degrees below freezing. The women stay inside the shanties almost all their time, and the tuberculosis rate is somewhat higher in them. The main food is white bread, tea stewed in the pot till black, fish occasionally, a little margarine and molasses. The fish is boiled and the water thrown away. Game has become scarce in recent years; old, dark-coloured flour—spoken of with disfavour—has been replaced by white flour. In consequence of this diet beri-beri has become rife to a most serious extent, and the hospitals are full of cases. Martin Flack and I have found by our feeding experiments that rats, mice, and pigeons cannot be maintained on white bread and water, but can live on wholemeal, or on white bread in which we incorporate an extract of the sharps and bran in sufficient amount. Recent work has shown the vital importance of certain active principles present in the outer layers of wheat, rice, &c., and in milk, meat, &c., which are destroyed by heating to 120° C. A diet of white bread or polished rice and tinned food sterilised by heat is the cause of beri-beri. The metabolism is endangered by the artificial methods of treating foods now in vogue. As to the prevalency of tuberculosis in Labrador, we have to consider the intermarriage, the bad diet, the over-rigorous work of the fishermen, the overheating of, and infection in, the shanties. Dr. Wakefield has slept with four other travellers in a shanty with father, mother, and ten children. In some there is scarce room on the floor to lie down. The shanties are heated with a stove on which pots boil all the time; water runs down the windows. The patients are ignorant, and spit everywhere, on bed, floor, and walls. In the schools the heat and smell are most marked to one coming in from the outside air. In one school 50 cubic feet per child is the allowance of space. The children are eating all day long, and are kept in close hot confinement. They suffer very badly from decay of the teeth. Whole families are swept off with tuberculosis, and the child who leaves home early may escape, while the rest of a family dies.

Here, then, we have people living in the wildest and least populated of lands with the purest atmosphere suffering from all those ill-results which are found in the worst city slums—tuberculosis, beri-beri, and decayed teeth.

The bad diet probably impels the people to conserve their body heat and live in the over-warm, confined atmosphere, just as our pigeons fed on white bread sit, with their feathers out, huddled together to keep each other warm. The metabolism, circulation, respiration, and expansion of the lung are all reduced. The warm, moist atmosphere lessens the evaporation from the respiratory tract, and therefore the transudation of tissue lymph and activity of the ciliated epithelium. The unexpanded parts of the lung are not swept with blood. Everything favours a lodgment of the bacilli, and lessens the defences on which immunity depends. In the mouth, too, the immune properties of the saliva are neutralised by the continual presence of food, and the temperature of the mouth is kept at a high level, which favours bacterial growth. Lieutenant Siem informs me that recently in Northern Norway there has been the same notable increase in tuberculosis. The old cottage fireplaces with wide chimneys have been replaced with American stoves. In olden days most of the heat went up the chimney, and the people were warmed by radiant heat. Now the room is heated to a uniform moist heat. The Norwegians nail up the windows and never open them during the winter. At Lofoten, the great fishing centre, motor-boats have replaced the old open sailing and row boats. The cabin in the motor-boat is very confined, covered in with watertight deck, heated by the engine, crowded with six or eight workers. When in harbour the fishermen used to occupy ill-fitted shanties, through which the wind blew freely; now, to save rent, they sleep in the motor-boat cabins.

Here, again, we have massive infection, and the reduction of the defensive mechanisms by the influence of the warm, moist atmosphere.

The Norwegian fishermen feed on brown bread, boiled fish, salt mutton, margarine, and drink, when in money, beer and schnapps; there is no gross deficiency in diet, as in Labrador, and beri-beri does not attack them. They return home to their villages and longshore fishing when the season is over. The one new condition which is common to the two districts is confinement in stove-heated, windless atmospheres. In old days the men were crowded together, but in open boats or in draughty shanties, and had nothing but little cooking-stoves.

The conditions of great cities tend to confine the worker in the office all way, and to the heated atmosphere of club, cinema show, or music hall in the evening. The height of houses prevents the town dweller from being blown upon by the wind, and, missing the exhilarating stimulus of the cool, moving air, he repels the dull uniformity of existence by tobacco

and by alcohol, or by indulgence in food, *e.g.*, sweets, which are everywhere to his hand, and by the nervous excitement of business and amusement. He works, he eats, and is amused in warm, windless atmospheres, and suffers from a feeble circulation, a shallow respiration, a disordered digestion, and a slow rate of metabolism.

Many of the employments of modern days are detestable in their long hours of confinement and monotony. Men go up and down in a lift all day, and girls in the bloom of youth are set down in tobacco stalls in underground stations, and their health and beauty there fade while even the blow-flies are free to bask in the sun. In factories the operatives feed machines, or reproduce the same small piece of an article day after day. There is no art, or change; no pleasure in contrivance and accomplishment. The miner, the fisherman, even the sewer-man, face difficulties, changing risks, and are developed as men of character and strength. Contrast the sailor with the steward on a steamer, the drayman outside with the clerk inside who checks the goods delivered at some city office, the butcher and the tailor, the seamstress and the market woman, and one sees the enormous difference which a confined occupation makes. Monotonous sedentary employment makes for unhappiness because the inherited functional needs of the human body are neglected, and education—when the outside field of interest is narrowed—intensifies the sensitivity to the bodily conditions. The sensations arising within the body—proprioceptive sensations—come to have too large a share in consciousness in comparison with exteroceptive. In place of considering the lilies how they grow, or musing on the beauty and motions of the heavenly bodies, the sedentary worker in the smoke-befouled atmosphere, with the limited activity and horizon of an office and a disturbed digestion, tends to become confined to the inward consideration of his own viscera and their motions.

