THURSDAY, SEPTEMBER 1, 1904.

AMERICAN AND BRITISH YACHTING.

American Yachting. By W. P. Stephens. Pp. ix+380. (London: Macmillan and Co., Ltd.) Price 8*s.* 6*d.* net.

THIS excellent book not merely contains a well written history of American yachting, but puts on record the principal points in the development of yacht designing, both in the United States and in this country, during the fifty years since the famous *America* came to this country (in 1851) and astonished English yachtsmen by her remarkable performances. The contests between English and American yacht designers have been continuous and keen, including struggles for the America Cup as well as matches of equal or possibly greater interest between yachts of many classes. Some of these have received little attention, although the results have had considerable influence on later construction. The author is a keen sportsman, fully informed upon all branches of his subject, and capable—as many other yachtsmen are in these days—of discussing the problems of yacht design on a scientific basis. Americans have inherited from this country the love of yachting as a sport, and have given repeated proofs that they are formidable rivals in the design and management of yachts. They have gradually reached an appreciation of what Mr. Stephens describes as "the importance of Yachting to a maritime nation." He says:—

"It is a stimulus to the advancement of Naval Architecture, such as is necessary in maintaining the Naval and Merchant Fleets at the highest standard; it is a training school for seamen both amateur and professional; and its mimic battles are constant reminders of the necessity for perpetual progress in all details of Naval development."

As to its influence on individual yachtsmen, Mr. Stephens considers that yachting

"can fairly claim a place amongst the arts and sciences as a purely intellectual pursuit. The Science of Yacht designing, a branch of Yachting which many amateurs follow as a recreation, offers an unlimited field for study and research. The man who can design his own Yacht, large or small, construct her, or at least plan and supervise the construction, and finally can guide her to the head of the fleet with his hand on the tiller, his active brain anticipating each move of clever opponents, may well lay claim to one of the highest achievements within the reach of any sportsman."

Concurrently with the abandonment of "rule of thumb" methods in yacht design, there has been an important change in regard to the publication of information respecting the forms and equipment of yachts. Formerly, secrecy was the rule. Yacht owners took elaborate precautions to prevent the publication of details. Very often this secrecy was associated with an ignorance of principles, resulting in false estimates of the relative value and importance of causes influencing success. The late Mr. Dixon Kemp did much to break down this practice; his books on yachting remain valuable to this day. Mr. Stephens does not enter into technicalities so fully as Mr. Dixon Kemp did, but he writes with intelligence and a grasp of principles, and his summary of events is accompanied by an analysis of distinctive features in successive designs which can be read with interest even by naval architects. He traces the influence of local conditions, and of rules of measurement for competitive sailing, upon American and British yachts. He indicates clearly how these widely differing types have, in process of time and as the result of continuous competition, gradually approximated, and led to the production of vessels on both sides of the Atlantic closely resembling one another in their main features. He gives illustrations of the general principle that as soon as a rule for time allowance is established, yacht designers begin to exercise their ingenuity so as to produce vessels which shall get the greatest possible advantage in time allowance under the particular rule in force, and he shows how, in some cases, very unsatisfactory types have been brought into existence simply for racing purposes. The story of the contests for the America Cup is told with fairness and good feeling. Like most practical yachtsmen, he does not consider that yachting has benefited on the whole thereby. He is too good a yachtsman to favour the production of mere "racing machines," and his opinion of the latest example of American skill (the *Reliance*) is noteworthy, being summed up in the words that while she "represented a new and extreme step in the development of the racing machine, her whole form is confessedly bad for all purposes but cup-racing." In his judgment the tendency of international racing has been to minimise the importance of model and construction, and to increase the influence of the designer, owner, and skipper. His remarks on the "challengers" in recent years run counter to the popular view. He directs attention to the fact that recent challenges have not come from yachtsmen who sail their own yachts, but from men of ample means with little or no yachting experience, who see, in the publicity attending a cup match, a means of advertising themselves.

Incidentally, Mr. Stephens brings into relief the fact that, in the United States, the design of the most successful yachts in recent years has been the work of men of considerable culture and scientific knowledge, like Burgess and the younger Herreshoff. Further, he makes perfectly clear the thoroughness of the study devoted to every problem affecting ultimate success. Not merely has close attention been given to form, stability, and sail equipment, but no expense is spared in the United States to obtain the best possible materials—thus associating strength with lightness; in modifying structural arrangements for the same purpose, or in arranging every item affecting efficiency and rapid working of sails. He frankly acknowledges that in all these matters (which greatly influence the result of yacht racing) his countrymen have obtained substantial advantages over ourselves, and equally he shows his appreciation of the favourable conditions under which they can proceed in drilling their crews and "tuning up" the vessels (to use an American expression) before the cup races take place. To one fact, however, he hardly attaches adequate importance.

namely, that as British yachts have to cross the Atlantic in order to take part in the cup races, they can never be built with that extreme lightness of hull which is possible in vessels constructed on the American coast. This undoubtedly counts for much.

Mr. Stephens is an advocate of yachting as a sport, not in the sense of the races for the America or Seawanhaka Cups. He believes in the Corinthian style of yachting—owners working their own vessels. It is obvious that if he could have his way mere racing machines would disappear. Some incidents which he describes as to the performances of American yachts, and the special risks run in consequence of the production of racing machines, are very striking. Only one can be mentioned, that of the *Mohawk*, a centre-board schooner 140 feet long and more than 30 feet broad, with a depth of hold of less than 9½ feet. This vessel drew only 6 feet when her centre-board was housed. Her sail area was enormous, and she had great initial stability; but in 1876, when at anchor off Staten Island, with all sails set and sheets made fast, she was capsized and sank, carrying with her half a dozen persons. On this side we have had equally extreme dimensions, but under our sailing rules, fortunately, there has not been the same inducement to accept serious risks; our vessels have not been lacking in stability in the sense that they were liable to be capsized.

The book may be heartily commended to all interested in yachting, either as a sport deserving continuance or as a branch of ship design.

W. H. WHITE.

A COMPREHENSIVE WORK ON PHYSICS.

Lehrbuch der Physik. By O. D. Chwolson. Translated into German by H. Pflaum. Second volume. Pp. xxii + 1056. (Brunswick: Vieweg und Sohn, 1904.) Price 18 marks.

A SERIOUS problem is presenting itself to lecturers and writers of text-books on physics. Never, perhaps, has there been such rapid accumulation of knowledge, both in respect to phenomena the fundamental facts of which were found out in the early ages of physical discovery and in respect to new phenomena which reveal themselves in succession to the physical investigator. The brilliant experimental discoveries of Faraday in electrodynamics, the equally distinguished theoretical and experimental researches of Fresnel in optics, the researches of Mayer, Helmholtz, Lord Kelvin, Clausius, and Joule in thermodynamics, which are unsurpassed in importance owing to their wide reaching application to almost every branch of physics, all these make the first half of the nineteenth century unique as an age of physical discovery. This period was followed by one of comparative quiet, in which physicists began to acquire a comfortable feeling that the universe was now known; details undoubtedly there were to be made out, but no striking discovery was expected. This attitude of content was roughly disturbed by the discovery of Röntgen rays in 1895, and still more startlingly so by the discovery of various other types of rays and emanations by Becquerel and his followers. Each of these discoveries has given birth in a most prolific way to a vast crowd of minor discoveries demanding a history of their own; and meanwhile the accumulation of fact and theory in older subjects has steadily gone on, and the problem which presents itself is, How is this huge and ever increasing amount of knowledge to be successfully presented to a student? It is becoming unmanageable. No single course of lectures can deal adequately with it. College courses are beginning to spread over two years, and even then merely skim the subject. The text-book under review illustrates the state of things. It is the second volume out of four. It extends to more than a thousand pages, and deals only with sound and with radiant energy. It contains no elaborate development of mathematical theory—in fact, the weak point of the book is that there is not enough mathematics in it. Wherever the mathematics required is other than of simple kind it is omitted; the final formula may be given, but it is often quoted unproven. How is a student to master the vast mass of material which is extended to him here? It seems inevitable that before long some process of selection must be adopted in order that a student's work may be made more easy for him. Of course, if a book is intended as a book of reference chiefly, the more encyclopædic it is the better; but the present volume is intended as a text-book, and not as an encyclopædia. We think that the ideal text-book is one which will present such a selection from ascertained knowledge as will give a student an adequate grasp of the facts, principles, and methods of his subject. The selection need not and should not be skimped, but no attempt should be made to include *all* that is known to be true.

Regarded as a book of reference, this volume is most admirable, and we commend the enterprise which now brings it into a wider circle of readers. German is not popular amongst English students, but Russian is barred altogether. The matter is excellent and is excellently presented. It is thorough, and is brought well up to date in this edition; *e.g.* there is a good account of Siedentopf and Szigmondy's recent work on the vision of (so-called) ultramicroscopic particles. The chapter on interference is specially good. The illustrations throughout are unusually clear, especially those explanatory of the various instruments of observation.

The man who gets this book has only himself to blame if he learns no physics. Our only quarrel is with the size of the dose. Experience has shown us that a student fights shy of this heroic treatment, and turns for help to the text-books of the cramming institutions. Less formidable treatment might induce him to put the latter away with advantage.

OUR BOOKSHELF.

Wilhelm Ostwald. By P. Walden. Pp. vii + 120. (Leipzig: Wilhelm Engelmann, 1904.) Price 4s. net.

PROF. OSTWALD has only just attained his fiftieth year, and in appearance he is full of life and vigour. He has done and is doing a great work in science; he is a man one may delight to honour, both for his intellect and for his heart. It may be merely the prejudice of the reticent Englishman, but I must confess to a feeling that these biographies of eminent men in the prime of life must be very uncomfortable to their subjects, and a doubtful kindness. If they are to become common, mediocrity will find a new consolation.

It is impossible, however, not to admire and, knowing Ostwald, not to share the warmth of feeling which has prompted the publication of this book. It is written on the occasion of the twenty-fifth anniversary of Ostwald's graduation, and in the 120 pages Prof. Walden gives a very readable account of his subject from the age when the hero was "unser Wilhelm" up to the present time. From it we learn that the life of Ostwald has been free from any very dramatic incidents, and that, like so many eminent men, he was an ordinary boy and a not strikingly exceptional student. When once inspired by the teaching of Lemberg, he really breasted the sea of science and struck out on the course which he has followed with such success. His early career as a teacher was fraught with scanty means and imperfect appliances, but resolution, single-minded devotion and splendid ability overcame all obstacles, and have been rewarded, as we know, with every kind of success to which a true man of science may properly aspire. The book will be read with interest not only by Ostwald's friends and pupils, but by all who are interested in the foundation of the modern school of physical chemists. A. S.

The Lepidoptera of the British Islands. A Descriptive Account of the Families, Genera, and Species Indigenous to Great Britain and Ireland, their Preparatory States, Habits, and Localities. By Charles E. Barrett, F.E.S. Vol. ix., Heterocera, Geometrina—Pyralidina. Pp. 454. (London: Lovell Reeve and Co., Ltd., 1904.) Price 12*s.* net.

THE ninth volume of Mr. Barrett's great work marks substantial progress, and practically completes the Macrolepidoptera. About 180 species are described. The Geometrina include the families Larentidæ (the conclusion here given chiefly consisting of the great genus Eupithecia, of which forty-eight British species are admitted, one doubtful, but also including Eubolia and its allies, formerly placed in a distinct family), and Œnochromidæ, with only two British genera, Tanagra and Aplasta. The Pyralidina include the families Pyraustidæ, Pyralidæ, Hydrocampidæ, Endotrichidæ, Scopariidæ, Pterophoridæ, Orneodidæ, and Phycitidæ. The last family is not quite completed in vol. ix., so there now remain but the Galleriidæ, Crambidæ, Tortricina, and Tineina to be dealt with. As it is possible that these may not require to be treated in such great detail as the Macrolepidoptera, perhaps four or five more volumes may be sufficient to complete the book, which will remain as a permanent record of the work accomplished by British lepidopterists during the latter half of the last century and the opening years of the present. Among the more interesting features of vol. ix. may be noted the carefully-drawn-up table of the large and difficult genus Eupithecia, which ought much to facilitate the determination of species; and the exact records of the occurrence of the rarer species of Pyralidæ, many of which are met with, at least in Britain, only singly and sporadically at long intervals and in widely separated localities. Many interesting species, some of wide distribution abroad, have thus been added to our British lists of late years.

It will be seen that to a considerable extent Mr. Barrett still follows an arrangement similar to that of Stainton's "Manual"; it is, however, a great improvement to associate the Pterophoridæ with the Pyralidæ, as is now generally done. The Orneodidæ are a more aberrant family, and we are not sure that their real affinities have yet been finally determined.

LETTERS TO THE EDITOR.

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The Flowering of the Bamboo.

I HAVE read Mr. Tingle's letter in NATURE for August 11, as well as Prof. Farmer's comments on it, and hope you will permit me to add my remarks to the discussion of the subject.

Mr. Tingle ought to have specified which of the Chinese bamboos it is that has now flowered. According to the list given by Dr. Rendle in the recently published part of the *Journal* of the Linnean Society, vol. xxxvi., there are about forty-two species of bamboo, large and small, in China, and it would be interesting to know which of them it is. Let us hope that Mr. Tingle is sending good specimens to the Kew and British Museum herbaria. Until the species referred to has been ascertained, discussion is rather difficult, except from a general point of view.

My own experience of bamboos is confined to India, where there are more than 120 species, large and small, but I have never heard that their flowering, even when it takes place gregariously, has caused alarm among the natives. The gregarious flowering of the common species such as *Dendrocalamus strictus* or *Bambusa arundinacea* often takes place in an exceptionally dry season, when there may also be partial failure of the crops, and on such occasions advantage is sometimes taken of the general seeding to collect and use the seeds for food. Signs of approaching flowering may, perhaps, occasionally be received with misgiving as foreshadowing a dry season and bad crops, but I have never heard of their being regarded with anything approaching to superstitious terror.

So far as we know at present, some of the Indian-Burmese species only flower gregariously at long intervals, but even then there is some doubt whether the flowering is local only or widespread. The well known Kyathaungwa (*Bambusa polymorpha*), a large species with culms up to 80 feet in height and 6 inches in diameter, and notable as a common associate of the teak tree, was collected in flower by Dr. M'Clelland in Pegu in 1854, by Sir D. Brandis in the Salween in 1862, and by Mr. S. Kurz in the Sittang Valley in 1871, and flowers have once been reported since from Bassein; but in more recent years it has not flowered, though its gregarious flowering is being anxiously awaited by forest officers, who hope to use the opportunity for the extension of teak reproduction. There are some species of bamboo which flower regularly every year and do not die off: among them are the little *Arundinaria Wightiana*, so common in the forests around Ootacamund in the Nilgiri Hills; *Bambusa lineata*, a small reedy species of the coast forests of the Malay Archipelago, extending westwards only to Rutland Island in the Andamans, though strangely enough it has not, so far as I am aware, been known to produce seed; and *Ochlandra stridula*, a shrubby species of the low country of Ceylon. The great majority of species, however, have their chief flowerings gregarious, at more or less regular intervals, while every now and again a few clumps may be found in flower sporadically in almost any year. This is especially the case with *Dendrocalamus strictus*, the "male bamboo" so widespread in the deciduous more or less dry forests of India and Burma; with the thorny *Bambusa arundinacea* of the Western Peninsula; with *Dendrocalamus Hamiltonii*, the most common species of northern Bengal and Assam; and with *Bambusa Tulda* in Bengal, the east coast hills, and Burma. Gregarious flowerings may really be often quite local, though widespread enough within their locality.

When, in India, bamboos flower gregariously, they usually produce quantities of good seed, and the old clumps then die off; but in sporadic flowerings my experience is that seed is very little produced, or if produced infertile, while the clumps occasionally may recover, though rarely. Damage to a clump may often produce a partial or sporadic flowering. Information on the subject is being gradually collected in India; the dates of flowering of the different species are, when observed by forest officers, recorded in their journal, the *Indian Forester*, and the behaviour of the clumps is being carefully watched, especially as the dying off of the clumps of a species over large areas may mean a serious dearth for several years of the most useful material for the construction of native houses and of many articles of common domestic use. I would therefore invite the attention of those interested in the subject to the pages of the journal mentioned, and I hope Mr. Tingle and others will collect similar information in China. As regards the flowering of cultivated species in the gardens of this country, some very useful information was given by Mr. Bean, of Kew, in the *Gardeners' Chronicle* for 1903. I am not quite sure that all the flowered clumps of *Arundinaria Falconeri* will die. I have one in my own garden, and I think it is quite likely to live. I recently saw, in a neighbour's garden, a large clump of *A. Simoni* which had flowered and apparently died, but the root-stock is now studded with young green shoots, and they look as if they intended to grow. I think it is because all the culms had been cut away after the flowering.

J. S. GAMBLE.

Highfield, Liss, Hants, August 14.

The Spontaneous Scintillations of Hexagonal Blende.

A SHORT time ago I pointed out in the *Chemical News* (1904, p. 33) that scintillations, similar to those produced by a radium salt, but feebler, can always be observed in hexagonal blende, in the absence of any radium or radium-emanation.

I have recently made experiments in order to determine whether the blende itself is radio-active, and whether such inherent radio-activity is the cause of the spontaneous scintillations.

An electroscope was used with paraffin-wax insulation and a long aluminium leaf. The rate of leak was first determined, and then the effect produced on the rate by placing the blende on the brass plate of the electroscope. Two specimens from a French firm were examined in this way, and showed no effect whatever; they were spread over the plate in the form of powder.

A specimen from an English firm, in the form of a screen 4 cm. square, showed a marked effect, but a piece of writing-paper of the same size produced the same effect; consequently, no radio-activity can be attributed to the blende on the screen. All these specimens showed the scintillations distinctly, and I can only adhere to my original opinion that the scintillations are caused by a spontaneous change in the structure of the crystals. E. P. PERMAN.

University College, Cardiff.

Sooty Rain.

I SHOULD be glad if any of your readers could explain the following phenomenon:—

It occasionally happens that on still days, usually with light northerly winds, a heavy shower of rain will carry down a black greasy deposit which forms a film or scum on this and other lakes in the district. It is a recognised nuisance to owners of pleasure boats, as, from the adhesive nature of the scum, scrubbing with soap and water is necessary to remove it.

This black deposit has been examined for me by a competent biologist, and contains no products of organic life. It has, in fact, the appearance and oily character of ordinary soot. I have seen a small handful (when dry) scraped up here from the shore. Sooty rain is the exception, and not the rule. In May last there were about eight days of sooty rain, with the wind out of the north-east. During the last three months, though the lake has risen more than a foot, there has been only one sooty rainfall, viz. on August 17, when the wind was again in the north.

Yesterday (Sunday, August 21, 4 p.m.) I had an opportunity of observing the formation of the scum, and was surprised to see how quickly it appeared. The day had been still, with heavy clouds at a considerable height coming up slowly from west-south-west, with an occasional light breeze from the north. At 4 o'clock the wind dropped entirely, and a sudden heavy shower of rain fell which lasted about fifteen minutes.

As soon as the rain began, the surface of the lake appeared broken up into faintly defined dull and bright patches, which in two or three minutes became strongly intensified without losing their original shape. The dull patches consisted of the sooty film, which was easily observable by dipping in a sheet of white paper, to which the soot adhered.

The position of the Lake District in regard to manufacturing centres renders the occurrence of sooty rain under the conditions described rather remarkable. It would be interesting, too, to know why the sooty film should not cover the surface of the water uniformly, instead of in patches. These patches, by the way, are known locally as "tarns," and are supposed to forecast a spell of bad weather.

Coniston, Lancs., August 22. J. B. COHEN.

Adaptive Colours of Eyes.

SOME time ago Prof. Wallace, of the School of Mines, Kimberley, suggested to me the possible explanation of the difference in colour of the light reflected from the iris of the eyes of different people—that it was in accordance with the natural law of protection against external influences. He pointed out that people hailing from regions where blue light is predominant—Swedes, Norwegians, and sailors, for instance—have blue eyes, whilst near the equator, or in sandy climes such as South Africa, where intense yellow light is experienced, the eyes take a rich dark yellow hue, as those of the Kaffirs and Malays, Italians and Spaniards. The Scotch have blue, the English grey, and the French dark eyes, generally speaking.

I wish to know whether this novel explanation will bear criticism under the searching light some of your readers may be able to throw on the matter.

A. VINCENT NAPIER.

Beaconsfield, Kimberley, South Africa, July 21.

An Optical Phenomenon.

SOME sixteen years ago I observed phenomena which appear to be related to those mentioned by Mr. Hillig on p. 366 of NATURE, and by Mr. Walker on p. 396. A disc, in which was a ring of holes, was rotated between the eye and the sky. I saw coloured patches and rings, changing with the velocity of rotation. The appearances vanished as the rate of rotation increased. The colours were pale green and purple. The purple flowed about as if fluid, and the green appeared as islands mottling its surface. It occurred to me that there might be some connection with the visual purple of the retina.

It would be of interest to repeat the experiments, using the different spectral colours, and varying the rates of rotation.

Intermittent stimulation of the retina may give rise to very curious and interesting results.

In the concluding chapter of Mr. Bidwell's "Curiosities of Light and Sight" will be found an account of some remarkable effects produced by intermittent illumination.

Leeds, August 27. C. T. WHITMELL.

The Constitution of Matter.

HAVING followed the almost brilliant discussions concerning the constitution of matter which took place at the recent Cambridge British Association meetings, I was not a little surprised to come across the following remarks made by Ralph Waldo Emerson in 1867. He said: "The chemists already find the infinite variety of things contained in sixty-six elements; and physicists promise that this number shall be reduced to twenty, ten, five. Faraday declares his belief that all things will, in the end, be reduced to one element with two polarities."

It would be interesting to know exactly the phraseology in which Faraday expressed this belief.

R. W. Emerson merely uses the statement to aid religious views. And yet in several of his writings he has selected almost prophetic utterances concerning science.

C. ALFRED SMITH.

King's College, London, August 29.

THE INFANTS' MILK DEPÔT.

