THURSDAY, AUGUST 15, 1901.

MIALL AND FOWLER'S "SELBORNE."

The Natural History and Antiquities of Selborne. By Gilbert White. Edited, with an Introduction and Notes, by L. C. Miall, F.R.S., and W. Warde Fowler, M.A. Pp. xl + 386. (London: Methuen, 1901.) Price 6*s.*

ECCE ITERUM! It is little over six months since the "painful" Mr. Sherborn compiled a bibliography of Gilbert White's matchless work, enumerating some 115 editions or issues of it, and here in England at least three more have since made their appearance, while we hear of another in America—to say nothing of the "Life and Letters" of the author now first fully given to light and recently reviewed in these columns (NATURE, July 18, 1901, p. 276)! Still, the edition of the evergreen classic, "Natural History and Antiquities of Selborne," with introduction and notes by Prof. Miall and Mr. Warde Fowler, deserves consideration here, for though these gentlemen have judiciously availed themselves of the labours of some of their predecessors in the art editorial and commentarial, they have added a good many notes of their own, not a few possessing a quite original character, while their introduction is of itself well worth reading.

Messrs. Miall and Fowler were, of course, too early to profit by Mr. Holt-White's biography of his great-granduncle, for their publication followed his by only a few weeks, and they must regret that this is so, since they depended for the most part on the statements of the late Prof. Bell, and naturally fell into his mistakes. From some of the worst of them, it is true, they might have saved themselves had they studied, instead of being content to mention, the memoir of Gilbert White which appeared more than eighteen months ago in the "Dictionary of National Biography"; but they seem, like most persons, to have supposed that an article in a dictionary is only for reference and not for reading. It may be said that, except in one case, their errors are of comparatively slight importance; but they have perpetuated the modern Oxford slander—now proved to be founded on imperfect acquaintance with the facts—that White was unpopular in his college and only held his fellowship there by holding his tongue, the sole ground of this imputation being two or three private memorandums of the then Provost of Oriel, who was temporarily smarting from a contested election in which White had been his rival. The two men had previously been friends, and it is satisfactory to know that friends they became again when the acrimony engendered by the competition had passed off. The worst of this mud having been thrown is that some of it will stick; but it behoves every member of that distinguished college—nay, every Oxford man—to do his best to wipe away this unfounded aspersion on White's fair fame. Mr. Fowler himself, we doubt not, must feel sorry that he has helped to spread this baseless accusation.

But our business here is not with White's book or life or character more than as they are dealt with by his present editors. With much of what Prof. Miall says we cordially agree, but when he writes that "White was a man of few books and of no great range of thought" we wholly dissent. It may be that he could not read French—easily at least—few Oxford clerics of his day could; but he certainly did know what Buffon was about, and Hérissant also, for he criticises both; and if he did not name Leeuwenhoek (who wrote in English, by the way) or Malpighi, why, we may ask, should he do so? Undoubtedly John Hunter was then dissecting, but for the most part of his life he was known to few as being more than a skilful surgeon, and what was there in the six or eight papers he had then published to call for White's notice of them? Prof. Miall remarks that "all the books which were essential to the 'Natural History of Selborne' would have gone into a single shelf." That is a mistake: the book of Nature is not to be shelved, and therein lay White's chief study. Again, we are told that he cared little for the British Museum or the Botanic Garden at Kew, and that Cook's voyages are not dwelt upon repeatedly and with interest. With all deference to Prof. Miall, such objections are futile. The collections then at the British Museum must have been extremely unimportant—the Museum of the time was the Leverian, which is repeatedly mentioned by White, and Kew Garden was the King's private affair, to which the public scarcely had access; but in Cook's voyages White plainly took very great interest, partly, no doubt, through his acquaintance with Banks, Cook's shipmate on the first of them. Reference to them is often made in his correspondence, though there was no need to bring it into his book. Surely Prof. Miall would justly resent being accused of indifference to the *Challenger's* voyage because we see no mention of it in the volume before us? We may charge him, however, with not having divested himself of the commonplace desire to fall foul of Pennant, who, he says, "was not enough of a zoologist to write books on zoology." This is amazing, for who then, we may ask, wrote the "British Zoology" (of which there were three editions and four issues in his lifetime), the "Indian Zoology" (two editions and a German translation), the "Arctic Zoology" (the same), to say nothing of the "History of Quadrupeds" and other works? It may be urged that in these labours he had assistance, and that some classes of animals met with scant treatment; but when has such not been the case? and in what other country were contemporary zoologies of similar character published with the same wealth of illustration? Prof. Miall admits that he was the best-known English zoologist of his day, and if in the later issues of the "British Zoology" his acknowledgment of White's aid was general rather than particular, is not the fact directly due to the latter having corrected, as he himself says he did, the former's proofs, when he naturally did not insert passages in his own favour? Unless Pennant in his own "Life" is guilty of positive misstatement, which there is not the least reason to believe, he expended very considerable sums in the illustration of his several works, and when he paid for the plates he reasonably thought he had some right to use them. This, we take it, was the cause of the misunderstanding, for it seems to have been nothing more, between him and John White in regard to illustrations for the latter's "Fauna Calpensis," which, unfortunately, was never published. It was natural for Gilbert White at first to take his brother's side and

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grumble at Pennant; but it would seem almost certain that explanations must have followed, and with them the discontent ceased. To us Pennant's influence on Gilbert White appears to have been distinctly advantageous, just as that of Barrington was the converse. No one can study Pennant's works without seeing that he was full of great ideas—whether they were original or not does not signify for our present purpose—and they were in the main true,[1] whereas Barrington's views seem to be always based on some prejudice or foregone conclusion, to support which he brought his very considerable forensic power to bear, and in the majority of cases arrived at an erroneous conclusion—take his ingenious argument as to the origin of the turkey, for example—and, though undoubtedly in many respects a benefactor, he was apparently White's evil genius in continually urging his absurd belief in the torpidity of the swallow-kind.