Many of the educated daughters of the well-to-do are no less confined at home; they are the flotsam and jetsam cast up from the tide in which all others struggle for existence—their lives are no less monotonous than the sweated sempstress or clerk. They become filled with "vapours" and some seek excitement not at the cannon's mouth but in breaking windows, playing with fire, and hunger strikes. The dull monotony of idle social functions, shopping and amusement no less than that of sedentary work and an asexual life, impels to a simulated struggle—a theatrical performance, the parts of which are studied from the historical romances of revolution. Each man, woman, and child in the world must find the wherewithal for living, food, raiment, warmth, and housing, or must die or get some other to find it for him. It seems to me as if the world is conducted as if ten men were on an island—a microcosm—and five sought for the necessaries of life, hunted for food, built shelters and fires, made clothes of skins, while the other five strung necklaces of shells, made loincloths of butterfly wings, gambled with knuckle-bones, drew comic pictures in the sand, or carved out of clay frightening demons, and so beguiled from the first five the larger share of their wealth. In this land of factories, while the many are confined to mean streets and wretched houses, possessing no sufficiency of baths and clean clothing, and are ill-fed, they work all day long, not to fashion for themselves better houses and clothing, but to make those unnecessaries such as "the fluff" of women's apparel, and a thousand trifles which relieve the monotony of the idle and bemuse their own minds.

The discovery of radium and its disintegration as a source of energy has enabled the physicist to extend Lord Kelvin's estimate of the world's age from some thirty to a thousand million years. Arthur Keith does not hesitate to give a million of these years to man's evolution. Karl Pearson speaks of hundreds of thousands of years. The form of the human skull, the brain capacity of man, his skill as evidenced by stone implements and cave drawings of animals in action, was the same tens of thousands of years ago as now. For ages primitive man lived as a wild animal in tropical climes, discovered how to make fire, clothe himself in skins, build shelters, and so enable himself to wander over the temperate and arctic zones. Finally, in the last few score of years, he has made houses draughtless with glass windows, fitted them with stoves and radiators, and every kind of device to protect himself from cold, while he occupies himself in the sedentary pursuits and amusements of a city life. How much better, to those who know the boundless horizon of life, to be a frontiersman and enjoy the struggle, with body hardened, perfectly fit, attuned to nature, than to be a cashier condemned to the occupation of a sunless, windless pay-box. The city child, however, nurtured and educated in confinement, knows not the largeness and wonders of Nature, is used to the streets with their ceaseless movement and romantic play of artificial light after dark, and does not need the commiseration of the country mouse any more than the beetle who lives in the dark and animated burrows of his heap. But while outdoor work disciplines the body of the countryman into health, the town man needs the conscious attention and acquired educated control of his life to give him any full measure of health and happiness.

Experimental evidence is strongly in favour of my argument that the chemical purity of the air is of no importance. Analyses show that the oxygen in the worst-ventilated school-room, chapel, or theatre is never lessened by more than 1 per cent. of an atmosphere; the ventilation through chink and cranny, chimney, door, and window, and the porous brick wall, suffices to prevent a greater diminution. So long as there is present a partial pressure of oxygen sufficient to change the hæmoglobin of the venous blood into oxyhæmoglobin there can arise no lack of oxygen.

At sea-level the pressure of oxygen in the pulmonary alveolar air is about 100 mm. Hg. Exposed to only half this pressure the hæmoglobin is more than 80 per cent. saturated with oxygen.

In noted health-resorts of the Swiss mountains the barometer stands at such a height that the concentration of oxygen is far less than in the more ventilated room. On the high plateau of the Andes there are great cities: Potosi with a hundred thousand inhabitants is at 4,165 metres, and the partial pressure of oxygen there is about 13 per cent. of an atmosphere in place of 21 per cent. at sea-level; railways and mines have been worked up to altitudes of 14,000 to 15,000 feet. At Potosi girls dance half the night, and toreadors display their skill in the ring. On the slopes of the Himalayas shepherds take their flocks to altitudes of 18,000 feet. No disturbance is felt by the inhabitants or those who reach these great altitudes slowly and by easy stages. The only disability to a normal man is diminished power for severe exertion, but a greater risk arises from want of oxygen to cases of heart disease, pneumonia, and in chloroform anæsthesia at these high altitudes. The newcomer who is carried by the railway in a few hours to the top of Pike's Peak or the Andes may suffer severely from mountain sickness, especially on exertion, and the cause of this is want of oxygen. Acclimatisation is brought about in a few days' time. The pulmonary ventilation increases, the bronchial tubes dilate, the circulation becomes more rapid. The increased pulmonary ventilation lowers the partial pressure of carbon dioxide in the blood and pulmonary air, and this con-

tributes to the maintenance of an adequate partial pressure of oxygen. Haldane and Douglas say that the percentage of red corpuscles and total quantity of the hæmoglobin increases, and maintain that the oxygen is actively secreted by the lung into the blood, but the CO method by which their determinations have been made has not met with unqualified acceptance. If waste products, which arise from oxygen want, alter the combining power of hæmoglobin, this alteration may not persist in shed blood; for these products may disappear when the blood is exposed to air. Owing to the combining power of hæmoglobin the respiratory exchange and metabolism of an animal within wide limits are independent of the partial pressure of oxygen. On the other hand, the process of combustion is dependent not on the pressure, but on the percentage of oxygen. Thus the aeroplanist may become seized with altitude sickness from oxygen want, while his gas engine continues to carry him to loftier heights.