THE annual toll of infant lives in all countries is a heavy one. At the present day in most civilised countries the problems of infantile mortality have come into prominence from many causes, chiefly the declining birth-rate, and although in England the general death-rate has fallen from 22.6 per 1000 in the five-yearly period 1851–5 to 17.6 in 1896–1900, the infant mortality, that is, the death-rate of infants under one year per 1000 births, has remained stationary (156) in those two periods. In the great industrial centres the infant mortality ranges from 168 to 182, and if it could be reduced to 104, which is the average of the semi-rural counties, there would be a saving of 40,000 lives annually. Dietetic diseases are mainly responsible for this terrible loss of life, and from one-third to one-half of the total infant mortality is due to diarrhœa, which is especially active in hot summers.

These conditions are chiefly attributable to improper feeding, and to the use of milk which bacteriologically is grossly polluted. These sources of danger to the infant population would, of course, be inoperative were breast-feeding the rule, but breast-feeding seems to be difficult to secure, partly from the selfishness of mothers, and partly from an ignorance which assumes that hand-feeding can take its place. It is naturally among the poor that improper feeding chiefly obtains. The infant from its earliest days, in lieu of its natural nourishment, has tit-bits from the parents' table and various concoctions of cow's milk, condensed milk, and infants' foods. With regard to the latter, it has been remarked that if a mixture of chicory with coffee is sold as pure coffee the trader is liable to prosecution, but that anyone may make up any sort of mixture and call it a perfect infants' food, and the law leaves him alone!

There is obviously a great field for specialised measures of prevention against the dietetic diseases of infants, and organisations have therefore been established for the supply of sterilised milk for the babies of the poor, and incidentally to teach the mothers how their children should be reared, and to encourage breast-feeding whenever practicable.

Many of these infants' milk depôts are now in active work, both on the Continent, and in England at St. Helens, Liverpool, Battersea, and other districts, and their administration is summarised by Dr. McCleary, the medical officer of health for Battersea, in a useful paper.[1] In Battersea this is as follows:—The milk for use at the depôt is carefully controlled, and special conditions have to be accepted by the contractor. The amount of milk requisite for a single meal, and suited to the age of the infant, is contained in a screw-stoppered bottle; for the youngest infants it is modified by the addition of water, cream, and sugar according to recognised principles. The bottles are then placed in the sterilising chamber (see illustration), steam is injected, and the temperature raised to 212° F., which is maintained for about ten minutes. They are then taken out of the steriliser and rapidly cooled in a cooling tank. The bottles are supplied in wire baskets, each basket holding from six to nine bottles, and containing a twenty-four hours' supply. The next day the basket of empty bottles is returned, and a fresh supply obtained. When a child is entered at the depôt the mother is instructed by the manageress as to the proper method of using the milk, and she receives a printed leaflet of instructions. The cost varies according to age, from 2*s.* to 2*s.* 9*d.* per week.

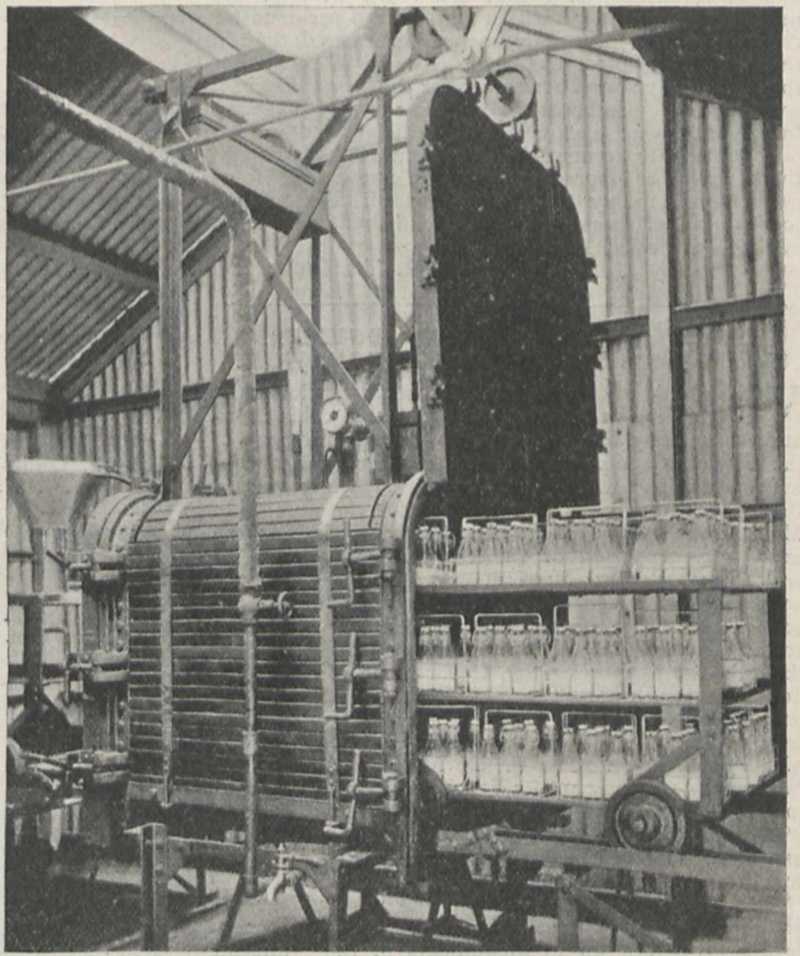

FIG. 1.—Infants Milk Depôt, Battersea. Interior of sterilising room, showing steriliser with loaded trolley. (From the *Journal of Hygiene.*)

The method of infant feeding is a very simple matter so far as the mother is concerned. When feeding time arrives, all she has to do is to place a bottle, unopened, in a basin of warm water until it reaches body temperature, to open the bottle, put on a rubber teat supplied at the depôt, and feed the baby from the sterilised bottle direct. There is no need for a "feeding bottle," which alone is a great advantage.

The homes of the children fed on the milk are visited by the lady sanitary inspectors, who endeavour

[1] "The Infants' Milk Depôt: its History and Function" (*Journal of Hygiene*, iv., No. 3, July, 1904, p. 329).

to secure that the instructions are properly carried out. If the child does not appear to be progressing favourably, the mothers are strongly advised to seek medical advice. Mothers are urged to bring the children once a week to be weighed.

As to the results of the working of these institutions, it is not yet possible to speak, and there are many fallacies that have to be guarded against in considering the statistics. Dr. Drew Harris calculated that for the three years 1899–1901 at St. Helens the death-rate among children attending the depôt averaged 104, while in the whole borough it was 173. At the recent Congress of the Royal Institute of Public Health, Mr. Councillor Shelmerdine stated his conclusions for Liverpool as follows:—"that of the 4453 infants coming very promiscuously to the depôts at varied ages and in conditions of health below the average the mortality was 78 per 1000 as against 159 per 1000 for the whole city. But it must be remembered that in that 159 per 1000 for the whole city and 88 to 118 for the best districts, and 212 to 215 for the worst districts, were included also breast-fed infants; clearly if breast-fed infants were excluded and artificially-fed infants only taken into account the rate of mortality amongst them would be enormously higher, and would show even more forcibly the advantages of the sterilised food which, of course, is an artificial food, over other methods of artificial feeding."

R. T. HEWLETT.

EXHIBITION OF ANCIENT EGYPTIAN SCULPTURE AT THE BRITISH MUSEUM.

VISITORS to the British Museum galleries of antiquities will notice that a considerable alteration has lately been effected in the arrangement of the Egyptian sculptures of the early period, and that many antiquities which have not hitherto appeared in the galleries are now on exhibition for the first time. Most of the newly exhibited monuments date to the most ancient period of the Egyptian monarchy, of which the British Museum has until lately not possessed many specimens; some are monuments of prime importance historically as well as artistically, and nearly all owe their appearance in London to the present Keeper of the Department of Egyptian and Assyrian Antiquities, Dr. E. A. Wallis Budge, who has personally superintended their removal from Egypt and their exhibition in the galleries of his department. The British Museum is now in a fair way of making up its deficiency in larger monuments of the older period—the "ancient" and "middle" Empires—and few museums out of Egypt can show so fine a collection of funeral stelæ of the fourth and fifth dynasties.

These are chiefly exhibited in the vestibule at the end of the Egyptian saloon. This vestibule is now practically given up to monuments of the "ancient Empire." The most important of them takes the central position, and is one of the finest Egyptian monuments in the museum. This is the great stele which faced the doorway in the *mastaba* tomb of Ptahshepses, at Saḳḳara. Ptahshepses was one of the chief men of the court of Shepseskaf, the last king of the fourth dynasty. He was brought up by Menkaura, Herodotus's Mykerinos, the builder of the third pyramid of Gîza, among the royal children, and was given the king's daughter Khamaat to wife. Offices of trust and honour were piled upon him, and to judge by the explanatory label below his monument, upon which all his titles are set forth, he ought to be the patron saint of pluralists. The colour of this monument is well preserved, and used as we may be to the idea of paint laid on under the eighteenth dynasty (B.C. 1500) being still preserved in all its pristine brilliancy of colour, it is another thing to find delicate colouring applied in the days of the pyramid builders—whose days were separated from those of the eighteenth dynasty by nearly as much time as separates the eighteenth dynasty from us—still bright and still delicate. It is to be hoped that London fogs will not sully it.

Other monuments of the same period and type are arranged round this fine centre-piece, and all are interesting. Those who are interested in the work of men's hands in the dawn age of civilisation should not miss this important exhibition of Egyptian antiquities of the Ancient Empire.

THE BRITISH ASSOCIATION AT CAMBRIDGE.

AT the final meeting of the general committee last week, a report from the committee of recommendations was received and accepted with some slight alterations. One of the recommendations was made with the object of securing the continuity of sectional committees from one meeting to the next. Secondly, it was proposed that each sectional committee should have power to appoint during the annual meeting not more than three vice-presidents. Another recommendation had reference to the constitution of the council and the appointment of assistant secretary.

The following is a synopsis of grants of money appropriated to scientific purposes by the general committee:—

Mathematics and Physics.	
*Rayleigh, Lord—Electrical Standards	£40
*Judd, Prof. J. W.—Seismological Observations ...	40
*Shaw, Dr. W. N.—Investigations of the Upper Atmosphere (Kites)	40
*Preece, Sir W. H.—Magnetic Observations	50
Chemistry.	
Kipping, Prof. F. S.—Aromatic Nitramines	25
Armstrong, Prof. H. E.—Dynamic Isomerism ...	20
*Roscoe, Sir A. E.—Wave-length Tables of Spectra ...	5
*Divers, Prof. E.—Study of Hydro-Aromatic Substances	25
Geology.	
*Watts, Prof. W. W.—Movements of Underground Waters	Balance in hand
*Marr, Dr. J. E.—Life Zones in British Carboniferous Rocks	Balance in hand
*Lamplugh, G. H.—Fossiliferous Drift Deposits	Balance in hand
*Marr, Dr. J. E.—Erratic Blocks...	10 and unexpended balance
*Herdman, Prof. W. A.—Fauna and Flora of British Trias	10
Zoology.	
*Woodward, Dr. H.—Index Animalium...	75
*Hickson, Prof. S. J.—Table at Zoological Station at Naples	100
*Weldon, Prof.—Development of Frog	10 and unexpended balance
*Hickson, Prof. S. J.—Higher Crustacea	15 and unexpended balance
Geography.	
Murray, Sir J.—Investigations in the Indian Ocean...	150
Economic Science and Statistics.	
*Cannan, Dr. E.—Trade Statistics	20

* Reappointed.

Anthropology.

*Read, C. H.—Age of Stone Circles	£40
*Cunningham, Prof. D. J.—Anthropometric Investigations	10
*Evans, A. J.—Excavations on Roman Sites in Britain	10
Evans, Sir J.—Excavations in Crete	75 and unexpended balance
Macalister, Prof. A.—Anthropometry of Native Egyptian Troops...	10
*Munro, Dr. R.—Glastonbury Lake Village ...	Balance in hand
*Tylor, Prof. E. B.—Anthropological Teaching	Balance in hand

Physiology.

*Gotch, Prof.—Metabolism of Individual Tissues ...	30 and unexpended balance
*Halliburton, Prof. W. D.—State of Solution of Proteids	20
Schäfer, Prof.—The Ductless Glands	40

Botany.

Scott, Dr. D. H.—Structure of Fossil Plants... ...	50
*Ward, Prof. H. Marshall—Physiology of Heredity ...	35
Miall, Prof.—Botanical Photographs	5

Educational Science.

Magnus, Sir P.—Studies suitable for Elementary Schools	20

Corresponding Societies.

*Whitaker, W.—Corresponding Societies Committee...	20
	£1000

The concluding meeting of the Association was held in the Senate House on August 24, the President being in the chair.

Sir J. Evans moved a vote of thanks to the Vice-Chancellor of the university and to the Mayor and Corporation of Cambridge for their reception of the Association, and for the use of the municipal and university buildings; also to the chairman of the County Council of Cambridge and the Isle of Ely for their assistance on behalf of the Association.

The Vice-Chancellor (Dr. Chase) replied for the university, the Mayor of Cambridge on behalf of the corporation, and Mr. E. S. Fordham on behalf of the county council.

Votes of thanks to the local committee and to the gentlemen and public bodies who had extended their hospitality to the Association were also carried.

At the suggestion of Mr. Balfour, Prof. George Darwin, the president of the meeting to be held next year in South Africa, made a few remarks, in the course of which he said that he was deeply sensible of the compliment that had been paid to him in nominating him for the office of president of the British Association, but he felt that he had exceptional difficulties to face. It was not only that for one year he had been nominated to serve as the figure-head of British science, but on this occasion he would have to act as a sort of ambassador for science in the home country to budding science in South Africa. Cambridge was a university of many centuries' standing; and South Africa had aspirations that her universities should in future be as great. But there was a long road to travel before that hope could be fulfilled. One of the objects of the Association's visit to South Africa was to aid her in achieving those aspirations. The visit might do much good in helping local men to foster their institutions for higher education and for the prosecution of science.

Mr. Balfour said that there could not be a more fitting conclusion to Prof. Darwin's speech than to announce, as he now did, that the meeting was adjourned until August 15, 1905, at Cape Town.

* Reappointed.

SECTION E.

GEOGRAPHY.

OPENING ADDRESS BY DOUGLAS W. FRESHFIELD, PRESIDENT OF THE SECTION.

On Mountains and Mankind.

A GEOGRAPHER or traveller who has been called upon to preside over the meetings of our Section of the British Association may be excused for feeling some hesitation as to the character he shall give to the Address which custom compels him to deliver. He cannot but be aware that his audience, while it includes not a few experts, probably far better qualified than himself to take the Chair, is composed mainly of those whose concern in Geography can only be a general and occasional one.

To compose a summary of the geographical events of the year would be a simple and obvious expedient, were I not conscious that in this I have been forestalled by the indefatigable President of the Royal Geographical Society. To consider the progress of geography, during, say, the last quarter of a century, might be instructive to "the general." On the other hand, on his special subject your President may possibly be able to add something to the common stock by way of observation or suggestion.

Bearing in mind the, from the point of view of posterity, almost excessive energy with which the nineteenth century carried on the exploration of the globe, narrowing in every direction the field left to our explorations and our imaginations, 1904 may so far be counted as an "annus mirabilis" in the annals of Geography. We have seen the successful return, if not as yet to our own shores, to safe seas, of the most important expedition ever sent South Polewards. In the success obtained by Captain Scott and his comrades, we have welcomed a full justification of the course taken in putting the supreme command and direction of the undertaking in the hands of an officer of His Majesty's Navy. "England expects every man to do his duty," and I will not indulge in hyperbolical praise, which must be distasteful to men who have shown in trying circumstances the daring, the cheerfulness, and the resourcefulness which we are accustomed to associate with the British Navy. We have every reason to expect that the results obtained by the energetic and capable men of science attached to the expedition will be of wide bearing and interest, but to attempt to estimate them to-day would be obviously premature.

The current year has been distinguished by a, perhaps, even more remarkable geographical event. His Majesty's Government, not satisfied with the laurels it has won in the Antarctic, has embarked on a second geographical adventure on a larger scale and at a far greater cost (which, however, will presumably be borne by India). It has sent forth a Gold Medallist of the Royal Geographical Society, Colonel Younghusband, with a numerous escort to reach the forbidden capital of Tibet. The saffron-vested monks on the "golden terraces" of the Pota La have seen the glimmer of British bayonets on the horizon, and the castle-palaces of Lhasa will, we hope, open to the military explorer their mysterious halls, hitherto known to us best by the descriptions of that entertaining traveller, my friend Chandra Das.

But the fruits of these great expeditions are not yet ripe. I must leave them to be plucked by my successors. I do so with regret, for I should have listened with a peculiar interest to an account of the fascinating land, over whose peaks and pastures I lately gazed from the Pisgah heights of the Jonsong La.

To review the progress of Geography during the last twenty-five years, the time that has passed since I first joined the Council of the Royal Geographical Society, is tempting. The retrospect would on the whole be encouraging. The past quarter of a century, if not an era of the most extensive discoveries, has been an era of profitable occupation—I mean profitable in the scientific and not in the commercial sense, though the two are frequently connected—of the ground seized by the great pioneers in Africa, in the backlands of North America, and elsewhere. And when we come to consider the manner in which the results of modern exploration are recorded, what an advance we find! Compare the geographical publications of Great Britain in 1880 and 1904; take the most conspicuous instance, those of the Royal Geographical Society at the two periods. Consider the way in which our lectures and literature are now illustrated by the aid of photography, new processes, and the lantern. Petermann's *Mitteilungen* was for long the one first-rate geographical magazine in Europe. We have now, as we ought to have had long before, a *Journal* that rivals it.

Take a wider survey. Look at maps, beginning with the Ordnance Survey. Compare the last issues of the one-inch maps, with all the advantages of colour-printing, over their doubtless (except as to roads) accurate, but far less intelligible predecessors. Consider the maps private firms, Messrs. Bartholomew and Messrs. Stanford, have provided us with; note the new editions of "Murray's Guides."

The correction and completion of maps by new explorations is always desirable. But it is even more important that a sound system for the delineation of natural features should be adopted both for Government surveys and general maps. I begin to look forward to a time when glaciers will no longer be represented, as they were on the early Indian and Caucasian surveys, without their heads or tails—that is, without either their névés or their moraine-cloaked lower portions or with rivers rising above them and flowing through them. In time, perhaps, every closet cartographer will recognise that glaciers do not lie along the tops of lofty ridges, but descend into valleys. In these matters I have had many an arduous struggle. It is cruel that a poor man should be set to delineate snow mountains who has never seen one, and when "a week at lovely Lucerne" can be had for 5*l*. 5*s*. it is inexcusable.

In my schooldays there was an exercise of memory known to us by the contemptuous appellation of "Jog," which boys and masters united to depreciate and despise. This sentiment is now confined to a few elderly generals and headmasters. Geography flourishes as a branch of science under the august shadow of the elder Universities. At Oxford we have produced Mr. Mackinder and Dr. Herbertson, Mr. Grundy, Mr. Hogarth, Mr. Beazley. We have started a school of Geography and a school of Geographers. At Cambridge a Board of Geographical Studies has been established. I may quote what Sir C. Markham said three months ago:—

"The staff of the new geographical school at Cambridge will consist, instead of one reader, of several lecturers and teachers, who will cover the various departments of the science. A diploma in geography will be granted as at Oxford. But Cambridge goes a step further than Oxford, by introducing geography into the examination for the B.A. degree. The importance of according geography such a position in the studies of the Universities must be evident to all, and must be specially gratifying to those who, for more than thirty years, have fought hard, amid much discouragement, to have geography recognised as a University subject. It will be interesting to see how the Board of Geographical Studies at Cambridge will draw up the detailed regulations for the degree and the diploma, what steps will be taken to secure a competent staff to cover the whole field of our science, and especially to train young University men for practical work in the field. We have every reason to expect that the results will prove satisfactory.

"The Geographical Association of Teachers, of which Mr. Mackinder and Dr. Herbertson are active members, is doing much to enlighten teachers with regard to the capabilities of the subject, to raise its standard, and to introduce improved methods of teaching. An interesting and useful conference was held last winter at the Chelsea Polytechnic, under its auspices, and in connection with the conference there was an excellent exhibition of appliances used in teaching geography, the usefulness of which was increased by sending it to various provincial centres."

In primary schools many teachers are furnishing excellent instruction, and are instructing themselves in the handbooks provided by our friends Dr. Mill and Mr. Chisholm and others. In the higher branches of education the problems of scientific geography are studied, and teachers are encouraged to develop the geographical aspects of other subjects, such as archæology, history, commerce, colonisation on the one hand, botany and natural history on the other. We have moved forwards and upwards, but do not let us flatter ourselves that we have as yet reached any considerable eminence. Probably many more of our countrymen can read a map in this generation than could in the last. A small percentage, I am glad to notice, are not hopelessly bewildered even by contour lines.

We are learning our geographical alphabet. In time we may, as a nation, be able to read and to understand what we read. We shall recognise that ability to use a map and judge ground is a considerable safeguard against waste of life and disasters in war, and that an acquaintance with the features of the earth's surface and geographical distribution is an invaluable help to a nation in the commercial rivalries and struggles of peace.

When the question of establishing Geography at Oxford was being discussed, Dr. Jowett (who had himself somewhere in the 'fifties suggested the erection of a geographical chair) asked me if I believed Geography could be taught so "as to make men think." We should, I believe, "think imperially" to more purpose if we also took pains "to think geographically." But I will not detain you and use up my time by going in any detail into the progress of Geography. I might find myself only repeating what others have said better. And as to one important branch, perhaps the most important branch, geographical education, on which I addressed this Section at Birmingham some fifteen years ago, I feel myself debarred by the fact that the Association has now a Section specially devoted to Education.

I have determined on the whole, therefore, to run the risk of wearying some of my listeners by inviting your attention to the place in Geography of the natural objects which have had for me through life the greatest and most enduring attraction. I propose to talk about mountains, their place in Nature, and their influence, both spiritual and material, on mankind.