This remark brings us to Mr. Fowler's part of the introduction, in which he tries to account for White's astonishing adhesion to that belief, and his readiness to grasp at any scrap of information which seemed to support it, in spite of his own failure to discover a particle of evidence in its favour, and the fact that he fully accepted migration in the "short-winged birds" while doubting it in those that possessed far superior power of flight. Mr. Fowler's mode of accounting for White's "loyalty to an old delusion" seems hardly adequate, yet we must confess our inability to offer a suggestion that satisfies ourselves. We can hardly think that Aristotle, great as we admit was his authority in the Middle Ages, was responsible for the misconception, or even Olaus Magnus—much less Carew. They only repeated the stories of the vulgar and unreflective, and how Willughby's language on the subject "served to perpetuate the tradition" (as Mr. Fowler maintains it did) is more than we can understand. The whole thing is inexplicable, and is really the one flaw in White's reputation as a reasoning naturalist. Though in his earliest letter to Pennant (printed as No. x.) he frankly says that no account of swallows being found torpid in Hampshire is worth attention, the two instances he immediately cites —on the authority of "a clergyman of an inquisitive turn" and of "another intelligent person," each of them being in his boyhood—must have greatly influenced him. He can hardly be said to have been credulous on the subject. He simply thought that the evidence in favour of torpidity, though not satisfying, was such as ought to be tested, and he would no doubt have been pleased to obtain confirmation of it. In this respect he was like many people in our own day who engage in psychical research. Spirits refuse to come at their call from the vasty deep or boundless space, and search as he might, and did, amid the shrubs of Selborne Hanger or under the roofs of his neighbours' cottages, nor swift nor swallow would show itself.

Taken as a whole, the notes to this edition are very good, and those by Prof. Miall on the geology of the district are most acceptable, for few, if any, of White's recent editors have touched upon that subject. Those by Mr. Fowler on ornithology are for the most part extremely effective, whether culled from his predecessors or added from his own experience, and though he does suggest (p. 35) that the bird "so desultory" in its flight, at which White shot in vain, was a siskin and not a chiff-chaff, and (p. 83) would seem to consider the motion of the redstart's tail open to doubt, we have no such impossible suppositions as are found elsewhere to the effect that White did not know a crow from a rook, or the song of the wryneck from the cry of the pied woodpecker. If the introduction could be but freed from the blemishes we have here noticed, and a few more beside, this edition of the "Natural History and Antiquities of Selborne" might be recommended as one of the most accurate, as it is one of the neatest and most handy.

[1] The often-quoted case of the herring migration must, of course, be excepted, but therein he was misled by the reports of fishermen whom he trusted.

THE ORIGIN OF EUROPEAN PEOPLES.

The Mediterranean Race: a Study of the Origin of European Peoples. By G. Sergi. Pp 320; 93 illustrations in the text. The Contemporary Science Series. (London: Walter Scott, 1901.) Price 6*s*.

THE problem of our origins must always prove an interesting subject for research; speculation has found it only too fertile a prey. At the present state of our knowledge fresh information is being amassed continually, so that the field for speculation is, fortunately, becoming more narrowed. A recent contribution to the problem is from the enthusiastic Italian anthropologist, Prof. G. Sergi, of Rome, who has published in English an entirely new book, based on his "Origine e diffusione della stirpe Mediterranea," 1895. Those who are acquainted with the previous writings of Prof. Sergi will quite know what to expect in this new volume. The familiar arguments and data are reinforced by additional facts, and the author's conclusions are clearly and definitely stated. The following is the position he has adopted in this book, and which we may take as the expression of his matured views.

Homo Neanderthalensis is a distinct European species, which includes the Spy type and which originated in Europe in early Quaternary or possibly late Tertiary times. Hitherto it has not been found south of the Alps, and it has not completely disappeared from Europe, but persists in the Baltic, in Friesland and elsewhere.

The Chancelade, Laugerie-Basse, Baumes-Chaudes, Cro-Magnon crania constitute a group that extended from the Upper Quaternary into early Neolithic times. The view of Hervé and other French anthropologists is that this was a hyperborean stock that migrated from north to south as far as Africa, but excluding Egypt and the Canary Islands. Sergi shows that all the characteristics of the Chancelade skull are found in typical Mediterranean crania; indeed, he defines it as

> "a *Pelasgicus stegoides* of the *Ellipsoides* class, still found to-day in East Africa. Why refer to the Eskimo, a skull to be found so near as the Mediterranean?" (p. 195).

The other cranial types are admittedly quite Mediterranean in character. If Scandinavia was not inhabited before the Neolithic period and northern Europe could not be inhabited by man until after the Glacial epoch, it is not easy to see how the centre and south of Europe could be invaded by a race originating in the north in the Quaternary epoch (p. 199).

The Neolithic dolichocephals, according to Sergi, were a northern migration of a group of *Homo Eurafricana*. This species may be divided into three races :—

"The *African*, with red-brown and black pigmentation ; the *Mediterranean*, of brunet complexion ; a *Nordic* race, of blond skin and hair, blue or grey eyes" (p. 259).

The Hamitic race never invaded Europe. In the late Quaternary epoch immigrations of the Eurafrican species took place from Africa into Europe. On the mainland of northern Europe a distinct differentiation took place so far as stature and pigmentation were concerned, but the cranial and facial forms were practically unaltered, and the Reihengräber type of the Germans and the Viking type of the Scandinavians were evolved. On pp. 252–255 the author discusses the obvious objections to this view. The whole of the Mediterranean basin, western Europe and the British Islands were inhabited by the brunet race.

The problem of the African blonds is fully discussed (pp. 59–83) by Prof. Sergi. After stating the views of various investigators, he says,

"It seems to me impossible to find in the blonds of Africa a racial element from northern Europe. If they had come at so early a period (in the times recorded by the Egyptian monuments) they would have radically modified Libyan civilisation beginning with funeral customs and imposed their own language" (p. 72).

In their "Libyan Notes" (1901), Messrs. D. Randall-Maciver and A. Wilkin state that the Berbers of Algeria are always a white-skinned people, and about ten per cent. are blond or fair-haired. Sergi is satisfied that the differences in colour of hair, skin and eyes between the darker and the lighter people are due to the influence of altitude, as the Atlas chain is the headquarters of the blonds in Morocco, and he regards these mountains as the centre of formation of the blond element in North Africa.