The partial pressure of oxygen in a mine at a depth of 3000 feet is considerably higher than at sea-level, and if the percentage is reduced to 17, while the firing of fire-damp and coal-dust is impossible, there need be in the alveolar air of the lungs no lower pressure of oxygen than at sea-level. Thus the simplest method of preventing explosions in coal mines is that proposed by J. Harger, viz., to ventilate them with air containing 17 per cent. of oxygen.[1] There is little doubt that all the great mine-explosions have been caused by the enforcement of a high degree of chemical purity of the air. In the old days when ventilation was bad there were no great dust explosions. Mr. W. H. Chambers, general manager of the Cadeby mine, where the recent disastrous explosion occurred, with the authority of his great and long practical experience of fiery mines, told me that the spontaneous combustion of coal and the danger of explosion can be wholly met by adequate diminution in ventilation. The fires can be choked out while the miners can still breathe and work. The Coal Mines Regulation Act enforces that a place shall not be in a fit state for working or passing therein, if the air contains either less than 19 per cent. of oxygen, or more than 1¼ per cent. of carbon dioxide. A mine liable to spontaneous combustion of coal may be exempted from this regulation by order of the Secretary of State.

The regulations impel the provision of such a ventilation current that the percentage of oxygen is sufficient for the spread of dust explosions along the intake airways, with the disastrous results so frequently recorded. If the mine were ventilated with air containing 17 per cent. of oxygen in sufficient volume to keep the miners cool and fresh, not only would explosions be prevented, but the mines could be safely worked and illuminated with electricity, and miners' nystagmus prevented, for this is due to the dim light of the safety lamp. The problem possibly may be solved by purifying and cooling the return air, and mixing and circulating this with a sufficiency of fresh air.

Owing to the fact that the percentage of CO_2 is the usual test of ventilation and that only a very few parts per 10,000 in excess of fresh air are permitted by the English Factory Acts, it is generally supposed that CO_2 is a poison, and that any considerable excess has a deleterious effect on the human body. No supposition could be further from the truth.

The percentage of CO_2 in the worst ventilated room does not rise above 0·5 per cent., or at the outside 1 per cent. It is impossible that any excess of CO_2 should enter into our bodies when we breathe such air, for whatever the percentage of CO_2 in the atmosphere may be, that in the pulmonary air is kept constant at about 5 to 6 per cent. of an atmosphere—by the action of the respiratory centre. It is the concentration of CO_2 which rules the respiratory centre, and to such purpose as to keep the concentration both in the lungs and in the blood uniform (Haldane); the only result from breathing air containing 0·5 to 1 per cent. of CO_2 is an inappreciable increase in the ventilation of the lungs. The very same thing happens when we take gentle exercise and produce more CO_2 in our bodies.

At each breath we rebreathe into our lungs the air in the nose and large air-tubes (the dead-space air), and about one-third of the air which is breathed in by a man at rest in dead-space air. Thus, no man breathes in pure outside air into his lungs. When a child goes to sleep with its head partly buried under the bedclothes, and in a cradle confined by curtains, he rebreathes the expired air to a still greater extent, and so with all animals that snuggle together for warmth's sake. Not only the new-born babe sleeping against its mother's breast, but pigs in a sty, young rabbits, rats, and mice clustered together in their nests, young chicks under the brooding hen, all alike breathe a far higher percentage than that allowed by the Factory Acts.

To rebreathe one's own breath is a natural and inevitable performance, and to breathe some of the air exhaled by another is the common lot of men who, like animals, have to crowd together and husband their heat in fighting the inclemency of the weather.

In the Albion Brewery we analysed on three different days the air of the room where the CO_2 generated in the vats is compressed and bottled as liquid carbonic acid. We found from 0·14 to 0·93 per cent. of CO_2 in the atmosphere of that room. The men who were filling the cylinders and turning the taps on and off to allow escape of air must often breathe more than this. The men engaged in this occupation worked twelve-hour shifts, having their meals in the room. Some had followed the same employment for eighteen years, and without detriment to their health. It is only when the higher concentrations of CO_2 are breathed, such as 3 to 4 per cent. of an atmosphere, that the respiration is increased, so that it is noticeable to the resting individual; but percentages over 1 per cent. diminish the power to do muscular work, for the excess of CO_2 produced by the work adds its effect to that of the excess in the air, and the difficulty of coordinating the breathing to the work in hand is increased.

Haldane and Priestley found that with a pressure of 2 per cent. of an atmosphere of CO_2 in the inspired air the pulmonary ventilation of a man at rest was increased 50 per cent., with 3 per cent. about 100 per cent., with 4 per cent. about 200 per cent., with 5 per cent. about 300 per cent., and with 6 per cent. about 500 per cent. With the last, panting is severe, while with 3 per cent. it is unnoticed until muscular work is done, when the panting is increased 100 per cent. more than usual. With more than 6 per cent. the distress is very great, and headache, flushing, and sweating occur.

Divers who work in diving dress and men who work in compressed-air caissons constantly do heavy and continuous labour in concentrations of CO_2 higher than 1 per cent. of an atmosphere, and so long as the CO_2 is kept below 2 to 3 per cent. they are capable of carrying out efficient work. In the case of workers in compressed air it is important to bear in mind that the effect of the CO_2 on the breathing depends on the partial pressure and not on the percentage of this gas in the air breathed.

By a series of observations made on rats confined

[1] Trans. Inst. of Mining Engineers, 1912.

in cages fitted with small, ill-ventilated sleeping-chambers, we have found that the temperature and humidity of the air—not the percentage of carbon dioxide or oxygen—determines whether the animals stay inside the sleeping-room or come outside. When the air is cold, they like to stay inside, even when the carbon dioxide rises to 4 to 5 per cent. of an atmosphere. When the sleeping-chamber is made too hot and moist they come outside.