We have all of us seen hills, or what we call hills, from the monstrous protuberances of the Andes and the Himalaya to such puny pimples as lie about the edges of your fens. Next to a waterfall, the first natural object (according to my own experience) to impress itself on a child's mind is a hill, some spot from which he can enlarge his horizon. Hills, and still more mountains, attract the human imagination and curiosity. The child soon asks, "Tell me, how were mountains made?" a question easier to ask than to answer, which occupied the lifetime of the father of mountain science, De Saussure. But there are mountains and mountains. Of all natural objects the most impressive is a vast snowy peak rising as a white island above the waves of green hills—a fragment of the arctic world left behind to commemorate its past predominance—and bearing on its broad shoulders a garland of the Alpine flora that has been destroyed on the lower ground by the rising tide of heat and drought that succeeded the last Glacial epoch. Midsummer snows, whether seen from the slopes of the Jura or the plains of Lombardy, above the waves of the Euxine or through the glades of the tropical forests of Sikkim, stir men's imaginations and rouse their curiosity. Before, however, we turn to consider some of the physical aspects of mountains, I shall venture, speaking as I am here to a literary audience, and in a University town, to dwell for a few minutes on their place in literature—in the mirror that reflects in turn the mind of the passing ages. For Geography is concerned with the interaction between man and Nature in its widest sense. There has been recently a good deal of writing on this subject—I cannot say of discussion, for of late years writers have generally taken the same view. That view is that the love of mountains is an invention of the nineteenth century, and that in previous ages they had been generally looked on either with indifference or positive dislike, rising in some instances to abhorrence. Extreme examples have been repeatedly quoted. We have all heard of the bishop who thought the devil was allowed to put in mountains after the fall of man; of the English scribe in the tenth century who invoked "the bitter blasts of glaciers and the Pennine host of demons" on the violaters of the charters he was employed to draft. The examples on the other side have been comparatively neglected. It seems time they were insisted on.

The view I hold firmly, and which I wish to place before you to-day, is that this popular belief that the love of mountains is a taste, or, as some would say, a mania, of advanced civilisation, is erroneous. On the contrary, I allege it to be a healthy, primitive, and almost universal human instinct. I think I can indicate how and why the opposite belief has been fostered by eminent writers. They have taken too narrow a time-limit for their investigation. They have compared the nineteenth century not with the preceding ages, but with the eighteenth. They have also taken too narrow a space-limit. They have hardly cast their eyes beyond Western Europe. Within their own limits I agree with them. The eighteenth century was, as we all know, an age of formality. It was the age of Palladian porticoes, of interminable avenues, of formal gardens and formal style in art, in literature, and in dress. Mountains, which are essentially romantic and Gothic, were naturally distasteful to it. The artist says "they will not compose," and they became obnoxious to a generation that adored composition, that thought more of the cleverness of the artist than of the aspects of Nature he used as the material of his work. There is a great deal to be said for the century; it produced some admirable results. It was a contented and material century, little stirred by enthusiasms and aspirations and vague desires. It was a phase in human progress, but in many respects it was rather a reaction than a development from what had gone before. Sentiment and taste have their tides like the sea, or, we may here perhaps more appropriately say, their oscillations like the glaciers. The imagination of primitive man abhors a void, it peoples the regions it finds uninhabitable with aery sprites, with "Pan and father Sylvanus and the sister Nymphs," it worships on high places and reveres them as the abode of Deity. Christianity came and denounced the vague symbolism and personification of Nature in which the pagan had recognised and worshipped the Unseen. It found the objects of its devotion not in the external world but in the highest moral qualities of man. Delphi heard the cry "Great Pan is dead!" But the voice was false. Pan is immortal. Every villager justifies etymology by remaining more or less of a pagan. Other than villagers have done the same. The monk driven out of the world by its wickedness fell in love with the wilderness in which he sought refuge, and soon learnt to give practical proof of his love of scenery by his choice of sites for his religious houses. But the literature of the eighteenth century was not written by monks or countrymen, or by men of world-wide curiosity and adventure like the Italians of the Renaissance or our Elizabethans. It was the product of a practical common-sense epoch which looked on all waste places, heaths like Hindhead, or hills like the Highlands, as blemishes in the scheme of the universe, not having yet recognised their final purpose as golf links or gymnasiums. Intellectual life was concentrated in cities and courts, it despised the country. Books were written by townsmen, dwellers in towns which had not grown into vast cities, and whose denizens therefore had not the longing to escape from their homes into purer air that we have to-day. They abused the Alps frankly. But all they saw of them was the comparatively dull carriage passes, and these they saw at the worst time of year. Hastening to Rome for Easter, they traversed the Maurienne while the ground was still brown with frost and patched untidily with half-melted snowdrifts. It is no wonder that Gray and Richardson, having left spring in the meadows and orchards of Chambéry, grumbled at the wintry aspect of Lanslebourg.

That at the end of the eighteenth century a literary lady of Western Europe preferred a Paris gutter to the Lake of Geneva is an amusing caricature of the spirit of the age that was passing away, but it is no proof that the love of mountains is a new mania, and that all earlier ages and peoples looked on them with indifference or dislike. Wordsworth and Byron and Scott in this country, Rousseau and Goethe, De Saussure and his school abroad broke the ice, but it was the ice of a winter frost, not of a Glacial period.

Consider for a moment the literature of the two peoples who have most influenced European thought—the Jews and the Greeks. I need hardly quote a book that before people quarrelled over education was known to every child—the Bible. I would rather refer you to a delightful poem in rhyming German verse written in the seventeenth century by a Swiss author, Rebman, in which he relates all the great things that happened on mountains in Jewish history: how Solomon enjoyed his Sommerfrische on Lebanon, and Moses and Elias both disappeared on mountain tops; how kings and prophets found their help among the hills; how closely the hills of Palestine are connected with the story of the Gospels.

Consider, again, Greece, where I have just been wandering. Did the Greeks pay no regard to their mountains? They seized eagerly on any striking piece of hill scenery and connected it with a legend or a shrine. They took their highest mountain, broad-backed Olympus, for the home of the gods; their most conspicuous mountain, Parnassus, for the home of poetry. They found in the cliffs of Delphi a dwelling for their greatest oracle and a centre for their patriotism. One who has lately stood on the top of Parnassus and seen the first rays of the sun as it springs from the waves of the Ægean strike its snows, while Attica and Bœotia and Eubœa still lay in deep shadow under his feet, will appreciate the famous lines of Sophocles, which I will not quote, as I am uncertain how you may pronounce Greek in this University. You may remember, too, that Lucian makes Hermes take Charon, when he has a day out from Hell, to the twin-crested summit, and show him the panorama of land and sea, of rivers and famous cities. The Vale of Tempe, the deep gap between Olympus and Ossa, beautiful in its great red cliffs, fountains, and spreading plane-trees, was part of a Roman's classical tour. The superb buttresses in which Taygetus breaks down on the valley of the Eurotas were used by the Spartans for other purposes besides the disposal of criminals and weakly babies. The middle regions—the lawns above the Langada Pass, "virginibus bacchata Lacænis Taygeta"—are frequented to this day as a summer resort by Spartan damsels. The very top, the great rock that from a height of 8000 feet looks down through its woods of oaks and Aleppo pines on the twin bays of the southern sea, is a place of immemorial pilgrimages. It is now occupied by a chapel framed in a tiny court, so choked with snow at the beginning of June that I took the ridge of the chapel roof for a dilapidated stoneman. I have no time to-day to look for evidence in classical literature, to refer to the discriminating epithets applied in it to mountain scenes.

A third race destined apparently to play a great part in the world's history—the Japanese—are ancient mountain lovers. We are all aware that Fusiyama to the Japanese is (as Ararat to the Armenians) a national symbol; that its ascent is constantly made by bands of pilgrims; that it is depicted in every aspect. Those who have read the pleasant book of Mr. Watson, who, as English chaplain for some years at Tokio, had exceptional opportunities of travel in the interior, will remember how often he met with shrines and temples on the summits of the mountains, and how he found pilgrims who frequented them in the belief that they fell there more readily into spiritual trances. The Japanese Minister, when he attended Mr. Watson's lecture at the Alpine Club, told us that his countrymen never climbed mountains without a serious—that is to say, a religious—object.

India and China would add to my evidence had I knowledge and time enough to refer to their literature. I remember Tennyson pointing out to me in a volume of translations from the Chinese a poem, written about the date of King Alfred, in praise of a picture of a mountain landscape. But I must return to the sixteenth and seventeenth centuries in Europe; I may go earlier—even back to Dante. His allusions to mountain scenery are frequent; his Virgil had all the craft of an Alpine rock-climber. Read Leonardo da Vinci's "Notes," Conrad Gesner's "Ascent of Pilatus"; study the narratives of the Alpine precursors Mr. Coolidge has collected and annotated with admirable industry in the prodigious volume he has recently brought out.

It is impossible for me here to multiply proofs of my argument, to quote even a selection from the passages that show an authentic enthusiasm for mountains that may be culled from writers of various nations prior to A.D. 1600. I must content myself with the following specimens, which will probably be new to most of my hearers.

Benoît Marti was a professor of Greek and Hebrew at Bern, and a friend of the great Conrad Gesner (I call him great, for he combined the qualities of a man of science and a man of letters, was one of the fathers of botany as well as of mountaineering, and was, in his many-sidedness, a typical figure of the Renaissance). Marti, in the year 1558 or 1559, wrote as follows of the view from his native city:—

"These are the mountains which form our pleasure and delight" (the Latin is better—"deliciæ nostræ, nostrique amores ") " when we gaze at them from the higher parts of our city and admire their mighty peaks and broken crags that threaten to fall at any moment. Here we watch the risings and settings of the sun and seek signs of the weather. In them we find food not only for our eyes and our minds but also for our bellies "; and he goes on to enumerate the dairy products of the Oberland and the happy life of its population. I quote again this good man: " Who, then, would not admire, love, willingly visit, explore, and climb places of this sort? I assuredly should call those who are not attracted by them mushrooms, stupid, dull fishes, and slow tortoises " (" fungos, stupidos insulsos pisces, lentosque chelones "). " In truth, I cannot describe the sort of affection and natural love with which I am drawn to mountains, so that I am never happier than on the mountain crests, and there are no wanderings dearer to me than those on the mountains." " They are the theatre of the Lord, displaying monuments of past ages, such as precipices, rocks, peaks and chasms, and never-melting glaciers "; and so on through many eloquent paragraphs.

I will only add two sentences from the preface to Simler's " Vallesiæ et Alpium Descriptio," first published in 1574, which seem to me a strong piece of evidence in favour of my view:—" In the entire district, and particularly in the very lofty ranges by which the Vallais is on all sides surrounded, wonders of Nature offer themselves to our view and admiration. With my countrymen many of them have through familiarity lost their attraction; but foreigners are overcome at the mere sight of the Alps, and regard as marvels what we through habit pay no attention to."

Mr. Coolidge, in his singularly interesting footnotes, goes on to show that the books that remain to us are not isolated instances of a feeling for mountains in the age of the Renaissance. The mountains themselves bear, or once bore, records even more impressive. Most of us have climbed to the picturesque old castle at Thun and seen beyond the rushing Aar the green heights of the outposts of the Alps, the Stockhorn, and the Niesen. Our friend Marti, who climbed the former peak about 1558, records that he found on the summit " tituli, rythmi, et proverbia saxis inscripta unà cum imaginibus et nominibus auctorum. Inter alia cujusdam docti et montium amœnitate capti observare licebat illud:

" 'Ο τῶν ὀρῶν ἔρως ἄριστος."

" The love of mountains is best." In those five words some Swiss professor anticipated the doctrine of Ruskin and the creed of Leslie Stephen, and of all men who have found mountains the best companions in the vicissitudes of life.

In the annals of art it would be easy to find additional proof of the attention paid by men to mountains three to four hundred years ago. The late Josiah Gilbert, in a charming but too little-known volume, " Landscape in Art," has shown how many great painters depicted in their backgrounds their native hills. Titian is the most conspicuous example.

It will perhaps be answered that this love of mountains led to no practical result, bore no visible fruit, and therefore can have been but a sickly plant. Some of my hearers may feel inclined to point out that it was left to the latter half of the nineteenth century to found Climbers' Clubs. It would take too long to adduce all the practical reasons which delayed the appearance of these fine fruits of peace and an advanced civilisation. I am content to remind you that the love of mountains and the desire to climb them are distinct tastes. They are often united, but their union is accidental, not essential. A passion for golf does not necessarily argue a love of levels. I would suggest that more outward and visible signs than are generally imagined of the familiar relations between men and mountains in early times may be found. The choicest spots in the Alpine region—Chamonix, Engelberg, Disentis, Einsiedlen, Pesio, the Grande Chartreuse—were seized on by recluses; the Alpine Baths were in full swing at quite an early date. I will not count the Swiss Baden, of which a geographer, who was also a Pope, Æneas Silvius (Pius II.) records the attractions, for it is in the Jura, not the Alps; but Pfäfers, where wounded warriors went to be healed, was a scene of dissipation, and the waters of St. Moritz were vaunted as superseding wine. I may be excused, since I wrote this particular passage myself a good many years ago, for quoting a few sentences bearing on this point from " Murray's Handbook to Switzerland." In the sixteenth century fifty treatises dealing with twenty-one different resorts were published. St. Moritz, which had been brought into notice by Paracelsus (died 1541), was one of the most famous baths. In 1501 Matthew Schinner, the famous Prince Bishop of Sion, built " a magnificent hotel " at Leukerbad, to which the wealthy were carried up in panniers on the backs of mules. Brieg, Gurnigel, near Bern, the Baths of Masino, Tarasp, and Pfäfers were also popular in early times. Leonardo da Vinci mentions the baths of Bormio, and Gesner went there.

It is not, however, with the emotional influences or the picturesque aspect of mountains that science concerns itself, but with their physical examination. If I have lingered too long on my preamble I can only plead as an excuse that a love of one's subject is no bad qualification for dealing with it, and that it has tempted me to endeavour to show you grounds for believing that a love of mountains is no modern affectation, but a feeling as old and as widespread as humanity.

Their scientific investigation has naturally been of comparatively modern date. There are a few passages about the effects of altitude, there are orographical descriptions more or less accurate in the authors of antiquity. But for attempts to explain the origin of mountains, to investigate and account for the details of their structure, we shall find little before the notes of Leonardo da Vinci, that marvellous man who combined, perhaps, more than anyone who has ever lived the artistic and the scientific mind. His ascent of Monte Boso about 1511, a mountain which may be found under this name on the Italian ordnance map on the spur separating Val Sesia and the Biellese, was the first ascent by a physical observer. Gesner with all his mountain enthusiasm found a scientific interest in the Alps mainly if not solely in their botany.

The phenomenon which first drew men of science to Switzerland was the Grindelwald glaciers—" miracles of Nature " they called them. Why these glaciers in particular, you may ask, when there are so many in the Alps? The answer is obvious. Snow and ice on the " mountain tops that freeze " are no miracle. But when two great tongues of ice were found thrusting themselves down among meadows and corn and cottages, upsetting barns and covering fields and even the marble quarries from which the citizens of Bern dug their mantelpieces, there was obviously something outside the ordinary processes of Nature, and therefore miraculous.

Swiss correspondents communicated with our own Royal Society the latest news as to the proceedings of these unnatural ice-monsters, while the wise men of Zürich and Bern wrote lectures on them. Glacier theories began. Early in the eighteenth century Hottinger, Cappeller, Scheuchzer, that worthy man who got members of our Royal Society to pay for his pictures of flying dragons, contributed their quota of crude speculation. But it was not until 1741 that Mont Blanc and its glaciers were brought into notoriety by our young countrymen, Pococke and Windham, and became an attraction to the mind and an object to the ambition of the student whose name was destined to be associated with them. Horace Benedict de Saussure, born of a scientific family, the nephew of Bonnet, the Genevese botanist and philosopher, who has become known to the world as a mountaineer and the climber of Mont Blanc, came twenty years later. In truth he was far more of a mountain traveller and a scientific observer, a geological student, than a climber. When looking at his purple silk frock-coat (carefully preserved in his country house on the shore of the Lake of Geneva), one realises the difference between the man who climbed Mont Blanc in that garment and the modern gymnast, who thinks himself *par excellence* the mountaineer.

De Saussure did not confine himself to Savoy or to one group, he wandered far and wide over the Alpine region, and the four volumes of his " Voyages " contain, besides the narratives of his sojourn on the Col du Géant and ascent of Mont Blanc, a portion of the fruit of these wanderings.

The reader who would appreciate De Saussure's claim as the founder of the Scientific Exploration of Mountains must, however, be referred to the List of Agenda on questions calling for investigation placed at the end of his last volume.

They explain the comparative indifference shown by De Saussure to the problems connected with glacial movement and action. His attention was absorbed in the larger question of earth-structure, of geology, to which the sections exposed by mountains offered, he thought, a key; he was bitten by the contemporary desire for "A Theory of the Earth," by the taste of the time for generalisations for which the facts were not always ready. At the same time, his own intellect was perhaps somewhat deficient in the intuitive faculty; the grasp of the possible or probable bearing of known facts by which the greatest discoverers suggest theories first and prove them afterwards.

The school of De Saussure at Geneva died out after having produced Bourrit, the tourist who gloried in being called the Historian of the Alps, a man of pleasant self-conceit and warm enthusiasm, and De Luc, a mechanical inventor, who ended his life as reader to Queen Charlotte at Windsor, where he flits across Miss Burney's pages as the friend of Herschel at Slough and the jest of tipsy Royal Dukes. Oddly enough, the first sound guess as to glacier movement was made by one Bordier, who had no scientific pretensions. I reprinted many years ago the singular passage in which he compared glacier ice to "cire amollie," soft wax, "flexible et ductile jusqu'à un certain point," and described it as flowing in the manner of liquids (*Alp. J.*, ix. 327). He added this remarkable suggestion foreshadowing the investigations of Prof. Richter and M. Forel: "It is very desirable that there should be at Chamonix someone capable of observing the glaciers for a series of years and comparing their advance and oscillations with meteorological records." To the school of Geneva succeeded the school of Neuchatel, Desor and Agassiz; the feat of De Saussure was rivalled on the Jungfrau and the Finsteraarhorn by the Meyers of Bern. They in turn were succeeded by the British school, Forbes and Tyndall, Reilly and Wills, in 1840–60.

In 1857 the Alpine Club was founded in this country. In the half-century since that date the nations of Western Europe have emulated one another in forming similar bodies, one of the objects of which has been to collect and set in order information as to the mountains and to further their scientific as well as their geographical exploration.

What boulders, or rather pebbles, can we add to the enormous moraine of modern Alpine literature—a moraine the lighter portions of which it is to be hoped for the sake of posterity that the torrent of Time may speedily make away with?

For fifty years I have loved and at frequent intervals wandered and climbed in the Alps. I have had something of a grand passion for the Caucasus. I am on terms of visiting acquaintance with the Pyrenees and the Himalaya, the Apennines and the Algerian Atlas, the mountains of Greece, Syria, Corsica, and Norway. I will try to set in order some observations and comparisons suggested by these various experiences.

As one travels east from the Atlantic through the four great ranges of the Old World the peaks grow out not only in absolute height but also in abruptness of form, and in elevation above the connecting ridges. The snow and ice region increases in a corresponding manner. The Pyrenees have few fine rockpeaks except the Pic du Midi d'Ossau; its chief glacier summits, the Vignemale, Mont Perdu, the Maladetta, correspond to the Titlis or the Buet in the Alps. The peaks of the Alps are infinite in their variety and admirable in their clear-cut outlines and graceful curves. But the central group of the Caucasus, that which culminates in Dykhtau, Koshtantau, and Shkara, 17,000 feet summits (Koshtantau falls only 120 feet below this figure) has even more stately peaks than those that cluster round Zermatt.

Seek the far eastern end of the Himalaya, visit Sikkim, and you will find the scale increased; Siniolchum, Jannu, and Kangchenjunga are all portentous giants. To put it at a low average figure, the cliffs of their final peaks are half as high again as those of Monte Rosa and the Matterhorn.

In all these chains you will find the same feature of watersheds or partings lying not in but behind the geological axis, which is often the line of greatest peak elevation. This is the case in the Alps at the St. Gothard, in the Caucasus for some forty miles west of the Dariel Pass, in the Himalaya, in Sikkim and Nepal, where the waters flowing from the Tibetan plateau slowly eat their way back behind Kangchenjunga and the Nepalese snows. The passes at their sources are found consequently to be of the mildest character, hills "like Wiltshire Downs" is the description given by a military explorer. It needs no great stretch of geological imagination to believe in the cutting back of the southern streams of Sikkim or the Alps, as for instance at the Maloya, but I confess that I cannot see how the gorges of Ossetia, clefts cut through the central axis of the Caucasus, can be ascribed mainly to the action of water.

I turn to the snow and ice region. Far more snow is deposited on the heights of the Central Caucasus and the Eastern Himalaya than on the Alps. It remains plastered on their precipices, forming hanging glaciers everywhere of the kind found on the northern, the Wengern Alp, face of the Jungfrau. Such a peak as the Weisshorn looks poor and bare compared with Tetnuld in the Caucasus or Siniolchum in the Himalaya. The plastered sheets of snow between their great bosses of ice are perpetually melting, their surfaces are grooved, so as to suggest fluted armour, by tiny avalanches and runnels.

In the Aletsch glacier the Alps have a champion with which the Caucasus cannot compete; but apart from this single exception the Caucasian glaciers are superior to the Alpine in extent and picturesqueness. Their surfaces present the features familiar to us in the Alps—icefalls, moulins, and earthcones.

In Sikkim, on the contrary, the glaciers exhibit many novel features due no doubt mainly to the great sun-heat. In the lower portion their surface is apt to be covered with the débris that has fallen from the impending cliffs, so that little or no ice is visible from any distance. In the region below the névé there are very few crevasses, the ice heaves itself along in huge and rude undulations, high gritty mounds, separated by hollows often occupied by yellow pools which are connected by streams running in little icy ravines; a region exceptionally tiresome, but in no way dangerous to the explorer. In steep places the Alpine icefall is replaced by a feature I may best compare with a series of earth-pillars such as are found near Evolena and elsewhere, and are figured in most text-books. The ice is shaped into a multitude of thin ridges and spires, resembling somewhat the Nieves Penitentes of the Andes—though formed in a different material.