Neither of the European races of the Eurafrican species has anything in common with the so-called Aryan races. Sergi holds that it is an error to maintain that the Germans and the Scandinavians, blond dolichocephals, are Aryans. The Aryans are of Asiatic origin, and constitute a variety of the Eurasiatic species.

The anthropological unity of Europe, existing from the late Quaternary epoch and greatly increased during Neolithic times, was broken, at first peacefully and to but a slight extent, and afterwards violently, by a new species coming from Asia. Even in Neolithic times the advance guard of the wave of migration of the brachycephalic *Homo Eurasica* had penetrated slowly and peacefully into France. But then they began to come in larger and hence more turbulent bodies, and caused many changes. These invaders were savages inferior to the Neolithic Europeans, whose civilisation they in large part destroyed, replunging Europe into barbarism, also introducing the new burial custom of cremation, together with other customs, and transforming the existing languages into their own, which was a flexional language. To-day this new anthropological family, which also constitutes a zoological unit, bears three chief names, indicating three characteristic linguistic groups—Celts, Germans, Slavs. The skull of this species shows four primary forms—cuboid, cuneiform or sphenoid, spheroid and platycephalic—all corresponding to broad, brachycephalic skulls which contrast with the pentagonal, ellipsoidal, ovoid and arrow-shaped (beloides) cranial varieties of the Eurafrican species.

Wherever the Mediterranean stock established itself it preserved its primitive burial custom of inhumation and the characteristic architecture of the chambered tomb. This varies from the natural and artificial grottoes of the Mediterranean region to nurags, pyramids, dolmens and tumuli. Sergi has previously expressed the opinion that the prehistoric artists of the French caves, who possessed such developed artistic feeling, were the precursors of the historical artists who created the marvellous works of Egypt, Greece and Rome ; but he strongly holds the view that the Mycenæan or Ægean civilisation was largely of Asiatic origin, although he does not subscribe to the theory of Montelius that "the Mycenæan civilisation in Greece is due, not to an influence from another country, but to immigration of a new people." Sergi believes that the Asiatic immigrants, Pelasgo-Tyrrhenians and possibly others, were not anthropologically foreign to the Mediterranean stock. These, and the inhabitants of the Ægean Islands and the Peloponnesus, already possessed a pre-Mycenæan civilisation in common with the Afro-Mediterranean civilisation, but the new culture was the result of Asiatic influences, probably Mesopotamian and Hittite.

The introduction of bronze into Europe has been a fruitful subject for discussion. Sergi has given up the Celtic theory, and now believes that the importation of bronze was due to the Mediterraneo-Oriental culture.

The use of a script is so ancient that it had already reached definite shape in the Magdalenian epoch, that is to say earlier than the Neolithic times, as is proved by the painted pebbles in the cave of Mas d'Azil in the south of France ; and writing signs were widely diffused in countries peopled by the Mediterranean race in very ancient times. The languages of these peoples were also of Eurafrican origin, corresponding to the languages otherwise called Hamitic.

It is evident that this book bristles with debatable points, and we may look forward to interesting discussions from all quarters, as the intrepid Italian savant does not belong to any one school of Continental thought. Doubtless Prof. Ridgeway, for one, will have something to say to Prof. Sergi when the second volume of his "Early Age of Greece" is published. A. C. H.

A MECHANISM FOR THE TRANSMISSION OF STIMULI IN PLANTS.

Die Reizleitung und die reizleitenden Strukturen bei den Pflanzen. Von Dr. B. Nemec. Mit 3 tafeln und 10 abbild. im Text. Pp. 153. (Jena : Verlag von Gustav Fischer, 1901.) Price Mk. 7.

IT has long been known that certain parts of many plants are capable of being irritated by appropriate means, and that the stimulus thus perceived is in some way transmitted through an intervening quiescent region to a spot or zone at which it is translated into a definite motile reaction. But it has also been constantly denied that there exists in plants anything comparable to the nervous system of animals; and the transmission of the stimulus has commonly been referred either to a serially altered condition of the protoplasm in its relation to water, or to vague suggestions arising from the well-known facts of protoplasmic continuity between adjacent cells, the onus of transmission being cast on the protoplasm as a whole.

Dr. Němec, however, contends that these notions demand reconsideration, and he gives an account in the book before us of observations which, if confirmed by subsequent examination, are of great importance as enabling us to obtain a more definite comprehension of the relations existing between perception and reaction in the motile organs of plants.

The author begins by studying the effects on the protoplasm of wounding the sensitive regions of roots and other organs, and, in the main, he confirms, and at the same time extends, the conclusions arrived at by Tangl some years ago. He distinguishes two traumatic phases as consequent on such an operation. The first, or *primary*, response consists in an aggregation of the protoplasm, and it may be of the nucleus also, to the woundward end of the cell. This effect is propagated with diminishing rapidity in a direction away from the wound, and at a rate which is not equal for the different tissues composing the organ. A curious fact relating to the travelling onward of the effect is brought to light in connection with cells in which nuclear division is proceeding, for the disturbance appears to miss these cells, though it reappears immediately beyond them. Shortly after this primary manifestation has passed over a cell, recovery supervenes, only, however, to give place to a *secondary* phenomenon. The protoplasm of the cells in the vicinity of the wound assumes a more or less gelatinous character, and the vacuoles begin to undergo fusion. This secondary effect is, however, apparently rather local, and travels neither so far nor so fast as does the primary one. It may perhaps be questioned whether the latter is not, at least mainly, due to a disturbance of hydrostatic equilibrium in the cells consequent on the lesion of the organ, whilst the secondary change may possibly be associated with the febrile condition known to be induced by mechanical and other injuries. Further investigation of the phenomena by means, *e.g.*, of plasmolysing reagents might prove of interest.

Of more general importance than these results is the statement that the author has succeeded, by means of appropriate stains, in demonstrating a continuous fibrillar structure in the cytoplasm. These fibrillæ, which are figured as somewhat thick cords, traverse the cell chiefly in the longitudinal direction; and, although the point was not definitely settled, they appeared to connect with similar ones in the contiguous cells of a longitudinal series. They are not equally present in every kind of tissue, sometimes they occur in the cortex whilst in other cases they are most abundant in the plerome. They are almost always met with in sensitive and motile organs, to which also they appear to be almost exclusively confined, and Němec believes that they represent the means whereby stimuli are rendered transmissible. He finds that conditions which impair or abolish such transmission also affect the fibrillar structure. The latter may, indeed, be temporarily or permanently disorganised, and so long as this is the case the organ appears to be insensitive.