The sanitarian says it is necessary to keep the CO_2 below 0·01 per cent., so that the organic poisons may not collect to a harmful extent. The evil smell of crowded rooms is accepted as unequivocal evidence of the existence of such. He pays much attention to this and little or none to the heat and moisture of the air. The smell arises from the secretions of the skin, soiled clothes, &c. The smell is only sensed by and excites disgust in one who comes to it from the outside air. He who is inside and helps to make the "fugg" is both wholly unaware of, and unaffected by it. Flügge points out, with justice, that while we naturally avoid any smell that excites disgust and puts us off our appetite, yet the offensive quality of the smell does not prove its poisonous nature. For the smell of the trade or food of one man may be horrible and loathsome to another not used to such.

The sight of a slaughterer and the smell of dead meat may be loathly to the sensitive poet, but the slaughterer is none the less healthy. The clang and jar of an engineer's workshop may be unendurable to a highly-strung artist or author, but the artificers miss the stoppage of the noisy clatter. The stench of glue-works, fried-fish shops, soap and bone-manure works, middens, sewers, become as nothing to those engaged in such, and the lives of the workers are in no wise shortened by the stench they endure. The nose ceases to respond to the uniformity of the impulse, and the stench clearly does not betoken in any of these cases the existence of a chemical organic poison. On descending into a sewer, after the first ten minutes the nose ceases to smell the stench; the air therein is usually found to be far freer from bacteria than the air in a schoolroom or tenement.

If we turn to foodstuffs we recognise that the smell of alcohol and of Stilton or Camembert cheese is horrible to a child, while the smell of putrid fish—the meal of the Siberian native—excites no less disgust in an epicure, who welcomes the cheese. Among the hardiest and healthiest of men are the North Sea fishermen, who sleep in the cabins of trawlers reeking with fish and oil, and for the sake of warmth shut themselves up until the lamp may go out from want of oxygen. The stench of such surroundings may effectually put the sensitive, untrained brain worker off his appetite, but the robust health of the fisherman proves that this effect is nervous in origin, and not due to a chemical organic poison in the air.

Ventilation cannot get rid of the source of a smell, while it may easily distribute the evil smell through a house. As Pettenkofer says, if there is a dung-heap in a room, it must be removed. It is no good trying to blow away the smell.

Flügge and his school bring convincing evidence to show that a stuffy atmosphere is stuffy owing to heat stagnation, and that the smell has nothing to do with the origin of the discomfort felt by those who endure it. The inhabitants of reeking hovels in the country do not suffer from chronic ill-health, unless want of nourishment, open-air exercise, or sleep come into play. Town workers who take no exercise in the fresh air are pale, anæmic, listless. Sheltered by houses they are far less exposed to winds, and live day and night in a warm, confined atmosphere.

The widespread belief in the presence of organic poisons in the expired air is mainly based on the statements of Brown Sequard and D'Arsenval, statements wholly unsubstantiated by the most trustworthy workers in Europe and America. These statements have done very great mischief to the cause of hygiene, for they led ventilating engineers and the public to seek after chemical purity, and neglect the attainment of adequate coolness and movement of the air. It was stated that the condensation water obtained from expired air is poisonous when injected into animals. The evidence on which this statement is based is not only not worthy of credence but is absurd, *e.g.* condensation water has been injected into a mouse in a quantity equivalent to injecting 5 kilogrammes into a man weighing 60 kilogrammes. No proper controls were carried out. It is recognised now that any distilled water contaminated by bacterial products may have a toxic effect. Flack and I have for fourteen weeks kept guinea-pigs and rats confined together in a box and poorly ventilated, so that they breathed air containing 0·5 to 1·0 per cent. of CO_2. The guinea-pigs proved wholly free from anaphylactic shock on injecting rats' serum. Therefore they were not sensitised by breathing the exhaled breath of the rats for many weeks, and we are certain that no foreign protein substance is absorbed in this way. It has been proved by others, and by us, that animals so confined do well so long as they are well fed and their cages kept clean, light, cool, and dry. It is wholly untrue that they are poisoned by breathing each other's breath. The only danger arises from droplet contagion in cases of infective disease.

To study the relative effect of the temperature and chemical purity of the atmosphere, I constructed a small experimental chamber of wood fitted with large glass observation windows and rendered airtight.

On one side of the chamber were fixed two small electric heaters, and a tin containing water was placed on these in order to saturate the air with water vapour. On another side of the chamber was placed a large radiator through which cold water could be circulated when required, so as to cool the chamber. In the roof were fixed three electric fans, one big and two small, by means of which the air of the chamber could be stirred. The chamber held approximately 3 cm. of air. In one class of experiments we shut within the chamber seven or eight students for about half an hour, and observed the effect of the confined atmosphere upon them. We kept them until the CO_2 reached 3 to 4 per cent., and the oxygen had fallen to 17 to 16 per cent. The wet-bulb temperature rose meanwhile to about 80° to 85° F., and the dry-bulb a degree or two higher. The students went in chatting and laughing, but by and by, as the temperature rose, they ceased to talk and their faces became flushed and moist. To relieve the monotony of the experiment we have watched them trying to light a cigarette, and, puzzled by their matches going out, borrowing others, only in vain. They had not sensed the diminution of oxygen, which fell below 17 per cent. Their breathing was deepened by the high percentage of CO_2, but no headache occurred in any of them from the short exposure. Their discomfort was relieved to an astonishing extent by putting on the electric fans placed in the roof. Whilst the air was kept stirred the students were not affected by the oppressive atmosphere. They begged for the fans to be put on when they were cut off. The same old stale air containing 3 to 4 per cent. CO_2 and 16 to 17 per cent. O_2 was whirled, but the movement of the air gave relief, because the air was 80° to 85° F. (wet bulb), while the air enmeshed in their clothes in contact with their skin was 98° to 99° F. (wet bulb). If we outside breathed through a tube the air in the chamber we felt none of the discomfort which was being experienced by those shut up inside. Similarly, if one of

those in the chamber breathed through a tube the pure air outside he was not relieved.