Great sun-heat acting on surfaces unequally protected, combined in the latter case with the strain of sudden descent, is no doubt the cause of both phenomena. Generally the peculiarities of the great glaciers of Kangchenjunga may be attributed to a vertical sun, which renders the frozen material less liable to crack, less rigid, and more plastic.

A glacier, as a rule, involves a moraine. Now moraines are largely formed from the material contributed by subaërial denudation, in plain words by the action of heat and cold and moisture on the cliffs that border them. It is what falls on a glacier, not that which it falls over, that mainly makes a moraine. The proof is that the moraines of a glacier which flows under no impending cliffs are puny compared with those of one that lies beneath great rock-walls.

Take, for example, the Norwegian glaciers of the Jostedals Brae and compare them with the Swiss. The former, falling from a great névé plain or snowfield, from which hardly a crag protrudes, are models of cleanliness. I may cite as examples the three fascinating glaciers of the Olden Valley. The Rosenlaui Glacier in Switzerland owed the cleanliness which gave it a reputation fifty years ago, before its retirement from tourists' tracks, to a similar cause—a vast snow-plateau, the Wetterkessel.

One peculiarity very noticeable both in the Himalaya and the Caucasus I have never found satisfactorily accounted for. I refer to the long grassy trenches lying between the lateral moraine and the hillside, which often seem to the mountain explorer to have been made by Providence to form grass paths for his benefit. They may possibly be due to the action of torrents falling from the hillside, which, meeting the moraine and constantly sweeping along its base, undermine it and keep a passage open for themselves. There are remarkable specimens of this formation on both sides of the Bezingi Glacier, in the Caucasus, and on the north side of the Zemu Glacier, in Sikkim.

Water is one of the greatest features in mountain scenery.

In Norway it is omnipresent. In this respect Scandinavia is a region apart; the streams of the more southern ranges are scanty compared with those of a region where the snowfall of two-thirds of the year is discharged in a few weeks. Greece stands at the opposite pole. By what seems a strange perversity of Nature, its slender streams are apt to disappear underground, to re-issue miles away in the great fountains that gave rise to so many legends. Arcadia is, for the most part, a dry upland, sadly wanting in the two elements of pastoral scenery, shady groves, and running brooks.

The Alps are distinguished by their subalpine lakes—

> "Anne lacus tantos? te, Lari maxime, teque,
> Fluctibus et fremitu assurgens, Benace, marino?"

of Virgil. But perhaps even more interesting to the student are the lake basins that have been filled up, and thus suggest how similar lakes may have vanished at the base of other ranges.

I know no more striking walk to anyone interested in the past doings of glaciers than that along the ridge of the mighty moraine of the old glacier of Val d'Aosta, which sweeps out, a hill 500 feet high, known as "La Serra," from the base of the Alps near Ivrea into the plain of Piedmont. Enclosed in its folds still lies the Lago di Viverone; but the Dora has long ago cut a gap in the rampart and drained the rest of the enclosed space, filling it up with the fluvial deposit of centuries.

It is, however, the tarns rather than the great lakes of the Alps which have been the chief subjects of scientific disputation. Their distribution is curious. They are found in great quantity in the Alps and Pyrenees, hardly at all in the Caucasus, and comparatively rarely in the part of the Himalaya I am acquainted with.

A large-scale map will show that where tarns are most thickly dotted over the uplands the peaks rise to no great height above the ridges that connect them. This would seem to indicate that there has been comparatively little subaërial denudation in these districts, and consequently less material has been brought down to fill the hollows. Again, it is in gneiss and granitic regions that we find tarns most abundant—that is, where the harder and more compact rocks make the work of streams in tapping the basins more lengthy. The rarity of tarns in the highlands behind Kangchenjunga, perhaps, calls for explanation. We came upon many basins, but, whether formed by moraines or true rockbasins, they had for the most part been filled up by alluvial deposits.

In my opinion, the presence of tarns must be taken as an indication that the portion of the range where they are found has until a comparatively recent date been under snow or ice. The former theory, still held, was that the ice scooped out their basins from the solid rock. I believe that it simply kept scoured pre-existing basins. The ice removed and the surrounding slopes left bare, streams on the one hand filled the basins with sediment, or, on the other, tapped them by cutting clefts in their rims. This theory meets, at any rate, all the facts I have observed, and I may point out that the actual process of the destruction of tarns by such action may be seen going on under our eyes in many places, notably in the glens of the Adamello group. Prof. Garwood has lately employed his holidays in sounding many of the tarns of the St. Gotthard group, and his results, I understand, tend to corroborate the conclusions stated.

I desire here to re-affirm my conviction that snow and ice in the High Alps are conservative agents: that they arrest the natural processes of subaërial denudation; that the scouring work done by a glacier is insignificant compared with the hewing and hacking of frost and running water on slopes exposed to the open sky without a roof of névé and glacier.

The contrast between the work of these two agents was forced upon me many years ago while looking at the ground from which the Eiger Glacier had then recently retreated. The rocks, it is true, had had their angles rubbed off by the glacier, but through their midst, cut as by a knife, was the deep slit or gash made by the subglacial torrent. There is in the Alps a particular type of gorge, found at Rosenlaui, at the Lower Grindelwald Glacier, at the Kirchet above Meiringen, and also in the Caucasus, within the curves of old terminal moraines. It is obviously due to the action of the subglacial torrent, which cuts deeper and deeper while the ice above protects the sides of the cutting from the effects of the atmosphere.

One more note I have to make about glaciers. It has been stated that glaciers go on melting in winter. Water, no doubt, flows from under some of them, but that is not the same thing. The end of the Rosenlaui Glacier is dry in January; you can jump across the clear stream that flows from the Lower Grindelwald glacier. That stream is not meltings, but the issue of a spring which rises under the glacier and does not freeze. There is another such stream on the way to the Great Scheideck, which remains free when frost has fettered all its neighbours.

I should like to direct your attention before we leave glaciers to the systematic efforts that are being made on the Continent to extend our knowledge of their peculiarities. The subject has a literature of its own, and two Societies —one in France, one in other countries—have been constituted to promote and systematise further investigations, especially with regard to the secular and annual oscillations of the ice. These were initiated by the English Alpine Club in 1893, while I was its president. Subsequently, through the exertions of the late Marshall Hall, an enthusiast on the subject, an International Commission of Glaciers was founded, which has been presided over by Dr. Richter, M. Forel, and others; and more recently a French Commission has been created with the object of studying in detail the glaciers of the French Alps. A number of excellent reports have been published, embodying information from all parts of the globe. There has been, and is, I regret to say, very great difficulty in obtaining any methodical reports from the British possessions oversea. The subject does not commend itself to the departmental mind. Let us hope for improvement: I signalise the need for it. Of course, it is by no means always an easy matter to get the required measurements of retreat or advance in the glacial snout, when the glacier is situated in a remote and only casually visited region. Still, with good-will more might be done than has been. The periods of advance and retreat of glaciers appear to correspond to a certain extent throughout the globe. The middle of the last century was the culmination of the last great advance. The general estimate of their duration appears to be half a century. The ice is now retreating in the Alps, the Caucasus, and the Himalaya, and I believe in North America. We live in a retrogressive period. The minor oscillation of advance which a few years ago gave hopes to those who, like myself, had as children seen the glaciers of Grindelwald and Chamonix at their greatest, has not been carried on.

Attempts are made to connect the oscillations of glaciers with periods of sun-spots. They are, of course, connected with the rain or snow-fall in past seasons. But the difficulty of working out the connection is obvious.

The advance of the ice will not begin until the snows falling in its upper basin have had time to descend as ice and become its snout; in each glacier this period will vary according to its length, bulk, and steepness, and the longer the glacier is, the slower its lower extremity will be to respond. Deficiency in snowfall will take effect after the same period. It will be necessary, therefore, to ascertain (as has been done in a tragic manner on Mont Blanc by the recovery in the lowest portion of the Glacier des Bossons of the bodies of those lost in its highest snows) the time each glacier takes to travel, and to apply this interval to the date of the year with which the statistics of deposition of moisture are to be compared. If the glacier shows anything about weather and climate, it is past, not contemporary, weather it indicates.

Another point in which the Asiatic ranges, and particularly the Himalaya, differ from the Alps is in the frequency of snow avalanches, earthfalls, and mud-slides. These are caused by the greater deposition of snow and the more sudden and violent alternations of heat and cold, which lead to the splitting of the hanging ice and snows by the freezing of the water in their pores. I have noticed at a bivouac that the moment of greatest cold—about the rising of the morning star—is often hailed by the reports of a volley of avalanches.

The botanist may find much to do in working out a comparison of the flora of my four ranges. I am no botanist: I value flowers according, not to their rarity, but to their abundance, from the artist's, not the collector's, point of view. But it is impossible not to take interest in such matters as the variations of the gentian in different regions, the behaviour of such a plant as the little Edelweiss (once the token of the Tyrolese lover, now the badge of every Alp-trotter), which frequents the Alps, despises the Caucasus, reappears in masses in the Himalaya, and then, leaping all the isles of the tropics, turns up again under the snows of New Zealand. I may mention that it is a superstition that it grows only in dangerous places. I have often found it where cows can crop it; it covers acres in the Himalaya, and I believe it has been driven by cows off the Alpine pastures, as it is being driven by tourists out of the Alps altogether.

The Italian botanists, MM. Levier and Sommier, have given a vivid account of what they call the Makroflora of the Central Caucasus—those wild-flower beds, in which a man and horse may literally be lost to sight, the product of sudden heat on a rich and sodden soil composed of the vegetable mould of ages. Has any competent hand celebrated the Mikroflora of the highest ridges, those tiny, vivid forget-me-nots and gentians and ranunculuses that flourish on rock-island "Jardins" like that of Mont Blanc, among the eternal snows, and enamel the highest rocks of the Basodano and the Lombard Alps? A comprehensive work on a comparison of mountain flora and the distribution of Alpine plants throughout the ranges of the Old World would be welcome. We want another John Ball. Allied to botany is forestry, and the influence of trees on rainfall, and consequently the face of the mountains, a matter of great importance, which in this country has hardly had the attention it deserves.

From these brief suggestions as to some of the physical features of mountains I would ask you to turn your attention to the points in which mankind come in contact with them, and first of all to History.

I fancy that the general impression that they have served as efficient barriers is hardly in accordance with facts, at any rate from the military point of view. Hannibal, Cæsar, Charles the Great, and Napoleon passed the Alps successfully. Hannibal, it is true, had some difficulty, but then he was handicapped with elephants. The Holy Roman Emperors constantly moved forwards and backwards. Burgundy, as the late Mr. Freeman was never weary of insisting, lay across the Alps. So until our own day did the dominions of the House of Savoy. North Italy has been in frequent connection with Germany; it is only in my own time that the Alps have become a frontier between France and Italy. But questions of this kind might lead us too far. Let me suggest that some competent hand should compose a history of the Alpine passes and their famous passages, more complete than the treatises that have appeared in Germany. Mr. Coolidge, to whom we owe so much, has, in his monumental collection and reprint of early Alpine writers, just published, thrown great light on the extensive use of what I may call the by-passes of the Alps in early times. Will he not follow up his work by treating of the Great Passes? I may note that the result of the construction of carriage roads over some of them was to concentrate traffic; thus the Monte Moro and the Gries were practically deserted for commercial purposes when Napoleon opened the Simplon. The roads over the Julier and Maloya ruined the Septimer. Another hint to those engaged in tracing ancient lines of communication. In primitive times, in the Caucasus to-day, the tendency of paths is to follow ridges, not valleys. The motives are on the spot obvious—to avoid torrents, swamps, ravines, earth-falls, and to get out of the thickets and above the timber-line. The most striking example is the entrance to the great basin of Suanetia, which runs not up its river, the Ingur, but over a ridge of nearly 9000 feet, closed for eight months in the year to animals.

From the military point of view mountains are now receiving great attention in Central Europe. The French, the Italians, the Swiss, the Austrians have extensive Alpine manœuvres every summer, in which men, mules, and light artillery are conveyed or carried over rocks and snow. Officers are taught to use maps on the spot, the defects in the official surveys are brought to light. It is not likely, perhaps, except on the Indian frontier, that British troops will have to fight among high snowy ranges. But I feel sure that any intelligent officer who is allowed to attend such manœuvres might pick up valuable hints as to the best equipment for use in steep places. Probably the Japanese have already sent such an envoy and profited by his experience.

A word as to maps, in which I have taken great interest, may be allowed me. The ordnance maps of Europe have been made by soldiers, or under the supervision of soldiers. At home when I was young, it was dangerous to hint at any defects in our ordnance sheets, for surveyors in this country are a somewhat sensitive class. Times have altered, and they are no longer averse from receiving hints and even help from unofficial quarters. Since the great surveys of Europe were executed, knowledge has increased so that every country has had to revise or to do over again its surveys. In three points that concern us there was great room for improvement, the delineation of the upper region as a whole, and the definition of snow and glaciers in particular, and in the selection of local names. In the two former the Federal Staff at Bern has provided us with an incomparable model. The number of local names known to each peasant is small, his pronunciation is often obscure, and each valley is apt to have its own set of names for the ridges and gaps that form its skyline. Set a stranger, speaking another tongue than the local *patois*, to question a herdsman, and the result is likely to be unsatisfactory. It has often proved so. The Zardezan is an odd transcription of the Gias del Cian of *patois*, the Gîte du Champ in French. The Grand Paradis is the last term an Aostan peasant would have used for the Granta Parei, the great screen of rock and ice of the highest mountain in Italy. The Pointe de Rosablanche was the Roesa Bianca, or white glacier. Monte Rosa herself, though the poet sees a reference to the rose of dawn, and the German professor detects "the Keltic *ros*, a promontory," is a simple translation of the Gletscher Mons of Simler, or rather Simler's hybrid term is a translation of Monte della Roesa. Roesa, or Ruize, is the Val d'Aostan word for glacier, and may be found in De Saussure's "Voyages."

An important case in this matter of mountain nomenclature has recently come under discussion—that of the highest mountain in the world. Most, if not all, mountaineers regret that the name of a Surveyor-General, however eminent, was fifty years ago affixed to Mount Everest. The ground for this action on the part of the Survey was the lack of any native name. Some years ago I ventured to suggest that the 29,002-feet peak (No. XV. of the Survey) was probably visible from the neighbourhood of Katmandu, even though the identifications of it by Schlagintweit and others might be incorrect, and that since some at least of the summits of the snowy group east of that city are apparently known in Nepal as Gaurisankar, that name might, following the practice which gave its name to Monte Rosa in the Alps, legitimately be applied to the loftiest crest of the mountain group of which the Nepalese Gaurisankar formed a part.

Recently, by the kindness of Lord Curzon, acting on a suggestion of my own, Captain Wood, a Survey officer, has been deputed to visit Katmandu and ascertain the facts. He has found that, contrary to the opinion of the late General Walker and the assertion of Major Waddell, Peak XV. is visible from the hills round the capital, and that the two highest snowpeaks visible from the city itself in the same direction were known to the Nepalese "nobles" as Gaurisankar.

These latter peaks or peak are about 36 miles distant from Peak XV., but are connected with it by a continuous line of glaciers. According to the principles that have prevailed in the division of the Alps, they would undoubtedly be considered as part of the same group, and the name, which, according to Captain Wood, is applied to a portion of the group, might legitimately be adopted for its loftiest peak.

But the chiefs of the Indian Survey take, as they are entitled to, a different view. They have decided to confine the name Gaurisankar to one of the peaks seen from Katmandu itself. I do not desire to raise any further protest against this decision. For since, in 1886, I first raised the question its interest has become mainly academical. A local Tibetan name for Peak XV., Chomo-Kankar, the Lord of Snows, has been provided on excellent native authority, confirmed by that competent Tibetan scholar, Major

Waddell, and I trust this name may in the future be used for the highest mountain in the world.[1] The point at issue is mainly one of taste. Indian surveyors may see no incongruity in naming after one of their own late chiefs the highest mountain in the world. But in this view they are, I believe, in a small minority.

I would urge mountain explorers to attempt in more distant lands what the late Messrs. Adams-Reilly and Nichols, Mr. Tuckett, and Lieut. Payer (of Arctic fame) did forty years ago with so much success in the Alps, what the Swiss Alpine Club have done lately, take a district, and working from the trigonometrically fixed points of a survey, where one exists, fill it in by planetabling with the help of the instruments for photographic and telephotographic surveying, in the use of which Mr. Reeves, the map curator to the R.G.S., is happy to give instruction. An excellent piece of work of this kind has been done by Mr. Stein in Central Asia.

There are, I know, some old-fashioned persons in this country who dispute the use of photography in mountain work. It can only be because they have never given it a full and fair trial with proper instruments.

Lastly, I come to a matter on which we may hope before long to have the advantage of medical opinion, based for the first time on a large number of cases. I refer to the effects of high altitudes on the human frame and the extent of the normal diminution in force as men ascend. The advance to Lhasa ought to do much to throw light on this interesting subject. I trust the Indian Government has taken care that the subject shall be carefully investigated by experts. The experience of most mountaineers (including my own) in the last few years has tended to modify our previous belief that bodily weakness increases more or less regularly with increasing altitude. Mr. White, the Resident in Sikkim, and my party both found on the borders of Tibet that the feelings of fatigue and discomfort that manifested themselves at about 14,000 to 16,000 feet tended to diminish as we climbed to 20,000 or 21,000 feet. I shall always regret that when I was travelling in 1899 on the shoulders of Kangchenjunga the exceptional snowfall altogether prevented me from testing the point at which any of our ascents were stopped by discomforts due to the atmosphere. Owing to the nature of the footing, soft snow lying on hard, it was more difficult to walk uphill than on a shingly beach; and it was impossible for us to discriminate between the causes of exhaustion.

Here I must bring this, I fear, desultory Address to an end. I might easily have made it more purely geographical, if it is geography to furnish a mass of statistics that are better and more intelligibly given by a map. I might have dwelt on my own explorations in greater detail, or have summarised those of my friends of the Alpine Club. But I have done all this elsewhere in books or reviews, and I was unwilling to inflict it for a second time on any of my hearers who may have done me the honour to read what I have written. Looking back, I find I have been able to communicate very little of value, yet I trust I may have suggested to some of my audience what opportunities mountains offer for scientific observations to mountaineers better qualified in science than the present speaker, and how far we scouts or pioneers are from having exhausted even our Alpine playground as a field for intelligent and systematic research.

And even if the value to others of his travels may be doubtful, the Alpine explorer is sure of his reward. What has been said of books is true also of mountains—they are the best of friends. Poets and geologists may proclaim—

> "The hills are shadows, and they flow
> From form to form, and nothing stands!"

But for us creatures of a day the great mountains stand fast, the Jungfrau and Mont Blanc do not change. Through all the vicissitudes of life we find them sure and sympathetic companions. Let me conclude with two lines which I found engraved on a tomb in Santa Croce at Florence:

> "Huc properate, viri, salebrosum scandite montem,
> Pulchra laboris erunt præmia, palma, quies."

1 See, for discussions of this question, *Proceedings* of the Royal Geographical Society, N.S., 1885, vii., 753; 1886, viii., 88, 176, 257; *Geographical Journal*, 1903, xxi., 294; 1904, xxiii., 89; *Alpine Journal*, 1886, xii., 448: 1902–3, xxi., 33, 317; *Petermann's Mitteilungen*, 1888, xxxiv., 338 1890, xxxvi., 251; 1901, xlvii., 40; 1902, xlviii., 14.

SECTION G.

ENGINEERING.

OPENING ADDRESS BY HON. CHARLES A. PARSONS, M.A., F.R.S., M.INST.C.E., PRESIDENT OF THE SECTION.

ON this occasion I propose to devote my remarks to the subject of invention.

It is a subject of considerable importance, not only to engineers but also to men of science and the public generally.

I also propose to treat invention in its wider sense, and to include under the word discoveries in physics, mechanics, chemistry, and geology.

Invention throughout the Middle Ages was held in little esteem. In most dictionaries it receives scant reference except as applied to poetry, painting, and sculpture.

Shakespeare and Dryden describe invention as a kind of muse or inspiration in relation to the arts, and when taken in its general sense to be associated with deceit, as "Return with an invention, and clap upon you two or three plausible lies."

As to the opposition and hostility to scientific research, discovery, and mechanical invention in the past, and until comparatively recent times, there can be no question, in some cases the opposition actually amounting to persecution and cruelty.

The change in public opinion has been gradual. The great inventions of the last century in science and the arts have resulted in a large increase of knowledge and the powers of man to harness the forces of Nature. These great inventions have proved without question that the inventors in the past have, in the widest sense, been among the greatest benefactors of the human race. Yet the lot of the inventor until recent years has been exceptionally trying, and even in our time I scarcely think that anyone would venture to describe it as altogether a happy one. The hostility and opposition which the inventor suffered in the Middle Ages have certainly been removed, but he still labours under serious disability in many respects under law as compared with other sections of the community. The change of public feeling in favour of discovery and invention has progressed with rapidity during the last century. Not only have private individuals devoted more time and money to the work, but societies, institutions, colleges, municipalities, and Governments have founded many research laboratories, and in some instances have provided large endowments. These measures have increased the number of persons trained to scientific methods, and also provided greatly improved facilities for research; but perhaps one of the most important results to engineers has been the direct and indirect influence of the more general application of scientific methods to engineering.

Sir Frederick Bramwell, in his Presidential Address to this Association in 1888, emphasised the interdependence of the man of science and the civil engineer, and described how the work of the latter has been largely based on the discoveries of the former; while the work of the engineer often provides data and adds a stimulus to the researches of the man of science. And I think his remarks might be further appropriately extended by adding that since the man of science, the engineer, the chemist, the metallurgist, the geologist, all seek to unravel and to compass the secrets of Nature, they are all to a great extent interdependent on each other.

But though research laboratories are the chief centres of scientific invention, and colleges, institutions, and schools train the mind to scientific methods of attack, yet in mechanical, civil, and electrical engineering the chief work of practical investigation has been carried on by individual engineers, or by firms, syndicates, and companies. These not only have adapted discoveries made by men of science to commercial uses, but also in many instances have themselves made such discoveries or inventions.