Němec himself considers some of the objections which may be urged against his view of the functions of the fibrils. Thus it might be argued that the same causes which result in a dislocation of the sensitive mechanism of an organ may also, and concomitantly, destroy the normal structural configuration of the protoplasm, but that it does not therefore follow that the two should necessarily stand in any causal connection with each other. The force of such an objection is, however, weakened by two observations made on roots. In *Vicia*, the fibrils are restricted to the axile cylinder (plerome) of the root. Now if the cortex be severed by an annular cut, after the disturbance which ensues as the result of the injury has passed away, the organ recovers the power of perceiving and transmitting stimuli; if, however, the plerome be cut through, by means of a needle, then the power of future response in the case of stimuli affecting the distal end will be found to have been finally lost. Again, it is known that the perception, by roots, of the stimulus given by gravity is limited to the actual growing point, whilst the motile region, in which the stimulus provokes a visible result, is situated at some distance behind it. If the tip of the root be cut away, the power of further response to the gravity-stimulus is thenceforth in abeyance pending the regeneration of the apex. Now in some instances it was observed that the power of response to the stimulus was not recovered even after the formation of the new growing point, but in every one of these cases further examination showed that the fibrillar continuity had not been properly restored. Hence the path of transmission between the percipient apex and the executive motile portion of the root still remained interrupted.

It is clear that Dr. Němec has opened up a promising field of investigation, and one which is no less important from the point of view of the plant world than from that of the lower animal organisms in which also no permanent nervous system is present. It is to be hoped that the observations may be thoroughly tested by physiological as well as by histological methods, a task which should be rendered the easier inasmuch as the structures can apparently be identified in the still living cells.

J. B. F.

AMERICAN AGRICULTURAL RESEARCHES.

Yearbook of the United States Department of Agriculture, 1900. Pp. 888. (Washington, D.C., 1901.)

THE bulky volume before us is as full of interest as its predecessors, and as profusely illustrated. Its contents are extremely various, for, as mentioned in the preface, there is not a single bureau, division or office of the Department that has not contributed to the present book. The reports occupy 633 pages. These are followed by an appendix of 231 pages, in which a great deal of statistical and miscellaneous information is brought together for the use of the farming community. We can only refer to a very few of the subjects discussed.

The report on the cultivation of Smyrna figs in California is full of interest of many kinds. For this fig to be brought to perfection, it is necessary that the flower should be fertilised by pollen from the wild fig, or caprifig. The pollen is conveyed by an insect, *Blastophaga grossorum*, which goes through its various stages of growth in the wild fig. It is the practice in Smyrna and other fig-growing countries to break off the fruits of the caprifig, and tie them to the limbs of the edible fig tree, at the time when the flower receptacles of the latter are in a suitable condition. The result is the production of figs far larger and finer than would be obtained without this operation. The American report gives a brief history of our knowledge on this subject, and a detailed account of the introduction of the Smyrna fig into California, the subsequent introduction of the caprifig, and the final successful introduction, after several failures of the insect, with details of the work done during the season of 1899, when the first crop of figs fully equal to the imported article was obtained. For the successful fertilisation of the Smyrna fig it is necessary that the caprifig should blossom at the same time as the Smyrna fig, and that the winged female insect should also at the same time be emerging from the galls containing the pupa. These adjustments are liable to be disturbed by variations in climate and season, and require careful study and skilled scientific superintendence if fig culture is to be successfully introduced into a new country.

The report on the cultivation of the date palm is also of great interest. A full account is given of the conditions under which the finest dates are produced in Algeria and the Sahara, and of the steps which have been taken to introduce the best varieties of the date palm into Arizona and other suitable climates in the United States. It is shown that the best varieties can only be introduced by means of offshoots, the plants grown from seed being very various in character. Different climates require the choice of different varieties. The tree has the great merit of flourishing in climates in which the summer is too hot and too dry to permit of ordinary cultivation; it flourishes even in soils impregnated with alkali salts, a condition frequently met with in dry climates. The report should be of considerable value to the Agricultural Department of our Indian Empire, where vast areas of waste alkali land are still waiting to be dealt with.

There is one more report, of special interest in connection with the present summer, of which we will briefly speak: its subject is hot waves, the conditions which produce them and their effect on agriculture. The continent of North America is at present admirably suited for the study of meteorological phenomena; the observers cover an immense area, and are all in telegraphic communication with the Central Weather Bureau at Washington. The report in question includes the study of three remarkable periods of heat, and is illustrated by maps showing the distribution of pressure and temperature over the continent during these periods. The first point that strikes one is the unsuitableness of the phrase "hot wave." The heat periods are, indeed, periods of stagnation in the atmosphere. The conditions appear to be similar in each instance which is discussed. There is an area of moderately high pressure in the subtropical region towards the south-east; an area of moderately low pressure in the northern central States, and a second area of high pressure on the west or north-west coast. These conditions are steadily maintained during the hot period. There is, of course, a slow flow of air from the subtropical, south-eastern area of high pressure to the central or north-central area of low pressure. The extreme temperatures occur between these two regions. The great heat is not simply due to air coming from a warm region; it is largely due to the clear sky affording full opportunity for the receipt of solar energy, and to the small radiation during the night from the earth's surface; the hot nights are, indeed, a striking feature of these periods. What is the cause of this absence of night radiation with an apparently clear sky? It appears to be due to the presence of a large quantity of transparent water vapour in the higher regions of the atmosphere, which allows the passage of solar radiation but forbids the return of the lower grade heat waves of terrestrial radiation.

R. WARINGTON.

SCHOOL HYGIENE.

School Hygiene. By Edward Shaw, Professor of the Institutes of Pedagogy, New York University. Pp. 260. (London: Macmillan and Co., Ltd., 1901.) 4*s.* 6*d.* net.

A Manual of School Hygiene. By E. W. Hope, M.D., Professor of Hygiene, University College, Liverpool, and E. A. Browne, F.R.C.S.E., Lecturer of Ophthalmology, University College, Liverpool. Pp. 207. (Cambridge: University Press, 1901.) 3*s.* 6*d.* net.