R. A. Rowlands and H. B. Walker carried out a large number of observations in the chamber, each acting as subject in turn.

They recorded the effect on the respiratory ventilation and on the pulse rate, both when resting and when working. The work consisted in pulling a 20-kilo. weight about 1 metre high by means of a pulley and rope.

In some of the experiments the exhaled carbonic acid was absorbed, and in others carbonic acid was put into the chamber. The subjects inside could not tell when the gas was introduced, not even if the percentage were suddenly raised by 2. The introduction of this amount of the gas made no sensible difference to them, but increased their pulmonary ventilation.

In every one of the experiments they suffered from the heat, and the putting on of the fans gave great relief, and in particular diminished the pulse rate during and after the working periods. The relief became much greater when cold water was circulated through the radiator and the temperature of the chamber lowered 10° F.

The subjects wore only a vest, pants, and shoes in most of these experiments. When they wore their ordinary clothing the effect on the frequency of the pulse was more marked and the discomfort from heat and moisture much greater.

I have made observations on men dressed in the Fleuss rescue apparatus for use in mines, and exposed in a chamber to 120° F. dry bulb and 95° F. wet bulb. The skin temperature rises to the rectal temperature and the pulse is greatly accelerated—*e.g.* to 150—and there arises danger of heat stroke. The conditions are greatly relieved by interposing on the inspiratory tube of the apparatus a cooler filled with carbonic acid snow. The cool inspired air lowers the frequency of the heart and makes it possible for the men to do some work at 95° F. wet bulb, and to endure this temperature for two hours.

The observations made by Pembrey and Collis on the weaving-mill operatives at Darwen show that the skin of the face may be 4° to 13° F. higher in the mill when the wet bulb is 71° F. than at home when the wet-bulb temperature is about 55° F. The tendency of the warm, humid atmosphere of the mill is to establish a more uniform temperature of the body as a whole (surface and deep temperatures) and to throw a tax upon the power of accommodation as indicated by the rapid pulse and low blood-pressure.

The mill workers are wet with the steam blown into the sheds, their clothes and bodies are moist, and the long hours of exposure to such uncomfortable conditions are most deleterious to physical vigour and happiness. The operatives asked that they might be allowed to work without steam-injectors and with diminished ventilation, so that the mill rooms became saturated with moisture evaporated from the bodies of the operatives. The old regulations, while forbidding more than 6 parts in 10,000 CO_2, put no limit to the wet-bulb temperature, and this often became excessive on hot summer days. The operatives were quite right. Less ventilation and a lower wet bulb is far better than ample ventilation and a high wet bulb. The permissible limit of CO_2 has now been raised to 11 parts in 10,000, and the wet-bulb temperature is to be controlled within reasonable limits.

The efficiency of workers in mills, mines, tunnels, stoke-holes, &c., is vastly increased by the provision of a sufficient draught of cool and relatively dry air, so as to prevent overtaxing of the heat-regulating mechanism. Mr. F. Green informs me that by means of forced draught the stokehole of an Orient steamer is rendered the coolest place when the ship is in the tropics.

The electric fan has vastly improved the conditions of the worker in the tropics. I would suggest that each clerk should have a fan just as much as a lamp on his desk. It will pay the employer to supply fans.

In the modern battleship men are confined very largely to places artificially lit and ventilated by air driven in by fans through ventilating-shafts. The heat and moisture derived from the bodies of the men, from the engines, from cooking-ranges, &c., lead to a high degree of relative moisture, and thus all parts of the ironwork inside are coated with granulated cork to hold the condensed moisture and prevent dripping.

The air smells with the manifold smells of oil, cooking, human bodies, &c., and the fresh air driven in by fans through the metal conduits takes up the smell of these, and is spoken of by the officers with disparagement as "tinned" or "potted" air. This air is heated when required by being made to pass over radiators. Many of the officers' cabins and offices for clerks, typewriters, &c., in the centre of a battleship, have no portholes, and are only lit and ventilated by artificial means. The steel nature of the structure prevents the diffusion of air which takes place so freely through the brick walls of a house. The men in their sleeping quarters are very closely confined, and as the openings of the air-conduits are placed in the roof between the hammocks, the men next to such openings receive a cold draught and are likely to shut the openings. To sleep in a warm moist "fugg" would not much matter if the men were actively engaged for many hours of the day on deck and there exposed to the open air and the rigours of sea and weather. In the modern warship most of the crew work for many hours under deck, and some of the men may scarcely come on deck for weeks or even months. Considering the conditions which pertain, it seems to be of the utmost importance that all the men in a battleship should be inspected at short intervals by the medical officers so that cases of tuberculosis may be weeded out in their incipiency. The men of every rating should do deck drill for some part of every day. In the Norwegian navy every man, cooks and all, must do gymnastic drill on deck once a day. In the case of our navy, with voluntary service, the men should welcome this in their own interest.

In a destroyer visited by me twelve men occupied quarters containing about 1700 cubic feet of air. There was a stove with iron pipe for chimney, from which fumes of combustion must leak when in use, and a fan which would not work. When the men are shut down the moisture is such that boots, &c., go mouldy, and the water drips off the structure. The cooling effect of the sea-water washing over the steel shell of the boat is beneficial in keeping down the temperature in these confined and ill-ventilated quarters. On the manœuvring platform in the engine-room the wet-bulb temperature reaches a very high degree owing to the slight escape of steam round the turbines. Commander Domvile was kind enough to send me the wet and dry bulb temperatures taken there on a number of days. The wet bulb was found to be never below 80° F., sometimes reaching 95° and even 98° F. It is impossible for officers to work at these temperatures without straining the heat-regulating mechanism of the body and diminishing their health and working capacity. If such wet-bulb temperatures are unavoidable, means should be provided, such as fans, which would alleviate the discomfort and fatigue caused thereby. A supply of compressed air fitted with a nozzle might be arranged and used occasionally to douche the body with cool air. I have tried this plan and found it very effectual.

and can recommend the compressed-air bath as the substitute for a bracing cold wind.