To return to the subject, let us for a moment consider in what invention really consists, and let us dismiss from our minds the very common conception which is given in dictionaries and encyclopædias that invention is a happy thought occurring to an inventive mind. Such a conception would give us an entirely erroneous idea of the formation of the great steps in advance in science and engineering that have been made during the last century; and, further, it would lead us to forget the fact that almost all important inventions have been the result of long training and laborious research and long-continued labour. Generally, what is usually called an invention is the work of many individuals, each one adding something to the work of his predecessors, each one suggesting something to overcome some difficulty, trying many things, testing them when possible, rejecting the failures, retaining the best, and by a process of gradual selection arriving at the most perfect method of accomplishing the end in view.

This is the usual process by which inventions are made.

Then after the invention, which we will suppose is the successful attempt to unravel some secret of Nature, or some mechanical or other problem, there follows in many cases the perfecting of the invention for general use, the realisation of the advance or its introduction commercially; this after-work often involves as great difficulties and requires for its accomplishment as great a measure of skill as the invention itself, of which it may be considered in many cases as forming a part.

If the invention, as is often the case, competes with or is intended to supersede some older method, then there is a struggle for existence between the two. This state of things has been well described by Mr. Fletcher Moulton. The new invention, like a young sapling in a dense forest, struggles to grow up to maturity, but the dense shade of the older and higher trees robs it of the necessary light. If it could only once grow as tall as the rest all would be easy, it would then get its fair share of light and sunshine. Thus it often occurs in the history of inventions that the surroundings are not favourable when the first attack is made, and that subsequently it is repeated by different persons, and finally in different circumstances it may eventually succeed and become established.

We may take in illustration almost any of the great inventions of undoubted utility of which we happen to have the full history—for instance, some of the great scientific discoveries, or some of the great mechanical inventions, such as the steam-engine, the gas-engine, the steamship, the locomotive, the motor-car, or some of the great chemical or metallurgical discoveries. Are not most, if not all, of these the result of the long-continued labour of many persons, and has not the financial side been, in most cases, a very important factor in securing success?

The history of the steam-engine might be selected, but I prefer on this occasion to take the internal-combustion engine, for two reasons—firstly, because its history is a typical one; and secondly, because we are to hear a paper by that able exponent and great inventor in the domain of the gas-engine, Mr. Dugald Clerk, describing not only the history, but the engine in its present state of development and perfection, an engine which is able to convert the greatest percentage of heat units in the fuel into mechanical work, excepting only, as far as we at present know, the voltaic battery and living organisms.

The first true internal-combustion engine was undoubtedly the cannon, and the use in it of combustible powder for giving energy to the shot is strictly analogous to the use of the explosive mixture of gas or oil and air as at present in use in all internal-combustion engines; thus the first internal-combustion engine depended on the combination of a chemical discovery and a mechanical invention, the invention of gunpowder and the invention of the cannon.

In 1680 Huygens proposed to use gunpowder for obtaining motive power in an engine. Papin, in 1690, continued Huygens's experiments, but without success. These two inventors, instead of following the method of burning the powder under pressure, as in the cannon, adopted, in ignorance of thermodynamic laws, an erroneous course. They exploded a small quantity of gunpowder in a large vessel with escape valves, which after the explosion caused a partial vacuum to remain in the vessel. This partial vacuum was then used to actuate a piston or engine and perform useful work. Subsequently several other inventors worked on the same lines, but all of these failed on account of two causes which now are very evident to us. Firstly, gunpowder was then, as it still is, a very expensive form of fuel, in proportion to the energy liberated on explosion; secondly, the method of burning the powder to cause a vacuum involves the waste of nearly the whole of the available energy, whereas had it been burned under pressure, as in the cannon, a comparatively large percentage of the energy would have been converted into useful work. But even with this alteration, and however perfect the engine had been, the cost of explosives would have debarred its coming into use, except for very special purposes.

We come a century later to the first real gas-engine. Street, in 1794, proposed the use of vapour of turpentine in an engine on methods closely analogous to those successfully adopted in the Lenoir gas-engine of eighty years later, or thirty years ago. But Street's engine failed from crude and faulty construction. Brown, in 1823, tried Huygens's vacuum method, using fuel to expand air instead of gunpowder, but he also failed, probably on account of the wastefulness of the method.

Wright, in 1833, made a really good gas-engine, having many of the essential features of some of the gas-engines of the present day, such as separate gas and water pumps, and water-jacketed cylinder and piston.

Barnett, in 1839, further improved on Wright's design, and made the greatest advance of any worker in gas-engines. He added the fundamental improvements of compression of the explosive mixture before combustion, and he devised means of lighting the mixture under pressure, and his engine conformed closely to the present-day practice as regards fundamental details. No doubt Barnett's engine, so perfect in principle, deserved commercial success, but either his mechanical skill or his financial resources were inadequate to the task, and the character of the patents would seem to favour this conclusion, both as regards Barnett and other workers at this period. Up to 1850 the workers were few, but as time went on they gradually increased in numbers; attention had been attracted to the subject, and men with greater powers and resources appear to have taken the problem in hand. Among these numerous workers came Lenoir, in 1860, who, adopting the inferior type of non-compression engine, made it a commercial success by his superior mechanical skill and resources. Mr. Dugald Clerk tells us: "The proposals of Brown (1823), Wright (1833), Barnett (1838), Bansanti and Matteucci (1857), show gradually increasing knowledge of detail and the difficulties to be overcome, all leading to the first practicable engine in 1866, the Lenoir." This stage of the development being reached, the names of Siemens, Beaude Roches, Otto Simon, Dugald Clerk, Priestman, Daimler, Dowson, Mond, and others, appear as inventors who have worked at and added something to perfect the internal-combustion engine and its fuel, and who have helped to bring it to its present state of perfection.

In the history of great mechanical inventions there is perhaps no better example of the interdependence of the engineer, the physicist, and the chemist than is evinced in the perfecting of the gas-engine. The physicist and the chemist together determine the behaviour of the gaseous fuel, basing their theory on data obtained from the experimental engines constructed by the mechanical engineer, who, guided by their theories, makes his designs and improvements; then, again, from the results of the improvements fresh data are collected and the theory further advanced, and so on until success is reached. But though I have spoken of the physicist, the chemist, and the engineer as separate persons, it more generally occurs that they are rolled into one, or at most two, individuals, and that it is indispensable that each worker should have some considerable knowledge of all the sciences involved to be able to act his part successfully.

Now let us ask, Could not this very valuable invention, the internal-combustion engine, have been introduced in a much shorter time by more favouring circumstances, by some more favourable arrangement of the patent laws, or by legislation to assist the worker attacking so difficult a problem? I think the answer is that a great deal might be done, and I will endeavour to indicate some changes and possible improvements.

The history of this invention brings before our minds two important considerations. Firstly, let us consider the patentable matter involved in the invention of the gas-engine, the utilisation for motive-power purposes of the then well known properties of the explosive energy of gunpowder or of mixtures of gas and oil with air. Are not these obvious inferences to persons of a mechanical turn of mind and who had seen guns fired, or explosions in bottles containing spirits of turpentine when slightly heated and a light applied to the neck? Surely no fundamental patent could have been granted under the existing patent laws for so obvious an application of known forces. Consequently, patent protection was sought in comparative details, details in some cases essential to success which were evolved or invented in the process of working out the invention. In this extended field of operations a slight protection was in some instances obtained. But in answer to the question whether such protection was commensurate with the benefits received by the community at large, there can, I think, be only one reply. Generally, those who did most got nothing, some few received insufficient returns, and in very few cases indeed can the return be said to have been adequate. The second important consideration is that of the methods of procedure of the patentees, for it appears that very few of them had studied what had been suggested or done before by others before taking out their own patent. We are also struck by the number of really important advances that have been suggested and have failed to fructify, either from want of funds or other causes, to be forgotten for the time and to be re-invented later on by subsequent workers.

What a waste of time, expense, and disappointment would be avoided if we in England helped the patentee to find out easily what had been done previously, on the lines adopted by the United States and German Patent Offices, who advise the patentee after the receipt of his provisional specification of the chief anticipatory patents, dead or alive! And ought we in England to rest content to see our patentees awaiting the report of the United States and German Patent Offices on their foreign equivalent specifications before filing their English patent claims? Ought not our Patent Office to give more facilities and assistance to the patentee?

Before proceeding further to discuss some of the possible improvements for the encouragement and protection of research and invention, I ask you further to consider the position of the inventor—the man anxious to achieve success where others have hitherto failed. To be successful he must be something of an enthusiast; and usually he is a poor man, or a man of moderate means, and dependent on others for financial assistance. Generally the problem to be attacked involves a considerable expenditure of money; some problems require great expenditure before any return can thereby accrue, even in the most favourable circumstances. In the very few cases where the inventor has some means of his own they are generally insufficient to carry him through, and there have unfortunately been many who have lost everything in the attempt. In nearly all cases the inventor has to co-operate with capital: the capitalist may be a sleeping partner, or the capital may be held by a firm or syndicate, the inventor in such cases being a partner—a junior partner—or a member of the staff. The combination may be successful and lasting, but unfortunately the best inventors are often bad men of business. The elements of the combination are often unstable, and the disturbing forces are many and active; especially is this so when the problem to be attacked is one of difficulty, necessitating various and successive schemes involving considerable expenditure, generally many times greater than that foreshadowed at the commencement of the undertaking. In such circumstances, unless the capitalist or the senior partner or board be in entire sympathy with the inventor or exercise great forbearance, stimulated by the hope of ultimate success and adequate returns, the case becomes hopeless, disruption takes place, and the situation is abandoned. Further, in the majority of cases, after some substantial progress has been made it is found that under the existing patent laws insufficient protection can be secured, and the prospect of a reasonable return for the expenditure becomes doubtful. In such circumstances the capitalist will generally refuse to proceed further unless the prospect of being first in the field may tempt him to continue.

Very many inventors, as I have said, avoid the expense of searching the patent records to see how far their problem has been attacked by others. In some cases the cost of a thorough search is very great indeed; sometimes it is greater than the cost of a trial attack on the problem. In the case of young and inexperienced inventors there sometimes exists a disinclination to enter on an expensive search; they prefer to spend their money on the attack itself. There are some, it is true, who have a foolish aversion to take steps to ascertain if others have been before them, and who prefer to remain in ignorance and trust to chance. It will, however, be said that the United States and German Patent Office reports ought to suffice to warn or protect the English patentee; but my own experience has been that such protection is not entirely satisfactory. There is, firstly, a considerable interval before such reports are received, and the life of a patent is short. Then, if the patent is upon an important subject, attracting general attention, the search is vigorous and sometimes overwrought, and the patent unjustly damaged or refused altogether. If, however, the patent is on some subject not attracting general attention, it receives too little attention and is granted without comment.

In some few instances it may be said that ignorance has been a positive advantage, and that if the patentee had realised how much of his patentable work was honeycombed by previous publications and patents, he would have lost heart and given up the task. It is, I think, a case of the exception proving the rule; and the patentee ought, as far as possible, in all cases to know his true position, and make his choice accordingly. The present patent law has some curious anomalies. Let us suppose some inventor has the good fortune to place the keystone in the arch of an invention, to add some finishing touch which makes the whole invention a complete success, and valuable. Then, success having been proved possible, others try to reap the results of his labour and good fortune, and, as often happens, it is discovered after laborious search that someone else first suggested the same keystone in some long-forgotten patent or obscure publication, but for some reason or other the public were none the better for his having done so. What does the law do? It says this is an anticipation, and instead of apportioning to all parties reasonable and equitable shares in the perfected invention, to which no one could object, it says that the patent is injured or perhaps rendered useless by the anticipation, and that its value to everyone concerned is thereby diminished or destroyed, as the case may be, and thrown open to the public. Until a few years ago, any anticipations, however old, might be cited; but recently the law has been amended, and at present none rank as anticipations which are more than fifty years old.

The perfecting of inventions and their introduction into general use require capital, as we have seen—sometimes a considerable amount, as in the introduction of the Bessemer process for steel, or the linotype system of printing—before any commercial success can be realised.

Capital having been found, the next difficulty is in the conservatism of persons and communities who are the buyers of the invention. There is always present in their minds the risk of failure and its consequent loss and worry to themselves, and in the event of success the advantage, in their estimation, may not be sufficient to counterbalance the risk. In large departments and companies the management of which is conducted by officials receiving fixed salaries, acting under non-technical supervision, there is a strong tendency among the officials to leave well alone, the organisation being such that the risk of failure, even though it be remote, more than counterbalances, in their estimation, the advantages that would result in the event of success. Next is the opposition of those who are financially interested in competing trades or older inventions; and if the invention is a labour-saving appliance, then the active opposition of the displaced labour is a serious, though generally only a temporary, barrier.

Fortunately, however, for the community, for research, and for invention, there is always to be found a considerable percentage of persons who, apart from the inventor, are able and willing to risk, and indeed to sacrifice, their personal interests in the cause of progress for the benefit of the community at large; and were it not for such persons the task of the introduction of most inventions would be an impossible one.

There are many problems of the highest importance in physics, engineering, chemistry, geology, and the arts, of which the investigation might probably prove of great benefit to the human race, and of which the probable monetary cost of the attack would be considerable, and of some very great indeed. Let us, then, inquire how the necessary funds could be raised. It is possible in the case of some of the more attractive problems that a group of rich philanthropists might be found, but in most cases it would be impossible to form a company on business lines, under the existing laws of this and other countries, as I shall endeavour to show.

In the case of many of the problems, no patents will give adequate protection; in some cases there is no subject-matter of novelty and importance involved. In other cases the probable duration of the investigation is so long that any initial patents would have expired before a commercial result was reached, and in either of these circumstances there would be no inducement to business men or financiers to undertake the risk.

As an illustration of my meaning I will take two investigations that have doubtless occurred to the minds of most of those present, though many others of greater or less importance might be cited. One is the thorough investigation of the problem of aërial navigation, with or without the assistance of flotation by gas. This problem could undoubtedly be successfully solved by an organised attack of skilled and properly trained engineers and the expenditure of a large sum of money. Assuming the problem solved, and commercially successful, it appears to be impossible under the existing patent laws to secure any adequate monopoly so as to justify the expectation of a reasonable return on the capital expended on the invention. For in view of the multitude of suggestions that have been made and the experiments that have been carried out, the practical solution of the problem would appear to rest on a judicious selection of old ideas by means of exhaustive experiments.

Another and perhaps more important investigation which has not, as yet, been attacked to any material extent is the exploration of the lower depths of the earth. At present the deepest shaft is, I believe, at the Cape, of a little more than one mile in depth, and the deepest bore-hole is one made in Silesia, by the Austrian Government, of about the same depth. What would be found at greater depths is at present a matter for conjecture, founded on the dip and thicknesses of strata observed on or near the surface. Much money and many valuable lives have been devoted to exploration of the polar regions, but there can be no comparison between the scientific interest and the possible material results of such exploration and the one I have chosen for illustration of the inadequate protection afforded by law—namely, a great engineering attack on a problem of geology.

I would ask you to consider the commercial aspect of this engineering geological enterprise, as compared with exploration into new or unknown areas on the surface of the earth.

An exploring expedition into a new country has before it generally the probability of the acquisition of territorial and mineral rights or possessions bringing material gain to the undertakers. The rights of such enterprises are well known, and capital can be obtained with or without national support, as the case may be. On the other hand, the explorer into the depths of the earth has no rights or monopolies beyond the mineral rights of the land he has purchased over his boring; further, it is improbable that he can obtain any patent of substantial value for his methods of boring to great depths. To succeed in the undertaking a great expenditure of money must be incurred, an expenditure far greater than that of an exploring expedition, and analogous to that of a military expedition or a small invading army, and to raise this sum the pioneers have practically no security to offer. For if they succeed in finding rich deposits of precious minerals in greater abundance, or succeed in making some geological discovery associated with deep borings, they gain no exclusive title to these under existing laws. Any other person or syndicate acting upon the experience gained, could sink other shafts in other places or countries, and, benefiting by the experience gained by the pioneers, could probably carry out the work more advantageously, and thus depreciate the first undertaking or render it valueless, as has often occurred before.

Let us consider more closely some of the essential features of sinking a shaft to a great depth, for I think it will be seen that it presents no unsurmountable difficulties beyond those incidental to an enterprise of considerable magnitude involving the ordinary methods of procedure and the ordinary methods adopted by mining engineers. That there would be some departures from ordinary practice on account of the great depth is true, but these are more of the character of detail. On the design of this boring I have consulted Mr. John Bell Simpson, the eminent authority on mining in the North of England. The shaft would be sunk in a locality to avoid as far as possible water-bearing strata and the necessity of pumping. It would be of a size usual in ordinary mines or coal-pits. The exact position of such shaft would require some consideration as to whether it should commence in the primary or secondary strata. It would be sunk in stages, each of about half a mile in depth, and at each stage there would be placed the hauling and other machinery, to be worked electrically, for dealing with each stage. The depth of each stage would be restricted to half a mile in order to avoid a disproportionate cost in the hauling machinery and the weight of rope, as well as increased cost in the cooling arrangements arising from excessive hydraulic pressures. At each second or third mile in depth there would be air-locks to prevent the air-pressure from becoming excessive owing to the weight of the superincumbent air, which at from two to three miles would reach about double the atmospheric pressure at the surface. A greater rise of pressure than this would be objectionable for two reasons—firstly, from the inconvenience to the workmen; secondly, from the rise of temperature due to the adiabatic compression of the circulating air for ventilating purposes. The air-pressure immediately above each air-lock would thus reach to about two atmospheres, and beneath to one atmosphere. In order to carry on the transfer of air through the air-locks for ventilating purposes pumps coupled to air-engines would be provided, the energy to work the pumps being obtained from electro-motors. To maintain the shaft at a reasonable temperature at the greater depth powerful means of carrying the heat to the surface would be provided.

The most suitable arrangement for cooling would probably consist of large steel pipes, an upcast and a downcast pipe, connected at the top and bottom of each half-mile section in a closed ring. This ring would be filled with brine, which by natural circulation would form a powerful carrier of heat; but the circulation, assisted by electrically driven centrifugal pumps, would be capable of carrying an enormous quantity of heat upwards to the surface. At each half-mile stage there would be a transfer of the heat from the ring below to the ring above by means of an apparatus similar in construction to a feed-water heater, or to a regenerator constructed of small steel tubes, through which the brine in the ring above would circulate, and around the outside the brine in the ring below could also circulate, the heat being transmitted through the metal of the tubes from brine ring to brine ring.

We have now presented to us two alternative arrangements for cooling. One arrangement would be to cool the brine to a very low temperature in the top ring at the mouth of the shaft by refrigerating machinery, so as to provide a sufficient gradation of temperature in the whole brine system, to ensure the necessary flow of heat upwards from brine ring to brine ring, and overcome all the resistances of heat-transfer, and so maintain the lowest ring at the temperature necessary for effectual cooling of the lowest section of the shaft. But a better arrangement would be to place powerful refrigerating machinery at certain of the lower stages, the function of this machinery being to extract heat from the ring below and deliver it to the ring above. This latter method would increase to a very great extent the heat-carrying power of the system, which in the first arrangement is limited by the freezing temperature of brine in the descending column and the highest temperature admissible in the ascending brine column. The amount of heat conducted inwards through the rock-wall and requiring to be absorbed and transferred to the surface depends on the temperature and conductibility of the strata. But there is no doubt that the methods I have indicated would be capable of maintaining a moderate temperature in the shaft to depths of twelve miles.

During the process of sinking at the greater depths the shaft bottom would require the application of a special cooling process in advance of the sinkers, similar to the Belgian freezing system of M. Poesche used for sinking through water-bearing strata and quicksands, and now in general use. It consists in driving a number of bore-holes in a circle outside the perimeter of the shaft to be sunk;

through these bore-holes very cold brine is circulated, thus freezing the rocks and quicksands and the water therein, and when this process is completed the sinking of the shaft is easily accomplished.

In our case this process would be maintained not only on the shaft bottom, but also for some time on the newly-pierced shaft sides, until the surrounding rock had been cooled for some distance from the face.

As to the cost, rate of boring, and normal temperature of the rock, an approximate estimate has been made, based on the experience gained on the Rand, but including the extra costs for air-locks and cooling :—

	Cost £	Time in Years	Temp. of Rock
For 2 miles depth from the surface.	500,000	10	122° F.
,, 4 ,, ,, ,, ,, ,,	1,100,000	25	152°
,, 6 ,, ,, ,, ,, ,,	1,800 000	40	182°
,, 8 ,, ,, ,, ,, ,,	2,700,000	55	212°
,, 10 ,, ,, ,, ,, ,,	3,700,000	70	242°
,, 12 ,, ,, ,, ,, ,,	5,000,000	85	272°

I hope I have succeeded in showing in the short time at our disposal that an exploration to great depths is not an impossible undertaking. But my main object in discussing the enterprise at some length has been to show that a pioneer company would not acquire any subsequent monopoly of similar works under the existing patent laws or the laws of any country.

In the scheme as I have described it, there appears to be nothing that could be patented; but let us suppose that some good patent could have been found that was absolutely essential to the success of the undertaking, it would certainly have expired before the pioneer company could have reaped any substantial return, and probably before the first enterprise had been completed. It follows therefore that at the present time there is no adequate protection, or indeed any protection at all, for the promoters of many great and important pioneer enterprises, some of which might prove of immense benefit to mankind.

Let us ask what change in the laws would place great pioneer research works on a sound financial basis. A Government grant, except for very special purposes, seems to be out of the question, seeing that the benefits to be derived are generally not confined to any one country. An extension of the life of patents, which is now from fourteen to sixteen years in different countries, would be undoubtedly a step in the right direction. It would be of great benefit generally if some scale of duration of patents could be fixed internationally, the scale being fixed according to the subject-matter, the difficulty of the attack, and the past history of the subject, but more especially in view of the utility of the invention.

One of the chief objections raised by the Privy Council against the extension of patents in this country has rightly been that undue prolongation is unfair to the British public, seeing that abroad no prolongations are granted. Therefore, if the duration of patents for important matters is to be extended at home it must also be extended abroad. In other words, such prolongations, to be effective, should necessarily extend to other countries. They should be international, and concurrent in all the countries interested.