IT has been the aim of the authors of these two works to set forth the conditions which should surround school pupils in order that their mental and physical health may be promoted. No true education in mental training can overlook the hygienic and physical relationship of mind and body, and no knowledge must be conveyed at the expense of physical and moral development; for it is true, as Mr. Herbert Spencer has reminded us, that the essential object of education is to teach us how to live happily. Moreover, the connection between physical health and the power of voluntary control and, consequently, of conduct, is very close, and perfect mental development cannot be brought about if the opportunity is not given for healthy physical development. Notwithstanding the general acceptance of these truisms, school buildings are still being erected with a view mainly to exterior effect, and an adequate system of ventilation in the crowded class-rooms is rarely to be met with. As Prof. Shaw has pointed out, the school-room should be the unit first to be considered in planning the school building, and the building should be a number of school-rooms properly disposed, and not a whole cut up into school-rooms whose size and arrangement are dependent upon the size and shape of the building.

The guiding principles of hygiene, so far as it is affected by the circumstances of school life, are well and clearly set forth in both books, and the essential facts of school health are brought within the easy reach of the parent or teacher. To do their duty in this respect, no great amount of detail knowledge is necessary, but rather one of general principles combined with an intelligent observation of children with the view of detecting those influences which tend to do harm. Many details in the practical work of the school are of the greatest hygienic importance, and these can only be directed by the teacher, who should recognise that it is the first duty of an educational system to promote good health among the scholars, and, indeed, that the success of any particular school is reflected in the physical health of those attending it as well as in their mental attainments.

"A Manual of School Hygiene" consists of two parts. In Part i., written by Prof. E. W. Hope, there are chapters upon site and soil, the school building, air, ventilation and warming, food and clothing, sickness, the personal aspect of infection, accidents and emergencies. Part ii. is written by Mr. E. A. Browne, and deals with the care of the eye, school furniture and writing, the air passages, exercise, over-pressure and the general management of health. The subjects of Part i. are not always treated with sufficient detail to meet the purposes of an elementary text-book. For instance, it is not sufficient to state that "other simple inlets for fresh air may be mentioned, such as Tobin's tubes, Louvres, Sherringham valves, Cooper's discs, &c." (p. 33); and again, that house drains "should be laid at such an inclination as will secure a velocity of not less than three feet per second, and the diameter should be four or six inches in accordance with the number of lavatories discharging into it" (p. 10). Many other instances could be quoted in which the matter given will convey little real information to one who already knows little or nothing of the subject. Owing to a hasty revision of the proof sheets, the carbonic acid of the general atmosphere is given as 0·4 per cent. on p. 16.

The treatment of the subjects of Part ii. is wholly excellent; the matter is scientifically sound, clearly written and sufficient, and it might well serve as a model to other text-books which deal with corresponding branches of school hygiene. We would commend Mr. Browne's definition of "over-pressure" as a very happy one; it is "a failure to reach the potentiality of the bodily and mental strength of any given child"; and every school teacher would do well to keep before him the writer's statement that "the holidays may be needed for the teachers, they may be desirable for the maintenance of home life and family ties, but they should be entirely superfluous in the matter of health."

The long range of subject-matter comprised within the title, "School Hygiene," is also dealt with a little unevenly in Prof. Shaw's work. The book contains some excellent chapters, notably those dealing with school furniture, postures, physical exercises and handwriting; but those dealing with sites and foundations of schools and sanitary fitments are somewhat poor, and generally insufficient. The reader will be puzzled by the reference, in the chapter dealing with ventilation, to "the well-known device of placing a board between the sashes of the window," and the scientific reader will not approve of the statement that the soil of the site should be free from organic matter. The book, however, is one which contains a great deal of valuable and well-expressed material, and it should be read by all those whose duty it is to be conversant with the subject of school hygiene. It is well printed, excellently illustrated, and contains a good bibliographical appendix.

OUR BOOK SHELF.

Illustrations of the Botany of Captain Cook's Voyage Round the World in H.M.S. "Endeavour" in 1768–1771. By the Right Hon. Sir Joseph Banks and Dr. Daniel Solander, with Determinations by James Britten, F.L.S., Senior Assistant, Department of Botany, British Museum. Part II.: Australian Plants. (London: Printed by order of the Trustees of the British Museum, 1901.)

THE first part of this work was noticed in NATURE, lxii. p. 547, October 1900, to which we may refer for explanations of its scope and character, as well as for some criticisms of the nomenclature and other points. The present part consists of plates 101 to 243, with descriptive letterpress, and illustrates the natural orders Myrtaceæ to Labiatæ, arranged after Bentham and Hooker's "Genera Plantarum." When complete, this work will be a great help to the botanists of East Australia, as it will comprise a considerable selection of the plants of the coast region from Cape Howe to Cape York. Almost all the natural orders are represented, though somewhat unequally. Thirteen genera of Myrtaceæ are figured, for example, and they include eight which are characteristically Australian. Nine species of the delicate and elegant genus *Utricularia* are also among those represented. In the way of names, such familiar genera as *Barringtonia*, *Careya*, *Sesuvium*, *Spermacoce*, *Olearia*, *Wahlenbergia*, *Trichodesma*, *Clerodendron* and *Plectranthus* are superseded by the obscure and usually less euphonious appellations of *Huttum*, *Cumbia*, *Halimum*, *Tardavel*, *Shawia*, *Cervicina*, *Borraginoides*, *Siphonanthus* and *Germanea*, respectively, on the ground of priority, often for a single species. Fortunately for the ordinary botanist and gardener, these and numerous other changes are not binding, and most of them are not recognised by Kew, Berlin and other botanical establishments which greatly influence the horticultural world. But the saviours of the familiar names are the nurserymen, who are careful not to mislead and mystify their customers by using fresh names for old plants.

W. BOTTING HEMSLEY.

Essays on the Theory of Numbers. I. Continuity and Irrational Numbers. II. The Nature and Meaning of Numbers. By Richard Dedekind. Authorised translation by W. W. Beman. Pp. 116. (Chicago: The Open Court Publishing Co.; London: Kegan Paul and Co., Ltd., 1901).