The suitability of the clothing is of the greatest importance, not only to the comfort but to the efficiency of man as a working machine, *e.g.* power of soldiers to march. On a still day the body is confined by the clothes as if by a chamber of stagnant air, for the air is enclosed in the meshes of the clothes and the layer in contact with the skin becomes heated to body temperature and saturated with moisture.

The observations of Pembrey show that himself and four soldiers, marching in drill order on a moderately warm day, lost more water and retained more water in their clothes than on another similar day when they worked with no jacket on. The average figures were loss of moisture 1600, against 1200 grms., and water retained in clothes 254, against 109 grms. With no jacket the pulse was, on the average, increased 28 against 41 in drill order, and rectal temperature 1° against 1·5° F. The taking off of the jacket or throwing open of the jacket and vest very greatly increase the physiological economy of a march. It is absurd that on a hot summer day Boy Scouts should march with coloured scarves knotted round their necks. Nothing should be worn for ornament or smartness which increases the difficulty of keeping down the body temperature. The power to march and the efficiency of an army depend on prevention of heart stagnation and avoidance of fatigue of the heart.

I conclude, then, that all the efforts of the heating and ventilating engineer should be directed towards cooling the air in crowded places and cooling the bodies of the people by setting the air in motion by means of fans. In a crowded room the air confined between the bodies and clothes of the people is almost warmed up to body temperature and saturated with moisture, so that cooling of the body by radiation, convection and evaporation becomes reduced to a minimum. The strain on the heat-regulating mechanism tells on the heart. The pulse is accelerated, the blood is sent in increased volume to the skin, and circulates there in far greater volume, while less goes through the viscera and brain. As the surface temperature rises, the cutaneous vessels dilate, the veins become filled, the arteries may become small in volume, and the blood-pressure low, the heart is fatigued by the extra work thrown upon it. The influence of the heat stagnation is shown by the great acceleration of the pulse when work is done, and the slower rate at which the pulse returns to its former rate on resting.

The increased percentage of carbonic acid and diminution of oxygen which has been found to exist in badly ventilated churches, schools, theatres, barracks, is such that it can have no effect upon the incidence of respiratory disease and higher death-rate which statistical evidence has shown to exist among persons living in crowded and unventilated rooms. The conditions of temperature, moisture, and windless atmosphere in such places primarily diminish the heat loss, and secondarily the heat production, *i.e.*, the activity of the occupants, together with total volume of air breathed, oxygen taken in and food eaten. The whole metabolism of the body is thus run at a lower plane, and the nervous system and tone of the body is unstimulated by the monotonous, warm, and motionless air. If hard work has to be done it is done under conditions of strain. The number of pathogenic organisms is increased in such places, and these two conditions run together—diminished immunity and increased mass influence of infecting bacteria.

The volume of blood passing through, and of water vapour evaporated from, the respiratory mucous membrane must have a great influence on the mechanisms which protect this tract from bacterial infection. While too wet an atmosphere lessens evaporation, a hot dry atmosphere dries up the mucous membrane. As the immunising powers depend on the passage of blood plasma into the tissue spaces, it is clear that a proper degree of moisture is important. The temperature, too, must have a great influence on the scavenger activity of the ciliated epithelium and leucocytes in the mucous membrane of the nose.

In the warm moist atmosphere of a crowded place the infection from spray, sneezed, coughed, or spoken out, is enormous. On passing out from such an atmosphere into cold moist air the respiratory mucous membrane of the nose is suddenly chilled, the blood-vessels constricted, and the defensive mechanism of cilia and leucocyte checked. Hence the prevalence of colds in the winter. In the summer the infection is far less. We are far more exposed to moving air, and the sudden transition from a warm to a cold atmosphere does not occur. I believe that infection is largely determined by (1) the mass influence of the infecting agent; (2) the shallow breathing and diminished evaporation from, and flow of tissue lymph through, the respiratory tract, in warm, moist confined air. Colds are not caught by exposure to cold *per se*, as is shown by the experience of Arctic explorers, sailors, shipwrecked passengers, &c.

We have very great inherent powers of withstanding exposure to cold. The bodily mechanisms become trained and set to maintain the body heat by habitual exposure to open-air life. The risk lies in overheating our dwellings and overclothing our bodies, so that the mechanisms engaged in resisting infection become enfeebled, and no longer able to meet the sudden transition from the warm atmosphere of our rooms to the chill outside air of winter. The dark and gloomy days of winter confine us within doors, and, by reducing our activity and exposure to open air, depress the metabolism; the influence of smoke and fog, gloom of house and streets, cavernous places of business and dark dwellings, intensify the depression. The immunity to a cold after an infection lasts but a short while, and when children return, after the summer holidays, to school and damp chill autumn days, infection runs around. The history of hospital gangrene and its abolition by the aseptic methods of Lister—likewise the history of insect-borne disease—show the great importance of cleanliness in crowded and much occupied rooms. The essentials required of any good system of ventilating are then (1) movement, coolness, proper degree of relative moisture of the air; (2) reduction of the mass influence of pathogenic bacteria. The chemical purity of the air is of very minor importance, and will be adequately insured by attendance to the essentials.

As the prevention of spray (saliva) infection by ventilation is impossible in crowded places, it behoves us to maintain our immunity at a high level. We may seek to diminish the spray output of those infected with colds by teaching them to cough, sneeze, and talk with a handkerchief held in front of the mouth, or to stay at home until the acute stage is past.