One possible solution of this difficult question would be to place such matters under the jurisdiction of a Central International Committee, who would have the apportionment of the life and privileges of patents and of the extension or curtailment of their duration, according to their handling by the owners. I would ask, Why has a patent a life of only fourteen to sixteen years, while copyright is for forty-two years? Why has a pioneer company making a railway under Act of Parliament generally rights for ever unless it abuses its privileges, or the requirements of the district necessitate the construction of competing lines, while a patent has in comparison a life of infinite shortness?

I might also cite gas companies, electrical supply companies, under Act of Parliament, or provisional orders of forty-two years' duration; and this reminds us of the fact that until the term of life for electric supply companies had been extended from twenty-one years to forty-two years by the bill of 1884, it was impossible to find capital for such undertakings.

Now, it may be urged that the grant of a patent is a different thing from the grant of power to a railway company, a gas or electric supply company. But the object of this Address has been to show that a patent, to be fair to the patentee, ought in many cases to be analogous to an Act of Parliament or a provisional order. Would it not place matters in a fairer position, especially in the case of expensive and lengthy researches, to grant to those who pledge themselves to spend a suitable and minimum sum within a stated period on the research a reasonable and fair monopoly, so that such person or syndicate might in the event of success be in the position to reap a reasonable return for their expenditure and risk?

Some such measure would unquestionably give an immense stimulus to research and invention by enabling capital to be raised and works started on commercial lines in fields of great promise at present almost untouched.

I pass over the disadvantages to the British inventor of the hostile patent tariffs of Continental nations and of the protective patent laws of some of the British dependencies, disadvantages greater than those imposed by protective tariffs on the ordinary British manufacturer.

There is, however, another aspect of the question to which I would briefly allude: it is the great benefits that the world at large has derived from the work of inventors in the past.

Think of the multitude and power of the great steam-engines and gas-engines that drive our factories, and pump the water out of our mines, and supply our cities with water, light, and power; of the great steamships scattered over the ocean and the locomotives on the railways.

Think of the billions of tons of steel that have been made by the Bessemer, Siemens-Martin, and Thomas Gilchrist processes, and of the great superiority and less cost of the material over the puddled iron which it superseded.

Think of the vast work performed by the electric telegraphs and telephones; and we must not fail to include the great chemical and metallurgical processes carried on all over the world, besides the countless other inventions and labour-saving appliances.

Can we form any idea of the commercial value of all these gigantic tools that past inventors have left as a heritage to the human race, and can we venture to place any order of magnitude on so vast a sum?

If we take as our unit of value the whole of the money spent on all inventions, both successful and unsuccessful, I think we shall be much below the mark if we assume that the value of the benefits has on the average exceeded by ten-thousandfold the money spent on making and introducing the inventions.

If this is so, let us see what it means. It means that for every unit of capital spent by the inventors and their friends on invention they have in some cases received nothing back. In some cases they have just got their capital back, in some cases two or threefold, occasionally tenfold, very rarely a hundredfold. Whereas the world at large has received a present of ten-thousandfold greater value than all the money spent and misspent by the small band of past inventors.

In conclusion, let us hope that the inventor will in the future receive more encouragement and support, that the patent laws will be further modified and extended, that the people at large will consider these matters more closely and recognise that they are of first importance to their progress and welfare, and that in the future it may be easier, nay in some cases possible, to carry on many great researches into the secrets of Nature.

SECTION H.

ANTHROPOLOGY.

OPENING ADDRESS BY HENRY BALFOUR, M.A., PRESIDENT OF THE SECTION.

IT has frequently been remarked, and not without some justification, that Anthropology is an exceedingly diffuse science, and that it lacks the compactness and relatively well-defined field of enterprise enjoyed by most other sciences. This characteristic has even been employed by many as an argument against regarding Anthropology as a subject of any considerable value for educational purposes, the suggested lack of cohesion being thought to militate against this science ever being allowed to occupy a similar position in the educational curricula and examination systems of this country as that to which the older sciences have for the most part been admitted. For my own part, I cannot but consider the validity of this argument as open to question. The term Anthropology, used in its unrestricted and, as I venture to think, proper sense, does, I readily admit, embrace a vast and varied field, and it inevitably overlaps, and even wanders far and at times freely into the domains of, other sciences. How should it and how can it be otherwise? We, surely, would be guilty of grievously undervaluing and paying scant respect to our genus were we to imagine that the science devoted to its comprehensive study could be otherwise than far-reaching—call it diffuse if you will—and that it could be expected to avoid driving its roots deeply into other sciences the chief practical interest of which lies, after all, in their adaptability to the service of Man.

In admitting the partial justice of the accusation as regards diffuseness, Anthropology, it seems to me, is really pleading guilty to the possession of an educational quality of which it may rather boast than feel ashamed. A science which is so far-reaching, and yet the nucleus or focussing point of which is so well defined, seems of itself to furnish the materials in great part for a liberal education, if properly handled, and to lend itself to the preparation of the inevitable syllabuses, adapted to the different grades both of general education and of higher scholarship.

I readily admit that the *word* Anthropology is unfortunately cumbersome; but it would seem to be inevitable, since no one has yet provided the science with a compact general name which may serve as an efficient substitute; and, since we must retain it, we may at least expect the word to work for its polysyllabic existence, by covering a wide area and serving as the most general term denoting the study of Man in a wide and all-embracing sense.

It is not my purpose to discuss here the educational value of Anthropology, but frankly and even gladly to admit that Anthropology, in spite of its late recognition as a distinct science worthy of encouragement, has in recent years progressed with rapid strides, and has already reached a stage of developmental progress at which it is necessary to differentiate the several branches of study which are included under the general science, and to adopt a classification which is ever becoming more complex as the various divisions become unwieldy and require subdividing. An extensive terminology has been growing up for the purpose of assigning appropriate names to the already fairly numerous divisions of the main subject. Anthropology is passing through the developmental stages which have been followed by the older sciences, and is merely following normal routine in advancing from the simple to the complex. With the increase of knowledge the elements which together constitute a given science necessarily develop individually as well as collectively, and the original science loses its primitive unity by becoming an ever-increasing aggregation of sub-sciences. This process of subdivision or branching is inseparable from the life-history of an active and progressive science.

The genesis, growth, and maturity of Section H reflects to some extent the development of the study of Anthropology. If we look back nearly sixty years, to a meeting of the Association held in Cambridge in 1845, we see that Ethnology was not mentioned at all in the programme and list of Sections, though one ethnological paper does certainly figure amongst those of the Zoological-Botanical group. We may, however, assume that at this meeting a start was made, and give to Cambridge due credit for having a distinct claim to the parentage of Section H. For, in the following year, 1846, we find in the list of Sections a definite *sub-Section* of Ethnology. Indeed, were we in doubt as to the parentage of the infant sub-Section, there is circumstantial evidence clearly indicating this ancient University city, in the subtle influence apparently exercised upon the mind of the parent by overpowering leanings towards applied mathematics, as manifested by the interesting and otherwise unaccountable fact that the "sub-Section of Ethnology" was in that year humbly parasitic upon Section G, which was then, as now, devoted to "Mechanics"!

From 1847 to 1850 the Ethnological sub-Section came under Section D (Zoology, Botany, and Physiology). In 1851 Ethnology appears in conjunction, and, apparently, on nearly equal terms, with Geography; and so it remained in the year 1862, when the Association again had the privilege of meeting in Cambridge, that profound and ingenious student of Man, Mr. Francis Galton, being president of the dual Section. The Geographico-Ethnological combination lasted until 1868, after which, and until 1880, we find the prospective Section H replaced under the charge of Section D—Biology (which included Zoology, Botany, Anatomy, and Physiology).

The steadily growing vitality of the study of Man is very evident through all these years, from the list of papers read, and one may gather, from the way in which the sub-Section was transferred from Section to Section, that the infant was rapidly outgrowing its nurses, and becoming a troublesome handful. Typographical signs of adolescence, coupled with a yearning for independence, appear in 1883, when, glancing at the list of Sections, we see that, although Anthropology is still a "Department of Biology," not only is it the only "department" specially announced under Section D, but the heading is printed in type of the same magnitude as that used for the Section itself. The printer proved to be a good prophet; for in the following year, 1884, at the meeting in Montreal, the inevitable occurred, and Anthropology blossomed out into the adult stage, and received the emancipation afforded by the assignment of an entire Section to itself, the "Section H," which has, I venture to think, thoroughly justified its existence ever since.

It may be doubted whether we have as yet reached the limit of expansion. The time is likely to come when Section H will be the parent of one or more vigorous sub-Sections, which, again, may repeat the developmental sequence, reaching at length maturity and discretion, and being perhaps allowed to set up for themselves as semi-independent Sections. The original title of a Section of the British Association may disappear entirely as such, after the sub-Sections comprised under it have received their full emancipation. This has happened in the case of Biology, which for some thirty years gave its name to Section D, but which finally gave way before the growth of its enterprising and very progressive offshoots (Zoology, Anthropology, Physiology, and Botany), which one after the other developed into independent Sections. With this segregation of the various component elements of Biology, the old generalised title ceased to appear on the list of the British Association. This, perhaps, will be the fate of the term "Anthropology," as the growth of the subjects which have developed under the wing of this very comprehensive science gradually causes, for the sake of practical convenience, a number of subordinate titles to replace the time-honoured and inclusive term. Should it thus happen, in response to the growth of the science, that this term is destined to follow the far wider term "Biology" into a position of dignified ease, we shall be wise to bear continually in mind that Anthropology is the main stem from which the various branches have sprung, and to the nourishment and growth of which it should be the principal aim of their individual activities to contribute. In an age of ever-increasing specialisation we may from time to time require a reminder of the fact that the true value of researches in the special fields of a science must be estimated by the degree to which their relationship to the whole can be and is rendered manifest. The work of specialists will necessarily lose half its value if there is a dearth of generalists who will gather together the threads and weave them into a substantial fabric, which shall show the importance of each individual piece of work to the progress of the science as a whole.

Once Anthropology became recognised as a definite science, and one worthy of encouragement, the number of its devotees increased steadily and apace, and the range of its work widened rapidly. Indeed, it would appear as though there were an almost feverish desire to make up for time lost through the phenomenal tardiness of the discovery of a seemingly obvious fact, which is that "Man" is in very truth a "proper study for mankind." Energy is not wanting, though this feverishness is kept in rigid subjection by the chilling and reducing effect of starvation for want of funds. The lack of adequate financial support is painfully apparent in Great Britain when we compare the conditions prevailing here with those obtaining in other countries.

I will not endeavour to cope with the many and varied aspects of Anthropology and its complex ramifications, nor will I attempt to enumerate the many distinguished men of science to whose stimulating work we chiefly owe the progress already achieved in Anthropology; the more prominent pioneers are well known to you, and several, I am glad to say, are yet with us. Their works remain as important landmarks in the developmental record of the Science of Man. I have, instead, selected as my principal theme one branch of the subject. My main object is to review, necessarily briefly, *one* of the factors which have played a part in stimulating scientific inquiry into the past and present conditions of Man, and in furthering the development both of the scientific and the popular interests of Anthropology. I wish to confine myself to the consideration of the contribution of one man towards the subject, a contribution which is the more valuable since it deals with wide principles, and thus affords a basis upon which a vast army of students may found valuable work. It amounted to the establishment of a particular school of research into the history of human culture, into which fresh workers are constantly being attracted, and which has stood the test of time through half a century.

It was about the middle of last century that an officer in Her Majesty's Army began to apply the lessons which he had learnt in the course of some of his professional experimental work to studies pursued by him as a hobby in a far wider field of science. The story of the famous ethnographical collection of Colonel Lane Fox is well known, and I need but briefly refer to it. During his investigations, conducted with a view to ascertaining the best methods whereby the service firearms might be improved, at a time when the old Tower musket was being finally discarded, he was forcibly struck by the extremely gradual changes whereby improvements were effected. He observed that every noteworthy advancement in the efficiency, not only of the whole weapon but also of every individual detail in its structure, was arrived at as a cumulative result of a succession of very slight modifications, each of which was but a trifling improvement upon the one immediately preceding it. Through noticing the unfailing regularity of this process of gradual *evolution* in the case of firearms, he was led to believe that the same principles must probably govern the development of the other arts, appliances, and ideas of mankind. With characteristic energy and scientific zeal Colonel Lane Fox began at once, in the year 1851, to illustrate his views and to put them to a practical test. He forthwith commenced to make the ethnological collection with which his name will always be associated, and which rapidly grew to large proportions under his keen search for material which should illustrate and perhaps prove his theory of progress by evolution in the arts of mankind.

Although as a collector he was somewhat omnivorous, since every artefact product fell strictly within his range of inquiry, his collection, nevertheless, differed from the greater number of private ethnological collections, and even public ones of that day, inasmuch as it was built up *systematically* with a definite object in view. It is unnecessary for me to describe in detail the system which he adopted in arranging his collection. His principles are well known to ethnologists, either from the collection itself or from his writings, more especially from the series of lectures which he gave at the Royal United Service Institution, in the years 1867–69, upon "Primitive Warfare": from his paper read before the Anthropological Institute in 1874 on "The Principles of Classification," as adopted in the arrangement of his anthropological collection, which was then exhibited at the Bethnal Green Museum; from that portion of the *catalogue raisonné* of his collection which was published in 1877; and from numerous other papers dealing with special illustrations of his theory. Suffice it to say that, in classifying his ethnological material, he adopted a *principal* system of groups into which objects of like form or function from all over the world were associated to form series, each of which illustrated as completely as possible the varieties under which a given art, industry, or appliance occurred. Within these main groups objects belonging to the same region were usually associated together in *local* sub-groups. And wherever amongst the implements or other objects exhibited in a given series there seemed to be suggested a *sequence of ideas*, shedding light upon the probable stages in the evolution of this particular class, these objects were specially brought into juxtaposition. This special grouping to illustrate sequence was particularly applied to objects from the same region as being, from their local relationships, calculated better to illustrate an actual continuity. As far as possible the seemingly more primitive and generalised forms—those simple types which usually approach most nearly to *natural* forms, or the use of which is associated with primitive ideas—were placed at the beginning of each series, and the more complex and specialised forms were arranged towards the end.

The primary object of this method of classification by series was to demonstrate, either actually or hypothetically, the origin, development, and continuity of the material arts, and to illustrate the variations whereby the more complex and specialised forms belonging to the higher conditions of culture have been evolved by successive slight improvements from the simple, rudimentary, and generalised forms of a primitive culture.

The *earlier* stages in these sequence series were more especially the object of investigation, the later developments being in the greater number of cases omitted or merely suggested. It was necessary for Colonel Lane Fox to restrict the extent of the series, any one of which, if developed to the full extent, would easily have filled a good-sized museum. The earlier stages, moreover, were less familiar, and presented fewer complications. The general principles of his theory were as adequately demonstrated by the ruder appliances of uncivilised races as by the more elaborate products of peoples of higher culture; and, moreover, there was doubtless a great attraction in attacking that end of the development series which offered a prospect at least of finality, inasmuch as there was always a chance of discovering the absolute origin of a given series. Hence the major part of his collection consisted in specimens procured from savage and barbaric races, amongst whom the more rudimentary forms of appliances are for the most part to be found.

The validity of the general views of Colonel Lane Fox as to evolution in the material arts of Man was rapidly accepted by a large number of ethnologists and others, who were convinced by the arguments offered and the very striking evidence displayed in their support. I have heard people object to the use of the term "evolution" in connection with the development of human arts. To me the word appears to be eminently appropriate, and I think it would be exceedingly difficult to find one which better expresses the succession of extremely minute variations by means of which progress has been effected. That the successive individual units of improvement, which when linked together form the chain of advancement, *are* exceedingly small is a fact which anyone can prove for himself if he will study *in detail* the growth of a modern so-called "invention." One reason why we are apt to overlook the greater number of stages in the growth of still living arts is that we are not as a rule privileged to watch behind the scenes. Of the numberless slight modifications, each but a trifling advance upon the last, it is but comparatively few which ever meet the eye of the public, which only sees the more important stages; those, that is to say, which present a sufficiently distinct advance upon that which has hitherto been in use to warrant their attracting attention, or, shall we say, having for a time a marketable value. The bulk of the links in the evolutionary chain disappear almost as soon as they are made, and are known to few, perhaps none, besides their inventors. Even where the history of some invention is recorded with the utmost care it is only the more prominent landmarks which receive notice; the multitude of trifling variations which have led up to them are not referred to, for, even if they be known, space forbids such elaborately detailed record. The smaller variations are, for the most part, utterly forgotten, their ephemeral existence and their slight individual influence upon the general progress being unrecorded at the time, and lost sight of almost at once. The immediately succeeding stage claims for the moment the attention, and it again in its turn becomes the stepping-stone upon which the next raises itself, and so on.

Before proceeding further, let me give as briefly as I can an example of a development series worked out, in the main, upon the general line of inquiry inaugurated by Colonel Lane Fox. It is commonly accepted as a fact, which is borne out by tradition, both ancient and modern, that certain groups of stringed instruments of music must be referred for their origin to the bow of the archer. The actual historical record does not help us to come to a definite conclusion on this point, nor does the direct testimony of archæology, but from other sources very suggestive evidence is forthcoming. A comparative study of the musical instruments of modern savage and barbaric peoples makes it very clear to one that the greater portion of the probable chain of sequences which led from the simple bows to highly specialised instruments of the harp family may be reconstructed from types still existing in use among living peoples, most of the well-defined early stages being represented in Africa at the present day.[1] The native of Damaraland, who possesses no stringed instrument proper, is in the habit of temporarily converting his ordinary shooting-bow into a musical instrument. For this purpose he ties a small thong loopwise round the bow and bow-string, so as to divide the latter into two vibrating parts of unequal length. When lightly struck with a small stick the tense string emits a couple of notes, which satisfy this primitive musician's humble cravings for purely rhythmic sound. Amongst many other African tribes we find a slight advance, in the form of special rather slightly made bows constructed and used for musical purposes only. In order to increase the volume of sound, it is frequently the custom amongst some of the tribes to rest the bow against some hollow, resonant body, such as an inverted pot or hollow gourd. In many parts, again, we find that the instrument has been further improved by *attaching* a gourd to the bow, and thus providing it with a permanent resonating body. To achieve greater musical results, it would appear that somewhere in Africa (in the West, I suspect) two or more small bows were attached to a single gourd. I have, so far, been unable to trace this particular link in Africa itself, but, curiously enough, this very form has been obtained from Guiana. It may be thought that I am applying a breaking strain to the chain of evidence when I endeavour to work an instrument from South America into an African developmental series. But, when we recall the fact that evidence of the existence of *indigenous* stringed instruments of music in the New World has yet to be produced, coupled with the certain knowledge that a considerable number of varieties of musical instruments, stringed and otherwise, accompanied the enforced migration of African natives during the days of the slave trade, and were thus established in use and perpetuated in many parts of the New World, including the north-east regions of South America, we may, I think, admit with some confidence that in this particular instance from Guiana to Guinea is no very far cry, and that the more than probable African origin of this instrument from South America gives it a perfect claim to take its place in the African sequence. I still anticipate that this type of instrument will be forthcoming from some hinterland region in West Africa. Were *no* evidence at all forthcoming of such a form, either in past or present, we should be almost compelled to infer that such a one had existed, as this stage in the sequence appears to be necessary to prevent a break in the continuity of forms leading to what is apparently the next important stage, represented by a type of instrument common in West Africa, having five little bows, each carrying its string, and all of which are fixed by their lower ends into a box-like wooden resonator. This method of attaching the bows to the now improved body of the instrument necessitates the lower attachment of the strings being transferred from the bows to the body, so that the bow-like form begins to disappear. The next improvement of which there is evidence from existing types consists in the substitution of a single, stouter, curved rod for the five little "bows," all the five strings being serially attached to the upper end of the rod, their lower ends to the body as before. This instrument is somewhat rare now, and it may well be a source of wonder to us that it has survived at all (unless it be to assist the ethnologist), since it is an almost aggressively inefficient form, owing to the row of strings being brought into two different planes at right angles to one another. The structure of this rude instrument gives it a quaintly composite appearance, suggesting that it is a banjo at one end and a harp at the other. This is due to the strings remaining, as in the preceding form, attached to the resonating body in a line disposed *transversely*, while the substitution of a single rod for the five "bows" has necessitated the disposal of their upper attachments in a *longitudinal* series as regards the longer axis of the instrument. Inefficient though it be, this instrument occupies an important position in the apparent chain of evolution, leading on as it does through some intermediate types to a form in which the difficulty as regards the strings is overcome by attaching their *lower* ends in a longitudinal series, and so bringing them into the same plane throughout their length. In this shape the instrument has assumed a harp-like form—a rude and not very effective one, it is true, but it is none the less definitely a member of the harp family. The modern varieties of this type extend across Africa from west to east, and the harps of ancient Egypt, Assyria, Greece, and India were assuredly elaborations of this primitive form. The Indian form, closely resembling that of ancient Egypt, still survives in Burma, while elsewhere we find a few apparently allied forms. In all these forms of the harp, from the rudest Central and West African types to the highly ornate and many-stringed examples of Egypt and the East, one point is especially noteworthy. This is the invariable *absence of the fore-pillar*, which in the modern harps of Western Europe is so important, nay, essential, a structural feature. In spite of the skill and care exercised in the construction of some of the more elaborate forms, none were fitted with a fore-pillar, the result being that the frame across which the strings were stretched was always weak and disposed to yield more or less to the strain caused by the tension of the strings. This implied that, even when the strings were not unduly strained, the tightening up of one of them to raise its pitch necessarily caused a greater or less slackening of all the other strings, since the free end of the rod or "neck" would tend to be drawn slightly towards the body of the instrument under the increased tension. One can picture the soul-destroying agonies endured by two performers upon these harps when endeavouring, if they ever did so, to bring their refractory instruments into unison, while, as for the orchestral music of the old Assyrian days—well, perhaps we had better not attempt to picture *that!* The mere addition of a simple, strut-like support between the free end of the "neck" and the "body" would have obviated this difficulty and rendered the instrument relatively efficient and unyielding to varying tension. And yet, even in Western Europe, this seemingly obvious and invaluable addition did not appear, as far as I can ascertain, until about the seventh or eighth century A.D.; and even then it seems to have been added somewhat half-heartedly, and a very long time had yet to elapse before the fore-pillar became an integral part of the framework and was allotted its due proportion in the general design.