IN the first of these tracts Prof. Dedekind gives a theory of irrational numbers and of the arithmetical *continuum* which is logically perfect, and in form, perhaps, more simple and direct than any other which has been or could be suggested; in the second he proceeds, by a marvellous chain of subtle inferences, from the idea of a *manifold* (or system of distinguishable objects in the widest sense) to the series of natural numbers and the elementary operations of arithmetic. It is to be hoped that the translation will make the essays better known to English mathematicians; they are of the very first importance, and rank with the work of Weierstrass, Kronecker and Cantor in the same field. The translation is rather painfully literal, and does not convey much idea of the graceful style of the original; but it is, on the whole, correct. On p. 46, l. 15, "hereafter" is a wrong rendering of *hierauf*; on p. 52, l. 18, $\psi(s')$ and s should be $\psi(S')$ and S; p. 61, last line but one, "such" is superfluous. On p. 34 there is an amusing complication of errors. What the author means is, "In this sense" (or "in the light of this fact"), "which I wish to express by the words ἀεὶ ὁ ἄνθρωπος ἀριθμητίζει, formed after a well-known saying, I hope," &c. The reference is to the motto on the title-page of the German edition, which was coined by the author in imitation of the Platonic dictum, ἀεὶ ὁ θεὸς γεωμετρίζει.

M.

Familiar Butterflies and Moths. By W. F. Kirby, F.L.S., F.E.S. Pp. 114; with 18 plates containing 216 illustrations in colour. (London, &c.: Cassell and Co., Ltd.) Price 6*s*.

THE interest of this book centres in the coloured plates, which for the most part are excellent, and, so far as they go, will enable any one to name his insects supposing them to be among the number figured, for it must be remembered these are only a "selection." Probably the only really bad figure is Fig. 11 on Plate x. Nearly one-fourth of the number are butterflies, and nothing is figured beyond the Geometridæ. A not inconsiderable number of the species noticed do not occur in Britain, but this should be no drawback, because so many of our amateur entomologists travel abroad nowadays and form collections on their tours. The text is written to the figures and is sound, and the whole book is remarkably well got up. It does not pretend to be of the strictly scientific class, but we can commend it to the notice of those desirous of making a cheap, handsome and useful present.

Lehrbuch der mathematischen Chemie. Von J. J. van Laar. Pp. xiii + 224. (Leipzig: Johann Ambrosius Barth, 1901.)

THIS book does not cover the whole ground of mathematical chemistry, but is concerned solely with equilibrium. The treatment is thermodynamical throughout, Planck's potential function being taken as mathematical basis.

The first section of the book gives the general thermodynamical theory; the second section, which has eight times the bulk of the first, applies the theory to concrete cases, examples being given of all ordinary equilibria in gaseous, dissolved and condensed systems.

To those who desire a formal mathematical treatment of this important branch of chemical theory the book may be heartily commended, more especially as due attention is paid to experimental work where possible, so that comparison between theory and experiment is made easy.

Philip's Educational Terrestrial Globe. Diameter 9 inches. (London: George Philip and Son, 1901.) Price 15*s*.

IT is unnecessary here to urge that familiarity with the features of a good terrestrial globe is an excellent faculty for the student of geography to possess. Good globes of a serviceable size should be regarded as essential to the satisfactory teaching of the subject. Messrs. Philip's new globe shows commercial routes, ocean currents and the new political boundaries; and it is a very clearly-printed representation of the world. The distances in nautical miles are shown upon the principal steamship routes. Of course it is impossible to represent details upon a globe nine inches in diameter, as the scale is so small that the British Isles can be covered with a three-penny piece. But the correct general view obtained by the inspection of even a small globe has many advantages in the early stages of geographical instruction. For real work, however, it is essential that a complete meridian divided into degrees, and a wooden horizon, be provided. The importance of this is apparently not sufficiently appreciated by globe makers, for all the comparatively cheap globes, such as that under notice, are mounted with a semi-meridian of brass, which is sometimes not even divided into degrees, and they have no horizon. It ought not to be difficult to devise a light and inexpensive globe having both meridian and horizon, and doubtless such a globe could be produced if geographical publishers cared to give attention to it. The great value of a globe of this kind in connection with problems of geodesy, navigation and physical geography can only be appreciated by those who have learnt or taught the use of the globes.

Die Krystallisation von Eiweissstoffen und ihre Bedeutung für die Eiweisschemie. By Dr. Fr. N. Schulz. Pp. 43. (Jena: Gustav Fischer, 1901.) Price M. 1.20.

THE investigation of the chemical and physical nature of albumins[1] has always been hampered by the absence of criteria for the determination of the purity of the specific preparation. In chemical research we possess in crystallisation our most valuable method for purifying a substance, but the application of this method to albumins presents a complex problem.

For albumin crystals—crystalloids as they are termed—possess remarkable properties which distinguish them from other crystals: when treated with various reagents they absorb liquid and swell up; they do not separate from pure solvents, but the crystallisation is effected by salting out, or by the addition of mineral acids; as soon as the crystallisation is started, the separation is spontaneous and independent of the concentration, rendering it impossible to grow large crystals.

In other respects, however, these crystalloids resemble true crystals, in so far as they belong to well-defined systems, possess similar optical properties, and their inclination towards crystallisation depends on their state of purity.

Dr. Schulz in this pamphlet gives a complete account of all albumins which occur or have been obtained artificially crystalline, and of the methods used to obtain the latter results, and indicates that in many cases the elementary analyses of crystalline albumins, by different experimenters, show a welcome agreement.

Though Dr. Schulz in no wise dogmatises on the two theories of the crystallisation of albumin, he inclines to the view put forward by Hofmeister, who considers the phenomenon simply a case of gradual purification, in preference to Gabriel's assumption of the depolymerisation of the molecules of amorphous albumin.

The object of the author, we think, is in the first place to demonstrate the comparative uselessness of scientific research on substances of the purity of which we have no guarantee; he does not believe the amorphous character of certain albumins to be an inherent property, but attributes it to our ignorance of experimental conditions, intensified by the sensibility and labile nature of the albumin molecule. We can warmly recommend Dr. Schulz's pamphlet to the physiological chemist.