In all these matters nurture is of the greatest importance, as well as nature. A man is born with physical and mental capacities small or great, with inherited characteristics, with more or less immunity to certain diseases, with a tendency to longevity of life or the opposite, but his comfort and happiness in life, the small or full development of his physical and mental capacities, his immunity and his longevity of life, are undoubtedly determined to a vast extent by nurture.

By nurture—I use the word in its widest sense to include all the defensive methods of sanitary science—plague, yellow fever, malaria, sleeping-sickness, cholera, hospital gangrene, &c., can be prevented by eliminating the infecting cause; smallpox and typhoid by this means, and also by vaccination; and most of the other ills which flesh is supposed to be heir to can be kept from troubling by approximating to the rules of life which a wild animal has to follow in the matter of a simple, and often spare diet, hard exercise, and exposure to the open air.

There is nothing more fallacious than the supposition commonly held that over-feeding and over-coddling indoors promotes health. The two together derange the natural functions of the body. He who seeks to save his life will lose it.

The body of a new-born babe is a glorious and perfect machine, the heritage of millions of years of evolution.

> "Not in entire forgetfulness,
> And not in utter nakedness,
> But trailing clouds of glory do we come.
>
> . . . . . .
>
> Shades of the prison house begin to close
> Upon the growing Boy."

The ill-conditioned body, anæmic complexion and undersized muscles, or the fat and gross habit, the decay of the teeth, the disordered digestion, the nervous irritability and unhappiness are the result of "Nurture"—not Nature.

In institutions children may be disciplined to vigorous health. After leaving school they are set adrift to face monotonous work in confined places, amusement in music-halls and cinema shows in place of manly exercise in the open air, injudicious diet, alcohol, and tobacco—everything which the trainer of an athlete would repel.

> "And custom lie upon him with a weight
> Heavy as frost, and deep almost as life."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

SHEFFIELD.—The council of the University of Sheffield has made the following appointments:—(1) Dr. H. R. Dean, to the Joseph Hunter chair of pathology, in succession to Prof. J. M. Beattie, who has been appointed to the chair of bacteriology in the University of Liverpool. Dr. Dean is at present assistant bacteriologist to the Lister Institute of Preventive Medicine. (2) Mr. Leonard Southerns, to the post of junior lecturer and demonstrator in physics, *vice* Dr. J. Robinson, resigned. Mr. Southerns is at present chief assistant at the Eskdalemuir Observatory, N.B. The council received the resignation of Prof. F. W. Hardwick of the professorship of mining, owing to his retirement from active work. Prof. Hardwick has been on the staff since October, 1891.

A COURSE of fifteen lectures on Indian sociology will be delivered at East London College (University of London), Mile End Road, E., by Mr. T. C. Hodson (late of the Indian Civil Service), on Wednesdays at 5.30, commencing October 23. The lectures are open to the public without fee.

DR. A. N. WHITEHEAD, F.R.S., University reader in geometry, will deliver at University College, London, a non-technical course of lectures on "The General Ideas of the Science of Geometry" during the first two terms of the session. The course will begin on Tuesday, October 8, at 5 p.m.

THE opening of the session at Edinburgh University will see the inauguration of the new scheme for engineering degrees by which the full resources of the University and the Heriot-Watt College are utilised for the first time to enable students to specialise in the three departments of civil, mechanical, and electrical engineering.

A REUTER message from Cape Town states that in view of the fact that there is no precedent for the Sovereign's holding office in any university of the Empire, the King has resigned the Chancellorship of the Cape University with which his Majesty was invested on the occasion of his visit to South Africa in 1901 as Duke of Cornwall. The Duke of Connaught has accepted nomination to the Chancellorship in succession to the King.

ANNOUNCEMENT is made of two courses of post-graduate lectures to be delivered at University College (University of London), by Prof. J. A. Fleming, F.R.S. (Pender professor of electrical engineering). One course, on "Electromagnetic Waves and the Theory of Electrons," will be delivered on Wednesdays at 5 p.m., beginning Wednesday, November 6, and the other, on "Electric Wave Wireless Telegraphy," will begin on Wednesday, January 22, 1913.

AT the University of Bristol, the calendar of which for the session 1912–13 has been received, the bachelor's degree can be taken in engineering, both by day and evening students. The final part of the curriculum may be in civil, mechanical, electrical, or motor-car engineering. At Bristol also, it is interesting to note, the Senate of the University is authorised to confer a testamur in social study and in journalism—a further indication of the desire of the modern university to assist directly every kind of professional work.

THE best criterion of the vitality of a university is the record of its members' contributions to knowledge. The magnitude of such a list cannot, of course, be taken as a measure of the importance of the original work accomplished, but it indicates the activity of the various departments of the university to which the list refers, and shows that attention is not being concentrated unduly upon examination standards. A list of memoirs, papers, &c., published during the years 1909–1912 by members of the teaching staff, scholars and fellows, research students, and others connected with the University of Glasgow has just been received, and it provides convincing evidence of the large amount of literary and scientific work published by members of the University. The uniform distribution of these products through all departments should be a particular cause of gratification to the principal.

THE needs of students of applied science receive increasing attention year by year from university authorities in different parts of the country. The new calendar of Armstrong College, Newcastle-upon-Tyne, one of the constituent colleges of the University of Durham, shows that here, for example, students, in addition to being able to obtain the degree of bachelor of science in pure science, may, if they prefer, offer instead one of seven branches of applied science. Degrees may, in fact, be obtained in agriculture, mechanical and marine engineering, electrical engineering, civil engineering, naval architecture, mining, or metallurgy. The calendar shows, too, that the active cooperation of engineering and shipbuilding firms in the district has been secured. Many manufacturers have promised to cooperate with the college by receiving pupils in the several departments of their works and in their drawing offices, and by permitting them to devote themselves exclusively during two or three sessions to their college studies.