I have purposely selected this particular series for my illustration, not because it is something new—indeed, it is already more or less familiar, and maybe has even some merit in its lack of newness, since, in accordance with a popular dictum, it may urge a greater claim to be regarded as true—nor because it is specially striking, but rather for the reason that it illustrates suitably several of the points upon which I wish briefly to touch. Even in the severely condensed form in which I have been obliged to present this series of developments from bow to harp, there is, I think, demonstrated the practical application of several of the general principles upon which is based the theory whereby Colonel Lane Fox sought to elucidate the phenomena of human progress.

A series of this kind serves, in the first place, to demonstrate that the absence of historical and archæological evidence of the *actual* continuity in development from simple to complex does not preclude investigations into the early history of any product of human ingenuity, nor prevent the formation of a suggestive and plausible if largely hypothetical series, illustrating the probable chain of sequences along which some highly specialised form may be traced back link by link to its rudimentary prototypes, or even to its absolute origin, which in this particular instance is the ordinary shooting bow *temporarily* converted into a musical instrument. Where an actual chronological series is not forthcoming, a comparative study of such types as are

[1] "The Natural History of the Musical Bow." By H. Balfour. Clarendon Press, Oxford.)

available, even though they be *modern* examples, reveals the fact that, if classified according to their apparent morphological affinities, these types show a tendency to fall into line, the gap between the extreme forms—that is, the most simple and the most advanced—being filled by a succession of intermediate forms, more or less completely linked together, according to the number of varieties at our disposal. We are thus, at any rate, in possession of *a* sequence series. Is it unreasonable for us to conclude that this reflects, in great measure, *the* actual chronological sequence of variations through which in past times the evolutionary history of the instrument was effected from the earliest rudimentary form?

It is difficult to account at all for the existence of many of the forms such as I have briefly described, except on the supposition that they are *survivals* from more or less *early stages* in a series of progressive evolution; and, for myself, I do not believe that so inefficient and yet so elaborate an instrument as, to take an example, the harp of ancient Egypt, Assyria, and India could have come into being by any sudden inventive process, by "spontaneous generation," as it were, to use a biological term; whereas, the innate conservatism of the human species, which is most manifest among the lower and more primitive races (I use the term conservatism, I need hardly say, in a non-political sense) amply accounts for such forms having been arrived at, since the rigid adherence to traditional types is a prevailing characteristic of human culture, and only admits of improvement by very slight and gradual variations upon existing forms. The difficulty experienced by man in a primitive condition of culture of emancipating himself from the ideas which have been handed down to him, except by a very gradual and lengthy process, causes him to exert somewhat blindly his efforts in the direction of progress, and often prevents his seeing very obvious improvements, even when they are seemingly forced upon his notice. For instance, the early Egyptian, Assyrian, and Greek harps, as I have already stated, were destitute of a fore-pillar, and this remained the case for centuries, in spite of their actually existing in an environment of other instruments, such as the lyre and *trigonon*, which in their rigid, unyielding frames possessed and even paraded the very feature which was so essential to the harp, to enable it to become a really efficient instrument. The same juxtaposition of similar types, without mutual influence, may be seen in modern Africa among ruder forms of these instruments.

And yet, in spite of instances such as this—where a valuable feature suggested by one instrument has not been adopted for the improvement of another, even though the two forms are in constant use side by side—we must recognise that progress in the main is effected by a process of bringing the experience gained in one direction to bear upon the results arrived at in another. This process of grafting one idea upon another, or, as we may call it, the hybridisation of ideas and experience, is a factor in the advancement of culture the influence of which cannot be overestimated. It is, in fact, the main secret of progress. In the animal world hybridisation is liable to produce *sterile* offspring; in the world of ideas its results are usually far different. A fresh stimulus is imparted, which may last through generations of fruitful descendants. The *rate* at which progress is effected increases steadily with the growth of experience, whereby the number of ideas which may act and react upon one another is augmented.

It follows, as a corollary, that he who would trace out the phylogenetic history of any product of human industry will speedily discover that, if he aims at doing so *in detail*, he must be prepared for disappointments. The tangle is too involved to be completely unravelled. The sequence, strictly speaking, is not in the form of a simple chain, but rather in that of a highly complex *system* of chains. The time-honoured simile afforded by a river perhaps supplies the truest comparison. The course of the *main stream* of our evolution series may be fairly clear to us, even as far as to its principal source; we may even explore and study the general effect produced by the more important tributaries; but to investigate in detail the contributions afforded in present and past of the innumerable smaller streams, brooks, and runlets is clearly beyond anyone's power, even supposing that the greater number had not changed their course at times, and even, in many cases, run dry. While we readily admit that important effects have been produced by these numberless tributary influences, both on the course and on the volume of the river, it is clear that we must in general be content to follow the main stream. A careful study of the series of musical instruments, of which I gave but a scanty outline, reveals very clearly that numberless ideas borrowed from outside sources have been requisitioned and have affected the course of development. In some cases one can see fairly clearly whence these ideas were derived, and even trace back in part their own phylogenetic history; but a complete analysis must of necessity remain beyond our powers and even our hopes.

It will have been observed that, in the example of a sequence series which I have given, the early developmental stages are illustrated entirely by instruments belonging to *modern savage races*. It was a fundamental principle in the general theory of Colonel Lane Fox that in the arts and customs of the still living savage and barbaric peoples there are reflected to a considerable extent the various strata of human culture in the past, and that it is possible to reconstruct in some degree the life and industries of Man in prehistoric times by a study of existing races in corresponding stages of civilisation. His insistence upon the importance of bringing together and comparing the archæological and ethnological material, in order that each might serve to throw light upon the other, has proved of value to both sciences. Himself a brilliant and far-seeing archæologist as well as ethnologist, he was eminently capable of forming a conclusion upon this point, and he urged this view very strongly.

The earth, as we know, is peopled with races of the most heterogeneous description, races in all stages of culture. Colonel Lane Fox argued that, making due allowance for possible instances of degradation from a higher condition, this heterogeneity could readily be explained by assuming that, while the progress of some races has received relatively little check, the culture development of other races has been retarded to a greater or less extent, and that we may see represented conditions of at least partially arrested development. In other words, he considered that in the various manifestations of culture among the less civilised peoples were to be seen more or less direct *survivals* from the earlier stages or strata of human evolution; vestiges of ancient conditions which have fallen out at different points and have been left behind in the general march of progress.

Taken together, the various living races of Man seem almost to form a kind of living genealogical tree, as it were, and it is as an epiphyte upon this tree that the comparative ethnologist largely thrives; while to the archæologist it may also prove a tree of knowledge the fruit of which may be eaten with benefit rather than risk.

This certainly seems to be a legitimate assumption in a general way; but there are numerous factors which should be borne in mind when we endeavour to elucidate the past by means of the present. If the various gradations of culture exhibited by the condition of living races—the savage, semi-civilised, or barbaric, and the civilised races—could be regarded as accurately typifying the successive stages through which the higher forms of culture have been evolved in the course of the ages; if, in fact, the different modern races of mankind might be accepted as so many sections of the human race the intellectual development of which has been arrested or retarded at various definite stages in the general progression, then we should have, to all intents and purposes, our genealogical tree in a very perfect state, and by its means we could reconstruct the past and study with ease the steady growth of culture and handicrafts from the earliest simple germs, reflecting the mental condition of primæval man up to the highest manifestations of the most cultured races.

These ideal conditions are, however, far from being realised. Intellectual progress has not advanced along a single line, but, in its development, it has branched off in various directions, in accordance with varying environment; and the tracing of lines of connection between different forms of culture, as is the case with the physical variations, is a matter of intricate complexity. Migrations with the attendant climatic changes, change of food, and, in fact, of general environment, to say nothing of the crossing of different stocks, transmission of ideas from one people to another, and other factors, all tend to increase the tangle.

Although in certain instances savage tribes or races show obvious signs of having *degenerated* to some extent from conditions of a higher culturedom, this cannot be regarded as the general rule, and we must always bear in mind the seemingly paradoxical truth that degradation in the culture of the lower races is often, if not usually, the direct result of contact with peoples in a far higher state of civilisation.

There can, I think, be little doubt that Colonel Lane Fox was well justified in urging the view that most savage races are in large measure strictly *primitive*, survivals from early conditions, the development of their ideas having from various causes remained practically stationary during a very considerable period of time. In the lower, though not degenerate, races signs of this are not wanting, and while few, possibly none, can be said to be absolutely in a condition of arrested development, their normal progress is at a slow, in most cases at a *very* slow, rate.

Perhaps the best example of a truly primitive race existing in recent times, of which we have any knowledge, was afforded by the native inhabitants of Tasmania. This race was still existing fifty years ago, and a few pure-blooded survivors remained as late as about the year 1870, when the race became extinct, the benign civilising influence of enlightened Europeans having wiped this extremely interesting people off the face of the earth. The Australians, whom Colonel Lane Fox referred to as being "the lowest amongst the existing races of the world of whom we have any accurate knowledge," are very far in advance of the Tasmanians, whose lowly state of culture conformed thoroughly with the characteristics of a truly primitive race, a survival not only from the Stone Age in general, but from almost the earliest beginnings of the Stone Age. The difference between the culture of the Tasmanians and that of the Australians was far greater than that which exists between man of the "River Drift" period and his Neolithic successors. The objects of every-day use were but slight modifications of forms suggested by Nature, involving the exercise of merely the simplest mental processes. The stone implements were of the rudest manufacture, far inferior in workmanship to those made by Palæolithic man; they were never ground or polished, never even fitted with handles, but were merely grasped in the hand. The *varieties* of implements were very *few in number*, each, no doubt, serving a number of purposes, the function varying with the requirements of the moment. They had no bows or other appliances for accelerating the flight of missiles, no pottery, no permanent dwellings; nor is there any evidence of a previous knowledge of such products of higher culture. They seem to represent a race which was isolated very early from contact with higher races; in fact, before they had developed more than the merest rudiments of culture—a race continuing to live under the most primitive conditions, from which they were never destined to emerge.

Between the Tasmanians, representing in their very low culture the one extreme, and the most civilised peoples at the other extreme, lie races exhibiting in a general way intermediate conditions of advancement or retardation. If we are justified, as I think we are, in regarding the various grades of culture observable among the more lowly of the still existing races of man as representing to a considerable extent those vanished cultures which in their succession formed the different stages by which civilisation emerged gradually from a low state, it surely becomes a very important duty for us to study with energy these living illustrations of early human history in order that the archæological record may be supplemented and rendered more complete. The material for this study is vanishing so fast with the spread of civilisation that opportunities lost now will never be regained, and already even it is practically impossible to find native tribes which are wholly uncontaminated with the products, good or bad, of higher cultures.

The arts of living races help to elucidate what is obscure in those of prehistoric times by the process of reasoning from the known to the unknown. It is the work of the zoologist which enables the palæontologist to reconstruct the forms of extinct animals from such fragmentary remains as have been preserved, and it is largely from the results of a comparative study of living forms and their habitats that he is able, in his descriptions, to equip the reconstructed types of a past fauna with environments suited to their structure, and to render more complete the picture of their mode of life.

In like manner, the work of the ethnologist can throw light upon the researches of the archæologist: through it broken sequences may be repaired, at least suggestively, and the interpretation of the true nature and use of objects of antiquity may frequently be rendered more sure. Colonel Lane Fox strongly advocated the application of the reasoning methods of biology to the study of the origin, phylogeny, and etionomics of the arts of mankind, and his own collection demonstrated that the products of human intelligence can conveniently be classified into families, genera, species, and varieties, and *must* be so grouped if their affinities and development are to be investigated.

It must not be supposed—although some people, through misapprehension of his methods, jumped at this erroneous conclusion—that he was unaware of the danger of possibly mistaking mere accidental resemblances for morphological affinities, and that he assumed that *because* two objects, perhaps from widely separated regions, appeared more or less identical in form, and possibly in use, they were necessarily to be considered as members of one phylogenetic group. On the contrary, in the grouping of his specimens according to their form and function, he was anxious to assist as far as possible in throwing light upon the question of the monogenesis or polygenesis of certain arts and appliances, and to discover whether they are exotic or indigenous in the regions in which they are now found, and, in fact, to distinguish between mere analogies and true homologies. If we accept the theory of the monogenesis of the human race, as most of us undoubtedly do, we must be prepared to admit that there prevails a condition of unity in the tendencies of the human mind to respond in a similar manner to similar stimuli. Like conditions beget like results; and thus instances of independent invention of similar objects are liable to arise. For this very reason, however, the arts and customs belonging to even widely separated peoples may, though apparently unrelated, help to elucidate some of the points in each other's history which remain obscure through lack of the evidence required to establish *local* continuity.

I think, moreover, that it will generally be allowed that cases of "independent invention" of similar forms should be considered to have established their claim to be regarded as such only after exhaustive inquiry has been made into the possibilities of the resemblances being due to actual relationship. There is the alternative method of assuming that, because two like objects are widely separated geographically, and because a line of connection is not immediately obvious, therefore the resemblance existing between them is fortuitous, or merely the natural result of similar forms having been produced to meet similar needs. Premature conclusions in matters of this kind, though temptingly easy to form, are not in the true scientific spirit, and act as a check upon careful research, which, by investigating the case in its various possible aspects, is able either to prove or disprove what otherwise would be merely a hasty assumption. The association of similar forms into the same series has therefore a double significance. On the one hand, the sequence of related forms is brought out, and their geographical distribution illustrated, throwing light, not only upon the evolution of types, but also upon the interchange of ideas by transference from one people to another, and even upon the migration of races. On the other hand, instances in which two or more peoples have arrived independently at similar results are brought prominently forward, not merely as interesting coincidences, but also as evidence pointing to the phylogenetic unity of the human species, as exemplified by the tendency of human intelligence to evolve independently identical ideas where the conditions are themselves identical. Polygenesis in his inventions may probably be regarded as testimony in favour of the monogenesis of Man.

I have endeavoured in this Address to dwell upon some of the main principles laid down by Colonel Lane Fox as a result of his special researches in the field of Ethnology, and my object has been twofold. First, to bear witness to the very great importance of his contribution to the scientific study of the arts of mankind and the development of culture in general, and to remind students of Anthropology of the debt which we owe to him, not only for the results of his very able investigations, but also for the stimulus which he imparted to research in some of the branches of this comprehensive science. Secondly, my object has been to reply to some criticisms offered in regard to points in the system of classification adopted in arranging his ethnographical collection. And, since such criticisms as have reached me have appeared to me to be founded mainly upon misinterpretation of this system, I have thought that I could meet them best by some sort of restatement of the principles involved.

It would be unreasonable to expect that his work should hold good in all details. The early illustrations of his theories were to be regarded as tentative rather than dogmatic, and in later life he recognised that many modifications in matters of detail were rendered necessary by new facts which had since come to light. The crystallisation of solid facts out of a matrix which is necessarily partially volatile is a process requiring time. These minor errors and the fact of our not agreeing with all his details in no way invalidate the general principles which he urged, and we need but cast a cursory glance over recent ethnological literature to see how widely accepted these general principles are, and how they have formed the basis of, and furnished the inspiration for, a vast mass of research by ethnologists of all nations.

It appears more than probable that Cambridge will be much involved in the future advancement of anthropological studies in Great Britain, if we may judge from the evident signs of a growing interest in the science, not the least of which is the recent establishment of a Board of Anthropological Studies, an important development upon which we may well congratulate the University. Within my own experience there have been many proofs of the existence in Cambridge of a keen sympathy with the principles of ethnological inquiry developed by Colonel Lane Fox, and I feel that, as regards my choice of a theme for the main topic of my address, no apology is needed. For my handling of this theme, on the other hand, I fear it must be otherwise. I would gladly have done fuller justice to the work of Colonel Lane Fox, but, while I claim to be among the keenest of his disciples, I must confess to being but an indifferent apostle.

I have been obliged, moreover, to pass over many interesting features in the work of this ingenious and versatile man of science. I have made no attempt to touch upon his archæological researches, since it has been necessary for me to restrict myself to a portion only of his scientific work. In this field, as in his ethnological work, his keen insight, ingenuity, and versatility were manifested, while the close attention which he bestowed upon matters of minute detail has rendered classical his work as a field archæologist. While the greater part of his ethnological work is associated with the name Lane Fox, by which he was known until 1880, most of his researches into the remains of prehistoric times were conducted after he had in that year assumed the name of Pitt Rivers, on inheriting an important estate which, by the happiest of coincidences, included within its boundaries a considerable number of prehistoric sites of the highest importance That he made full use of his opportunities is amply manifested in his published works. In his archæological work are repeated the characteristics of his ethnological researches, and one may with confidence say of his contributions to both fields of inquiry that, if he advanced science greatly through his results he furthered its progress even more through his methods. By his actual achievements as a researcher he pushed forward the base of operations; by his carefully-thought-out systems for directing research he developed a sound strategical policy upon which to base further organised attacks upon the Unknown.

NOTES.

THE Hugh Miller Memorial Institute at Cromarty was opened on Friday last by Mr. Andrew Carnegie. The institute, which had its inception at the Hugh Miller centenary celebrations two years ago, is a short distance from the house where the geologist was born, and the accommodation provided includes a public library. The site was given by Colonel Ross, of Cromarty; the cost of the building, amounting to 1200*l.*, was defrayed by Mr. Carnegie, and the public subscribed 400*l.* for an endowment fund.

THE director of the Paris Museum of Natural History has been authorised to accept a gift made by M. Durand of a collection of herbaria and a botanical library, a sum of 5000 francs to pay the expense of transporting and installing these collections, and a further sum of 50,000 francs to be invested with a view to provide a fund for the upkeep of the herbaria and the purchase of plants and of works on botany.

THE International Congress of Physiologists was opened at the Solvay Institute in Brussels on Tuesday.

THE fourth congress of the International Aëronauts Committee, convened by the Imperial Academy of Sciences, was opened at St. Petersburg on Monday.

IT is reported that Mr. Henry Phipps has given 4000*l.* to the Johns Hopkins University, for the study of tuberculosis.

IT is announced that the late Mr. John Innes bequeathed the sum of 300,000*l.* for the erection of a museum at Merton, Surrey.

THE committee appointed by the Texas Legislature to investigate methods for the extermination of the boll weevil and pay a reward of 10,000*l.* to the discoverer of any such method, has decided, says *Science*, that no one has earned this reward.

THE Lancashire and Western Sea Fisheries Joint Committee has appointed Dr. J. T. Jenkins, professor of biology in Hartley University College, Southampton, to be superintendent of sea fisheries in place of the late Captain Dawson.

MR. W. I. LAST, senior keeper in the science division of the Victoria and Albert Museum, has been appointed director of that division of the museum in succession to Major-General Festing, C.B., F.R.S., who has recently retired at the age of sixty-four on the operation of the age limit. Mr. Last was senior Whitworth scholar in 1877, and a Watt medallist of the Institution of Civil Engineers in 1887, and has been for the last few years senior keeper in the science division of the museum, with the special charge of the engineering collections.

THE second International Congress on the History of Religions was opened at Basel on Tuesday. Prof. von Orelli, president of the organising committee, read an address, in the course of which he pointed out that the objects of the conference were purely scientific, and that a propaganda in favour of a particular sect and controversies on the lines of religious discussions during the Middle Ages would not be allowed.

WITH the view to obtain further information on the growth and migrations of salmon (including sea-trout, salmon-trout, peal, sewin, &c.), the Board of Agriculture and Fisheries had had a number of such fish "marked" by attaching a small oblong silver label (oxidised, or blackened, and bearing distinctive letters and numbers) to the dorsal or large back fin. Small rewards will be paid for the recovery of fish bearing such labels or other "marks," or for information respecting them. The Board has prepared lists of persons in the south and west of England, in Wales and Monmouthshire, and in the north of England, who will receive marked fish. The experiments will be continued during a series of years, and the cooperation of net-fishermen, anglers, fishmongers, and all interested in the improvement of the salmon fisheries, is invited in order that the fullest possible results may be secured.

THE value and possibilities of wireless telegraphy as a journalistic adjunct are described in Saturday's *Times* by the special correspondent who established a wireless telegraph system at the theatre of war operations in the Far East with such success that both the belligerents regarded the enterprise as dangerous to their interests. The Japanese Government placed such limitations upon the free movements of the *Haimun*—the vessel chartered by the *Times* for its wireless telegraph service—that this means of communication was discontinued of necessity; and there seems little doubt that in future the use of all systems of wireless communication will be controlled by international law. The De Forest system, with its telephonic receiver, was adopted by the *Times* correspondent as most suitable for war messages, as it will allow the operators to record twenty to thirty words a minute, and its usefulness is not impaired by the working of other systems in the vicinity. The land station was at Wei-hai-wei, where a mast 170 feet high was erected. Even with a mast 90 feet high and 102 feet exposure of wire on board the moving ship, there was not the slightest difficulty in keeping up intercommunication at a distance of 100 sea miles. With the 170 feet mast on land, perfect communication was established over a distance of 180 sea miles, and on one occasion over 210 miles. A long message sent from a point 155 miles from the land station had to cross 30 miles of the mountainous corner of the Shan-tung promontory, the hills of which vary from 200 feet to 1860 feet in height, yet the message reached its destination. As soon as the apparatus was in working order, both Russian and Japanese messages were received by the operator, who could easily recognise the difference in the systems employed, and by this means it was possible approximately to tell the distance of the *Haimun* from the various ships. Moreover, the operator began to recognise the notes of various ships, that is to say, he could tell if a Russian ship was at sea by listening for the answering communication from the shore. He could also detect whether the Japanese messages were being transmitted by relay to the naval base or whether the fleet itself was at sea. The information thus obtained guided the movements of the correspondent, and thus assisted the enterprise, which has had to be abandoned on account of the restrictions placed upon it.