W. T. L.

Flowers and Ferns in their Haunts. By M. O. Wright. Pp. xix + 358. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1901.) Price 10*s*. 6*d* net.

THE authoress, in the "invitation" which prefaces this book, asks her readers to "spare an idle hour to look with the eye of the mind and the camera at a few of the flowers and ferns in their haunts." From this it will be evident that the work is not in any sense a scientific one and must not be criticised as if it were. It is a pleasantly written account of the more familiar flowering plants and ferns met with in a district in North America as they present themselves in the landscape. It is very fully illustrated with plates and drawings, the former being reproduced from photographs, the latter based on them. The plates, which represent the plants as they grow, are very good. The book will interest those who are familiar with the plants of which it treats, while others who know the wild plants of England will obtain from it a general idea of the common wild flowers of another country. A useful feature is a list of the scientific names of plants, which are mentioned in the text by their local popular names.

W. H. L.

[1] English current literature writes album*e*n and album*i*n indifferently—in America the term "egg-white" is frequently used, but rarely album*e*n.

LETTERS TO THE EDITOR.

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

Pearl and Pearl-shell Fisheries.

IN connection with Sir West Ridgeway's anxiety, as Governor of Ceylon, to revive the pearl fishery off the north-west coast of the island, and the appointment by the Secretary of State for the Colonies of so able a zoologist as Prof. Herdman to report on the subject—so classic to zoologists since Dr. Kelaart's paper and the display of fine examples of the pearl shells by the Indian Government in the London Fisheries' Exhibition of 1883—it may be interesting to mention the activity of the Queensland Government in this and allied subjects. Besides the work of Mr. Saville Kent and the recent (private) investigations of Mr. Lyster Jameson, the Queensland Government early last year appointed an able young zoologist, Mr. James R. Tosh, to make investigations on the life-history of the species which produces the pearl-shells of commerce, the formation and growth of pearls, and other questions bearing on the pearl fishery. He is now busy on Thursday Island. Moreover, Mr. Tosh informs me that the Queensland Government has just sanctioned a grant of 1500*l*. for the erection of a marine laboratory on a small island about two miles distant (from Thursday Island), and in the centre of the pearl-fishing grounds, though at some distance from the coral area. This laboratory will have, besides the work-room and quarters for Mr. Tosh and his staff, three concrete tanks for experimental work. W. C. McINTOSH.

Barham, Springfield, Fife.

A Possible Method of Attaining the Absolute Zero of Temperature.

IN your issue of July 25 there appeared an interesting article on the liquefaction of gases. It was shown that by rapidly evaporating hydrogen, Prof. Dewar obtained a temperature of 13–15° C. (absolute). By a similar use of the more volatile helium, probably an even lower temperature could be obtained.

But, as the author pointed out, such methods will not enable us to reach the absolute zero itself.

May I be allowed to suggest that thermoelectric phenomena will be of some use in attaining the desired result?

Peltier showed that if a current be passed across an antimony-bismuth junction, in one direction heat is developed and in the reverse heat is absorbed and an appreciable cooling effect obtained.

Similarly, in the case of any two other metals, heat is generated if the current traverses the surface of contact in one direction and is consumed if it passes in the opposite direction—the quantity of reversible heat being in each case proportional to the strength of the current and to a coefficient π, depending on the nature of the metals and their temperature.

So that, in general, if r is the resistance of the part of the circuit containing the junction, the energy converted into frictional heat is C^2rt and the energy converted into reversible heat is $C\pi$.

Hence, if H be the quantity of heat produced in t seconds we have:—

$$J.H = C\pi t + C^2rt.$$

By making a small hole at the junction of a bismuth and antimony bar, in which was placed a drop of water and a small thermometer, the whole being cooled to zero, Lenz found that when a current was passed from bismuth to antimony the water was frozen and the thermometer sank to −3·5° C.

Opposing this fall in the junction's temperature there are, in general, two influences. Firstly, when a current is passed through a conductor a frictional generation of heat occurs, which tends to mask the cooling effect. Secondly, when one part of a circuit is at a much lower temperature than the other parts, heat will flow by conduction from the hotter to the colder parts and thus again oppose further cooling.

When a stationary low temperature has been reached by the junction, we must suppose that as much heat is absorbed by the current in unit time as is imparted to the junction by means of both of those influences I have mentioned working together.

If, therefore, we could diminish or do away with these, a very great cooling effect could be obtained.

The frictional heating effect could be eliminated to a great extent by cooling the whole to the lowest temperature attainable by the use of liquid hydrogen. Recent experiments by Profs. Fleming and Dewar show that an astonishing fall in the specific resistance of most metals takes place at very low temperatures. Thus the specific resistances of copper and iron fall from 1564 and 9115 respectively at 0° C. to 289 and 1220 at −200° C., while at a temperature only 20° C. lower, these numbers become 144 and 660—*i.e.* the specific resistance at −220° C. is actually half that at −200° C. (*vide* Foster and Atkinson's "Electricity and Magnetism," p. 162, 1896 ed.) Such an enormous diminution in the specific resistance leads one to expect that at only 13–14° C. from the absolute zero—the lowest temperature yet attained by Dewar—the resistance would be practically negligeable, so that the term C^2rt in the above expression would become extremely small even when currents are employed considerably more powerful than those which can be used at ordinary temperatures for producing the Peltier effect.

If, then, π remained appreciably large, it is quite possible that matter could by such means be chilled almost to the absolute zero without the masking effect of frictional heat becoming sensible.

The second influence, namely, the flow of heat by conduction from the hotter parts of the bar to the cold junction, could be eliminated by avoiding a sensible temperature difference between the chilled junction and the rest of the circuit. For instance, each small section of the main circuit could be cooled simultaneously with the junction by means of a number of other chilled thermoelectric junctions. By the use of some such contrivance, the temperature of the junction need never become very much lower than that of the rest of the circuit.

The coefficient π would certainly alter with the temperature; unless it completely vanishes for all bodies at very low temperatures, such an effect could be corrected by suitably choosing the metals forming the junctions. GEOFFREY MARTIN.

Bristol, July 26.

Food of the Senegal Galago.

THE following facts may interest some of your readers as pointing out the possibility of a rare tropical animal being able to maintain itself unaided for some weeks in an English country town.