THE prospectus for the session 1912–13 of the day and evening college for men and women at the South-Western Polytechnic, Chelsea, serves excellently to

illustrate the very complete provision for higher education provided by the London polytechnic institutions. In both the day and evening classes at Chelsea students can prepare for degrees at the University of London under favourable conditions. In the day college those students who enter for technical instruction should have received previously, the prospectus points out, a sound English education and should have acquired an elementary knowledge of mathematics, and, if possible, of physics and chemistry. The courses are arranged to occupy three years. On entering the student states whether he wishes to be trained as a mechanical or electrical engineer, or as a consulting or industrial chemist. In any of these cases he will find mapped out for him a complete course of study, involving laboratory instruction and instruction in the workshops. Students, having completed a three years' course, should be in a position to obtain situations, in many cases without payment of premium, in important industrial firms. Similarly in the evening classes, instruction is provided in a wide range of scientific, technological, and other subjects.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, September 23.—M. A. Grandidier in the chair.—E. L. **Bouvier**: *Caridinopsis chevalieri,* and the genera of the Atyideæ peculiar to tropical Africa.—Henri **Douvillé**: The Orbitolines and their connections.—A. **Verschaffel**: The earthquake of the night of September 14–15, 1912. An account of the phenomena observed at the Observatory of Abbadia.—**Claude** and **Driencourt**: The orthostathmescope or intrument for observing the passage through the zenith of the alignment of two stars on the celestial sphere.—Th. **De Donder**: The invariants of the calculus of variations.—N. **Lusin**: The absolute convergence of trigonometric series.—F. **Briner** and E. L. **Durand**: The conditions of formation of nitrous and nitric acids starting from the oxides of nitrogen and water; application of the law of mass action. Nitric oxide was compressed with solutions of nitric acid of varying concentrations; a general account of the changes noted is given, full details being reserved for a later paper.—Félix **Robin**: The crystallisation of metals by annealing. The metals examined included tin, lead, zinc, aluminium, copper, and iron. The grain developed by annealing was studied by etching with suitable liquids and microscopic examination.—H. **Jumelle** and H. Perrier de la **Bathe**: The cabbage palm of Madagascar.—M. **Chaillot**: The biology and anatomy of Labiates with subterranean stolons.—A. **Desmoulière**: The antigenic bodies in the Wassermann reaction. An account of the effects of the addition of cholesterol to the alcoholic extract of syphilitic liver. The sensibility and keeping powers are increased.—Maurice **Piettre**: The influence of some chemical compounds on the artificial melanines.

BOOKS RECEIVED.

The Simple Carbohydrates and the Glucosides. By Dr. E. F. Armstrong. Second edition. Pp. viii+171. (London: Longmans, Green and Co.) 5*s.* net. (Monographs on Biochemistry.)

Oxidations and Reductions in the Animal Body. By Dr. H. D. Dakin. Pp. viii+135. (London: Longmans, Green and Co.) 4*s.* (Monographs on Biochemistry.)

The Teratology of Fishes. By Dr. J. F. Gemmill. Pp. xvii+74+xxvi plates. (Glasgow: J. MacLehose and Sons.) 15*s.* net.

Wild Flowers as They Grow. Photographed in Colour direct from Nature. By H. Essenhigh Corke, with descriptive text by G. Clarke Nuttall. Fourth series. Pp. viii+300. (London: Cassell and Co., Ltd.) 5*s.* net.

Mind and its Disorders. By Dr. W. H. D. Stoddart. Second edition. Pp. xvi+518. (London: H. K. Lewis.) 12*s.* 6*d.* net.

South America: Observations and Impressions. By James Bryce. Pp. xxv+611. (London: Macmillan and Co., Ltd.) 8*s.* 6*d.* net.

Greek Sculpture: One Hundred Illustrations. By J. Warrack. Pp. xxx+plates. (Edinburgh: G. Schulze and Co.) 3*s.* 6*d.* net.

Twelve Moons. By F. A. Bardswell. Pp. 91. (London: Elkin Matthews.) 2*s.* 6*d.* net.

Radnorshire. By L. Davies. Pp. xi+156. (Cambridge University Press.) 1*s.* 6*d.* (Cambridge County Geographies.)

Celluloid: its Manufacture, Applications, and Substitutes. By Masselon, Roberts, and Cillard. Translated from the French by Dr. H. H. Hodgson. Pp. xx+356. (London: C. Griffin and Co., Ltd.) 25*s.* net.

Modern Mine Valuation. By M. H. Burnham. Pp. xi+160. (London: C. Griffin and Co., Ltd.) 10*s.* 6*d.* net.

Leuchtende Pflanzen. By Dr. H. Molisch. Zweite Auflage. Pp. viii+198. (Jena: Gustav Fischer.) 7.50 marks.

Legends of Our Little Brothers: Fairy Lore of Bird and Beast. Retold by L. Gask. Pp. 268. (London: G. G. Harrap and Co.) 3*s.* 6*d.* net.

Modern Problems. By Sir Oliver Lodge. Pp. vii+320. (London: Methuen and Co., Ltd.) 5*s.* net.

Treatise on General and Industrial Inorganic Chemistry. By Dr. E. Molinari. Third edition. Translated by Dr. E. Feilmann. Pp. xvi+704. (London: J. and A. Churchill.) 21*s.* net.

The Birds of Africa. By G. E. Shelley. Vol. v., part ii. Pp. viii+165–502+plates. (London: H. Sotheran and Co.) 1*l.* 11*s.* 6*d.* net.

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