IN NATURE of June 2, Dr. H. A. Wilson pointed out (p. 101) that Prof. Rutherford's value for the absorption coefficient of α rays is nearly 2000 times greater than Lenard's value for the absorption coefficient of β rays of the same speed. He suggested, as an explanation, that the α rays consist of positive electrons having a radius 2000 times smaller than negative electrons. Prof. W. H. Bragg, of the University of Adelaide, in a letter which the limitations of space prevent us from publishing, gives reasons for believing that the α rays penetrate further than β rays of the same speed because they do not suffer from deflection by collision, whereas β radiation of this speed is very much affected thereby.

THE results of an attempt to derive formulæ by which the effect of wind and atmospheric pressure on the tides could be calculated were given by Mr. F. L. Ortt in NATURE several years ago (1897, vol. lvi. pp. 80–84). Dr. Wegemann informs us that these formulæ are printed in the *Getijtafels* for 1904, though they are only true for the deep water at the Hook of Holland and Ymuiden. Theoretical considerations have shown that the tables are not applicable to shallow water (Wegemann, *Annalen der Hydrogr.*, 1904, v.). Dr. Wegemann suggests that in deriving a general formula it would be desirable to name the directions of the wind, not according to the compass, but to the angle at which they touch the coast. The places should also be grouped according to depth, coast-line, and formation of the sea floor.

DURING each of the months April to June last, the usual scientific balloon ascents have taken place in the countries which generally participate in these useful experiments. Some of the flights have attained great altitudes, *e.g.* three registering balloons sent up by Baron v. Bassus, from Munich, averaged more than 19,000 metres. Two ascents, from Pavlovsk and from Itteville (near Paris), attained 17,600 metres or more, and one from Trappes reached 16,540 metres. Kite ascents were also made each month by Mr. Rotch at Blue Hill (U.S.), and in May and June by Mr. Dines at Oxshott (Surrey). The value of these researches is recognised by the Royal Academy of Sciences of Amsterdam, which has awarded the Buys-Ballot medal for 1903 to Messrs. R. Assmann, director of the Aëronautical Observatory at Tegel (near Berlin), and A. Berson, of the same institution, for "the great services they have rendered to the development of meteorology" by means of daily observations of the upper air, and as editors of, and contributors to, an elaborate work on scientific balloon ascents.

FROM a report which we have received, it is seen that the present Meteorological Service in Japan is highly organised and more centralised than in this country. It is placed under the direction of the Central Observatory at Tokio, and under the supervision of the Minister of Education, who determines the sites of the provincial stations; any persons who desire to erect meteorological stations (except for rainfall only) must obtain the necessary sanction from the Minister. All provincial stations of the first and second orders have to forward monthly and annual registers to the Central Observatory, while stations of the third order (of which there are more than 1200) send their observations to the "provincial" stations to which they belong. The method of taking observations and the reductions are made in accordance with the regulations of the International Meteorological Committee, and each station is inspected once in three or four years. The principal publications are the daily weather map, monthly and annual reports, and a monthly weather review. The text of the daily weather map is given in English and Japanese. Storm warning telegrams are issued to some 360 stations, and signals are hoisted by day and night. The average success of weather forecasts is 82 per cent., and that of storm warnings 70 per cent. Maritime meteorology has been carried on since 1888; all ships with a tonnage exceeding 100 tons forward logs to the Central Observatory. Much attention is given to earthquake phenomena and to magnetic observations, and since 1880 several expeditions have been made from time to time to high mountains in various portions of the Empire to investigate the processes of the higher strata of the atmosphere. The present director of the service is K. Nakamura.

THE first part of a new serial, *Memoirs of Natural Sciences of the Brooklyn Museum*, is devoted to an account of the medusas of the Bahamas, by Mr. A. G. Mayer. Numerous new forms are described, and the author directs special attention to the difference between the medusa-fauna of the Bahamas and that of the Tortugas—a difference correlated with physical differences in the two areas.

WE have received the July issues of the *Emu* and the *Victorian Naturalist*, the contents of both of which are chiefly devoted to matters of local interest, although a new kestrel from Western Australia is described in the former.

ORNITHOLOGICAL subjects constitute the contents of the August number of the *Zoologist*, so far at least as the separate articles are concerned, the measurements and weights of the eggs of the commoner members of the plover tribe being recorded in the first article by the Messrs. Buchanan. A photograph of the new Orkney vole, in juxtaposition with one of the common vole, forms the frontispiece to the number.

A BICAUDATE specimen of the king-crab is described by Mr. F. F. Smith in No. 8 of *Tuft's College Studies*, while Mr. G. Winslow records three cases of structural abnormalities in tailed amphibians. The origin of the hypophysis cerebri in the salamander, Amblystoma, especially in connection with the dispute as to whether it is an endodermal or ectodermal structure, is discussed at considerable length by Messrs. Kingsley and Thyng, and the histology of the digestive tract of the same creature receives attention at the hands of Mr. G. A. Bates. In a list of the mammals in the Barnum Museum of Tuft's College, by Mr. A. E. Preble, it is somewhat curious to find the African elephant "Jumbo" figuring as *Elephas indicus*; it is sincerely to be hoped that this is an error, and not the result of a discovery that *E. indicus* is the proper title of the African elephant.

IN the *American Journal of Science* for August, Dr. C. R. Eastman discusses the nature of the limb-like appendages in the fish-like creatures collectively known as Osteostraci, as exemplified in the family Asterolepididæ. Five theories have been propounded to explain the nature of these structures. They have been likened, firstly, to arthropod limbs; secondly, they have been regarded as produced and jointed extensions of the head-angles of forms like Cephalaspis; thirdly, they have been derived from a fixed body-spine like that of Acanthaspis; fourthly, they have been considered to be the degenerate development from the lobate fins of the fringe-finned (crossopterygian) ganoids; while, fifthly, they may be *sui generis*. The first two hypotheses Dr. Eastman dismisses as being founded upon misconceptions. The third he regards as presupposing impossible or anomalous conditions. Against the fourth, which was suggested by Mr. C. T. Regan in his paper on the phylogeny of the Teleostomi, recently noticed in our columns, the author advances a number of objections, while he pins his faith on the fifth. Dr. Eastman also takes occasion to record his dissent from Mr. Regan's views as to the existence of a close affinity between the Osteostraci (Cephalaspis, Asterolepis, &c.) and the Arthrodira (Coccosteus); and also as to the alleged relationship between the latter and the fringe-finned ganoids.

IN the same issue Mr. E. H. Sellards publishes an important contribution to our knowledge of Palæozoic cockroaches. Hitherto these insects have been chiefly known by the wings. It is now demonstrated that in bodily organisation they conform essentially to the modern Orthoptera, this agreement also extending to their development, as exemplified by the resemblance of the young to the adult, and by the growth taking place by means of a succession of moults, during which the wings are gradually evolved.

THE fourth volume of the new series of the *Proceedings* of the Aristotelian Society, containing the papers read before the society during the twenty-fifth session, 1903–4, has been published by Messrs. Williams and Norgate. Dr. Shadworth Hodgson contributes two papers dealing respectively with method in philosophy and with reality. Prof. G. F. Stout deals with primary and secondary qualities, and Dr. E. Westermarck has a paper entitled "Remarks on the Subjects of Moral Judgments." Miss E. E. C. Jones recapitulates the main points of Prof. Sidgwick's ethical view, and attempts to answer some of the objections to it that have been brought forward in recent criticisms.

IN vol. xxiv., part iv., of *Notes* from the Leyden Museum, Madame C. M. L. Popta describes as new a number of species of cat-fishes (Siluroids) collected by Dr. Nieuwenhaus in Central Borneo in 1898 and 1900. In the same issue Dr. Jentink records the plantain-bat (*Cerivoula picta*) from Sumatra.

MESSRS. PATTEN AND HART have found that the soluble phosphorus of wheat-bran is organic in nature, existing as the magnesium-calcium-potassium salt of a phospho-organic acid having the formula $C_2H_8P_2O_9$, and probably identical with Posternak's anhydro-oxymethylene diphosphoric acid (*Bull.* No. 250, New York Agricult. Exper. Station). This acid and its salts seem to be of wide distribution in the vegetable kingdom, having already been isolated from peas, beans, pumpkin and lupine seeds, and from the potato and other tubers and bulbs.

IN the July number of the *Gazzetta Chimica Italiana*, a convenient and practical method for the preparation of nitrosyl chloride is described by Francesconi and Bresciani. It is found that carefully prepared animal charcoal exerts a very considerable catalytic influence on the combination of nitric oxide and chlorine, the temperature most favourable for the reaction being 40° to 50° C. Below 35° and above 70° C. the influence of the catalyser is much less marked.

SEVERAL observations are to be found in the literature which indicate that hydrobromic acid at 1000° C. and hydrochloric acid at 2000° C. are perceptibly dissociated into the elements. The direct quantitative measurement of the extent of dissociation at these high temperatures has not yet been found possible. In the *Zeitschrift für physikalische Chemie* (vol. xlix. p. 70), Messrs. Bodenstein and Geiger have, however, calculated the percentage dissociation from known experimental data, the numbers obtained being:—

	1000° abs.	2000° abs.
Hydrobromic acid ...	0·18 per cent. ...	6·0 per cent.
Hydrochloric acid ...	0·002 ,, ...	0·8 ,,

IN the current number (vol. xlix. p. 162) of the *Zeitschrift für physikalische Chemie*, Dr. P. P. Fedotieff gives an account of an investigation of the ammonia-soda process from the standpoint of the phase rule. According to the experimental data, it is theoretically possible to convert 80 per cent. of the sodium chloride used into bicarbonate, and in practice the yield under favourable conditions should not fall below 70 per cent. It is interesting to note that, from a purely chemical standpoint, the Solvay process, in which ammoniacal brine is treated with carbonic acid, is not the best form of the process. The author concludes from his measurements that the treatment of sodium chloride solution with solid ammonium bicarbonate is to be preferred.

AN account of milk investigations at Garforth is given by Dr. C. Crowther in the *Transactions* of the Highland and Agricultural Society of Scotland for 1904. It is found that change from a highly nitrogenous diet to one relatively poor in nitrogen causes secretion of a larger quantity of milk, but the milk is poorer in fat, the change in the fat-content being much more pronounced in the morning than in the evening milk. During the summer months of 1901, 1902, and 1903, the average percentage of fat in the morning milk of the Garforth herd was found on most days to fall below the standard of 3 per cent. embodied in the regulations for the sale of milk at present in force.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN SEPTEMBER:—

Sept. 2. 11h. 55m. to 12h. 34m. Moon occults σ^2 Tauri (mag. 4·8).
6. Saturn. Major axis of outer ring=42″·96. Minor axis of outer ring=11″·67.
,, 9h. 53m. Minimum of Algol (β Persei).
9. Total eclipse of the Sun, invisible at Greenwich.
15. Venus. Illuminated portion of disc=0·947, of Mars=0·972.
23. Sun enters Libra: autumn commences.
,, 12h. 18m. Neptune's satellite at eastern elongation.
26. 10h. Jupiter in conjunction with Moon. Jupiter 1° 52′ N.
,, 10h. 42m. Neptune's satellite at western elongation.
,, 11h. 36m. Minimum of Algol (β Persei).
29. 8h. 25m. Minimum of Algol (β Persei).
,, 9h. 17m. to 10h. 2m. Moon occults γ Tauri (mag. 3·9).
,, 12h. 33m. to 13h. 8m. Moon occults 71 Tauri (mag. 4·6).
,, 13h. 40m. to 14h. 57m. Moon occults θ^1 Tauri (mag. 3·9).
,, 13h. 50m. to 15h. 0m. Moon occults θ^2 Tauri (mag. 3·6).
,, 18h. 42m. to 19h. 10m. Moon occults α Tauri (mag. 1·1).
30. 11h. 15m. Inferior conjunction of Sat. IV. with Jupiter.

CATALOGUE OF STARS NEAR THE SOUTH POLE.—No. 1, vol. liii., of the Harvard College Observatory *Annals* contains the results obtained during a photographic investigation of the positions of about 200 stars, all of which are situated within half a degree of the South Pole. The positions were measured on negatives enlarged six times from the originals, and nine stars from Gilliss's "Catalogue of 16,478 Southern Stars" were taken as standards.

During the discussion of the results it was found that the values of the residuals exhibited marked gradation, depending on the magnitudes of the stars; the differences were seen to be serious in the final results, and were not eliminated by reversing the plate during the measurements.

A table of magnitude corrections was therefore prepared by graphical methods, and, when applied, reduced the average deviation of the value of the x coordinate from the normal, from $\pm 0''\cdot 68$ to $\pm 0''\cdot 36$.

This result was so important that the corrections were also applied to the results given in a similar catalogue for stars near the North Pole, which was published in No. 1, vol. xlviii., of the *Annals*. The resulting corrections are now published in No. 2 of vol. liii.

ANNUAL REPORT OF THE PARIS OBSERVATORY (1903).—The annual report of the Paris Observatory for 1903 was presented to the council by M. Loewy, the director, on March 22.

Among other matters it gives a detailed account of the work accomplished last year in connection with the International Chart and the Eros observations for the re-determination of the solar parallax.

In connection with the former work, thirty-five charts, showing the triple images of some 47,300 stars, have been distributed, and it is hoped that the second volume of the photographic catalogue will be published during the present year.

For the Eros campaign, 10,858 photographic observations of comparison stars and *étoiles de repère*, 284 photographic determinations of the equatorial positions of the planet, and 281 visual micrometric measures, were made during last year.

The seventh part of the "Atlas de la Lune" was published, and the plates show very plainly the marked inferiority of eye observations, as compared with photographs, of our satellite. Several interesting points in selenography, such as the absence of water and the presence of an atmosphere at a remote period, were deducible from the photographs.

The report also gives the details of the large amount of routine work done in the different departments during the past year, and concludes with a bibliography of the published results.

Three important pieces of work, based on novel methods, are to be undertaken in the near future. The first will deal with the determination of latitude and its variations, the second with precise measures of the constant of aberration, and the third with the application of M. Lippman's photographic telescope to meridian observations.

PHOTOGRAPHIC MAGNITUDES AND PLACES OF 350 PLEIADES STARS.—Mr. Dugan publishes the magnitudes and places of 350 stars situated in the Pleiades, which he has obtained from measurements of several plates of the region, in No. 3964 of the *Astronomische Nachrichten*. The star-places are given for 1900, and a chart showing the catalogue number placed against each star image accompanies the paper.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

MR. F. C. WILLCOCKS, demonstrator in entomology and botany at the South-Eastern Agricultural College, Wye, has been appointed entomologist to the Khedivial Agricultural Society at Cairo.

MR. A. LAUDER, assistant lecturer and demonstrator in chemistry at the University College of North Wales, Bangor, has been appointed lecturer in agricultural chemistry at the Edinburgh and East of Scotland College of Agriculture; and Mr. F. E. Rees, assistant lecturer and demonstrator in physics, has been appointed inspector of secondary and technical schools under the Glamorganshire County Council.

IT has been resolved by the Senate of the University of London that the Preliminary Scientific Examination be in future designated the "Preliminary Scientific Examination, Part i.," and the examination in organic chemistry for medical students be designated the "Preliminary Scientific Examination, Part ii." Students are to be permitted to present themselves for Part ii. after an interval of not less than six months from the date of passing Part i. Internal and external students in the Faculty of Medicine who have passed in physics, or chemistry, or botany and zoology, at the final B.Sc. examination will be exempted from examination in the subjects in which they have already passed. Such students, if they have passed in chemistry at the B.Sc. examination, will be excused inorganic chemistry in Part i. and also Part ii. of the Preliminary Scientific Examination. No exemption in biology at the preliminary examination will be granted to students who have not passed in botany and in zoology either at an intermediate examination in science or agriculture, or at the final B.Sc. examination. In future internal and external candidates for Part i. will be required to present themselves for examination either in inorganic chemistry and physics taken together, or in biology, or in all three subjects; but if they fail in any one subject they will be permitted to present themselves for re-examination in that subject taken alone.

MR. FREDERICK SODDY has concluded a series of university extension lectures in Western Australia. The last lecture was delivered on July 23, and on this occasion the Premier of the colony, Mr. Walter James, in proposing a vote of thanks to Mr. Soddy, referred to the desirability of establishing a university in Western Australia. During the course of the last twelve months one distinct step has been taken in advancing the movement by the passage of the University Endowment Act. Endowment trustees have been appointed, and in these trustees some 700 or 800 acres of land have been vested, which promise to give the future university the richest endowment enjoyed by any university in Australia. They were very apt to think, Mr. James continued, that no university could be established unless they first expended a large sum of money in an elaborate building. He wished only they could convince the residents of Western Australia that so long as they had efficient workshops for their professors, the sooner they commenced to get their professors the sooner could they begin the work of the university, without money overburdening it in the first instance. Mr. Soddy's visit has done good in bringing home more thoroughly than before how necessary it is that the establishment of this university should be commenced without undue delay.

SOCIETIES AND ACADEMIES.

EDINBURGH.

Royal Society, July 4.—Prof. Geikie in the chair.—Prof. Cunningham read an obituary notice of the late Prof. His, honorary fellow.—Dr. J. **Halm,** in a note on the structure of the series of line spectra, gave an interesting extension of Balmer's formula for the distribution of lines in a spectrum. Various other formulæ have been given by Rydberg, Kayser and Runge, and others, but none are satisfactory in the sense of being applicable to all substances. Balmer's formulæ for the two hydrogen series may be put in the forms $1/n = am^2$, and $1/n = a(m-\frac{1}{2})^2$, where a is a constant and n is the difference of the oscillation frequencies of the last line of the series and of the mth line in the spectrum. Dr. Halm finds that the series of any other substance can be represented with great accuracy by either of the formulæ $1/n = am^2 + b$, $1/n = a(m-\frac{1}{2})^2 + b$, where b is a constant characteristic of the particular substance. The whole sets of series for all substances may be represented very concisely by a geometric figure consisting of one set of radiants and a set of transversals each one of which corresponds to the line spectrum of a substance.—Mr. J. R. **Milne** described some of the modifications of his new form of spectrophotometer for measuring the light absorption of dilute solutions. The main feature considered was the use of a Wollaston prism so as to act in the reverse way, that is, to bring together two different rays, instead of separating one ray into two.—The Rev. F. H. **Jackson** communicated a paper giving the complete solution of the differential equation satisfied by his generalised form of Bessel function.

July 18.—Sir John Murray in the chair.—Dr. T. H. **Bryce** read a paper on the histology of the blood of the larva of Lepidosiren (part ii., histogenesis). The paper dealt with the development of the blood corpuscles, and was fully illustrated with lime-light projections. One of the most important results concerned the origin of the leucocytes. They were found arising *in situ*, before the appearance of thymus or spleen, in specialised tracts of the mesenchyme, first in the splanchnic layer and slightly later in the tissue round the nephric tubules.—Mr. J. R. **Milne,** in some notes on experiments in spectrophotometry, gave an account of his method for obtaining what might be called an artificial line spectrum, and so enabling him to use a powerful and steady source of light. In front of the photographic plate an opaque screen with a series of fine transparent slits was set. Only the parts of the continuous spectrum corresponding in position to these slits were photographed on the plate. When a solution of an absorbent substance was introduced, the spectrum photographed was shortened and a fewer number of lines were photographed; but by widening the slit and so increasing the intensity of light it was possible to obtain the original length of spectrum. In this way, in terms of the intensities of light, an estimate of the absorbing power of different solutions could be obtained, probably quite as accurate as by any of the other known methods.—In a note on the magnetic condition of nickel demagnetised by decreasing reversals, Mr. J. **Russell** discussed the production of magnetisation at right angles to a magnetising force which is made to act upon a toroidal tube of nickel after the metal has been demagnetised by reversals. The force was applied at various orientations relatively to the direction of the original magnetisation, which was apparently destroyed by the reversals. Results for iron have already been published, and the results for nickel are similar, though differing considerably in detail. Thus in nickel the transverse induction is much smaller than in iron, being roughly speaking about a twentieth. Also the maximum, which in the case of iron is obtained when the applied field makes an angle of 45° with the original direction of magnetisation, is obtained in the case of nickel at other orientations.—Prof. **Chrystal** read a paper on some particular results in the theory of seiches. The differential equation of free oscillations of a lake of water was found to be capable of a comparatively simple solution when the longitudinal section of the lake was bounded below by a parabola, either concave or convex upwards. The solution was obtained in the form of series which were particular cases of hypergeometric series, but which do not seem to have been discussed. They had properties which were analogous to the properties of sines and cosines, and the functions were accordingly named the seiche-sine, the seiche-cosine, and the hyperbolic seiche-sine and seiche-cosine. In a particular case of special interest in the seiche problem the roots of the cosine and sine are the products 1·2, 3·4, 5·6, &c., and 2·3, 4·5, 6·7, &c., respectively, and this corresponds to the case of the concave parabolic bottom. The roots for the hyperbolic function are not so easily found. They correspond to the case of the convex parabolic bottom, that is, a lake with a shallow in the middle and deeper parts towards the ends. Some promising applications of the investigations have already been made, and it is hoped that when more experimental data are accumulated in regard to the periods of the uni-nodal, bi-nodal, tri-nodal, &c., oscillations, a real explanation of the seiche phenomena will be obtained.

PARIS.

Academy of Sciences, August 22.—M. Mascart in the chair.—The flow of underground water: J. **Boussinesq.** A continuation of preceding papers on the same subject.—On stelliform or ramefied cartilage: Joannes **Chatin.** This type of cartilage has been found in the larynx of a mammal.—Thermoelectric inversion and the neutral point: G. **de Metz.** Previous researches have indicated two simple relations between the temperature of inversion and the neutral point. The author has examined the behaviour of several couples at temperatures down to −185° C., and has found that these equations hold only for the platinum-zinc couple. This couple is therefore valuable for the measurement of low temperatures.—The study and synthetical preparation of some symmetrical cyclic thio-ureas: Emm. **Pozzi-Escot.** The primary amines react with carbon bisulphide in alcoholic solution in presence of caustic potash, with evolution of sulphuretted hydrogen. Details are given of the properties of several of these thio-ureas.—On the freezing point of milk in health and disease: MM. **Giraud** and **Lasserre.** Milk from healthy subjects has a freezing point of −0°·55 to −0°·56. In the case of diseased subjects the freezing point is slightly lower, −0°·58 to −0°·61.

CONTENTS.