On the evening of June 20 an African galago (*G. senegalensis*) escaped from my laboratory in Eton. For some little time it was not seen or heard, but after that it constantly made its appearance in gardens, on house roofs, &c., until, on the night of July 28, it was caught while rifling a cupboard. Previous to this date it had never been seen inside a house, so that how it managed to obtain food is somewhat of a mystery. Probably it lived on fledglings which it took out of the nest, and later on the decrease in their numbers forced it to forage for less tempting prey. Its strictly nocturnal habits and great agility no doubt preserved it from being destroyed by dogs. M. O. HILL.

Pseudoscopic Vision without a Pseudoscope.

THE curious optical illusion which has been noticed by Prof. R. W. Wood and described by him in NATURE for August 8 under the heading of "A New Optical Illusion" has been known for many years.

It is mentioned in Helmholtz's great work on physiological optics in the chapter on the stereoscope and pseudoscope. It appears to have been first described by Prof. Joseph Le Conte in 1869 (see Silliman's *American Journal of Science* for January 1869 and *Phil. Mag.* February 1869).

Both these authorities mention a further similar illusion not described by Prof. Wood, which I think is a more striking illusion. If one looks at a pattern of which the distance between the centres of contiguous figures is somewhat less than the distance between the two eyes, and if we gaze at it in such a manner as if we were looking at a distant object beyond it, we then get the illusion of a much increased pattern at a considerably greater distance from the eye. A. S. DAVIS.

Roundhay, Leeds, August 9.

PHOTOGRAPHIC ANALYSIS OF THE MOVEMENTS OF ATHLETES.[1]

M. MAREY has again applied his chronophotographic methods in making an analysis of the movements of athletes while exercising their strength in different ways. His delightful experiments, which have been but little repeated by others, are described in detail in "Le Mouvement" (par E. Marey. Paris: 1894. Translated into English by E. Pritchard. London: Heinemann, 1895). The methods are, for the most part, so simple, and the results so valuable, that they should prove themselves attractive to the student of those subjects in which movement of any kind is to be measured. In 1900, during the exhibition in Paris, there was a large gymnastic meeting and athletic sports. The administration of the exhibition nominated a commission of physiology and hygiene, for the purpose of following the meetings and gathering from that unique assembly of the best athletes in the world the information which it afforded. Its object was to determine, from a physiological point of view, the action of the various forms of exertion on the organic functions, viz. the respiration, the circulation of the blood, the digestion and, finally, the general health. The commission also studied different kinds of sports with a view to understand their mechanical details and discover the secret of the superiority of certain athletes.

FIG. 1.—Composite picture of putting the weight by Sheldon.

The chronophotographic method gives a series of instantaneous photographs, on a long ribbon which is unwound; the number of pictures varies from fifteen to twenty or more per second. By this means the phases of a movement are perfectly represented. Figures so produced on a band being somewhat difficult to compare with one another, it was found to be more convenient to arrange them, as in Fig. 3, in three columns, the succession of pictures in each column reading from top to bottom, commencing on the left. The subject is that of "putting the weight" by the American athlete, Sheldon. The weight used by all competitors was 7·25 kilogrammes, = 15·95 lb., or the 16 lb. shot used in English athletic sports, and the distance covered was 14·02m. = 45·98 feet. Fig. 3 shows the athlete at the moment of his take-off from the right leg. At the end of his jump, and at the moment when the left foot touches the ground, he brings his right arm into action, which moves the shot upwards and forwards, giving it the greatest velocity possible.

The competitor is allowed a run of 2m., and he stands in a square traced on the ground, the boundary of which he must not pass. In order that the velocity of the different movements of the athlete may be estimated, it is necessary to introduce into the pictures the representation of both time and space. The time is measured by means of a chronograph (visible only in the five last pictures); it consists of a black dial furnished with divisions, over which a white pointer moves; the pointer makes one revolution in one second. The angular space swept out by the needle between two successive pictures indicates the time which has elapsed. An easy way of measuring these intervals is to determine the number of images contained in one, a half or quarter revolution of the needle. In Fig. 3, the last five pictures were made in one quarter of a revolution of the pointer, or at the rate of twenty pictures per second, so that between two successive images the displacement (which is estimated for any point on the body) is made in 1/20th second, and it is the same for the displacement of the weight. The true extent of displacement is finally determined by placing a divided metric scale on the ground; this rule is photographed at the same instant as each new position of the athlete, and it serves as a scale whereby the path traced out by each point under consideration may be computed—M. Marey gives the following *method of comparing images by superposition.*

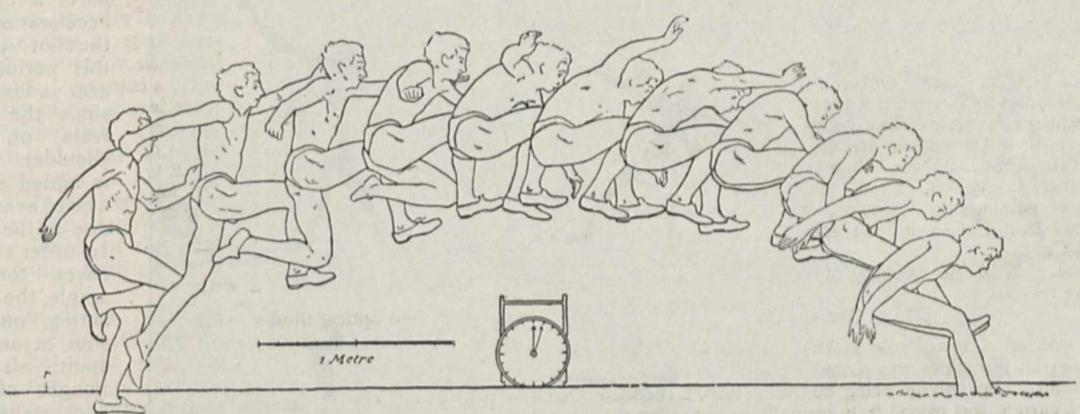

FIG. 2.—Composite picture of long jump by Sweeney.

[1] The accompanying illustrations are from *La Nature.*

Project the first image of a series (Fig. 1) on to a piece of paper, mark the ground line and a fixed point on it, *r*—a small stick planted in the ground—then trace

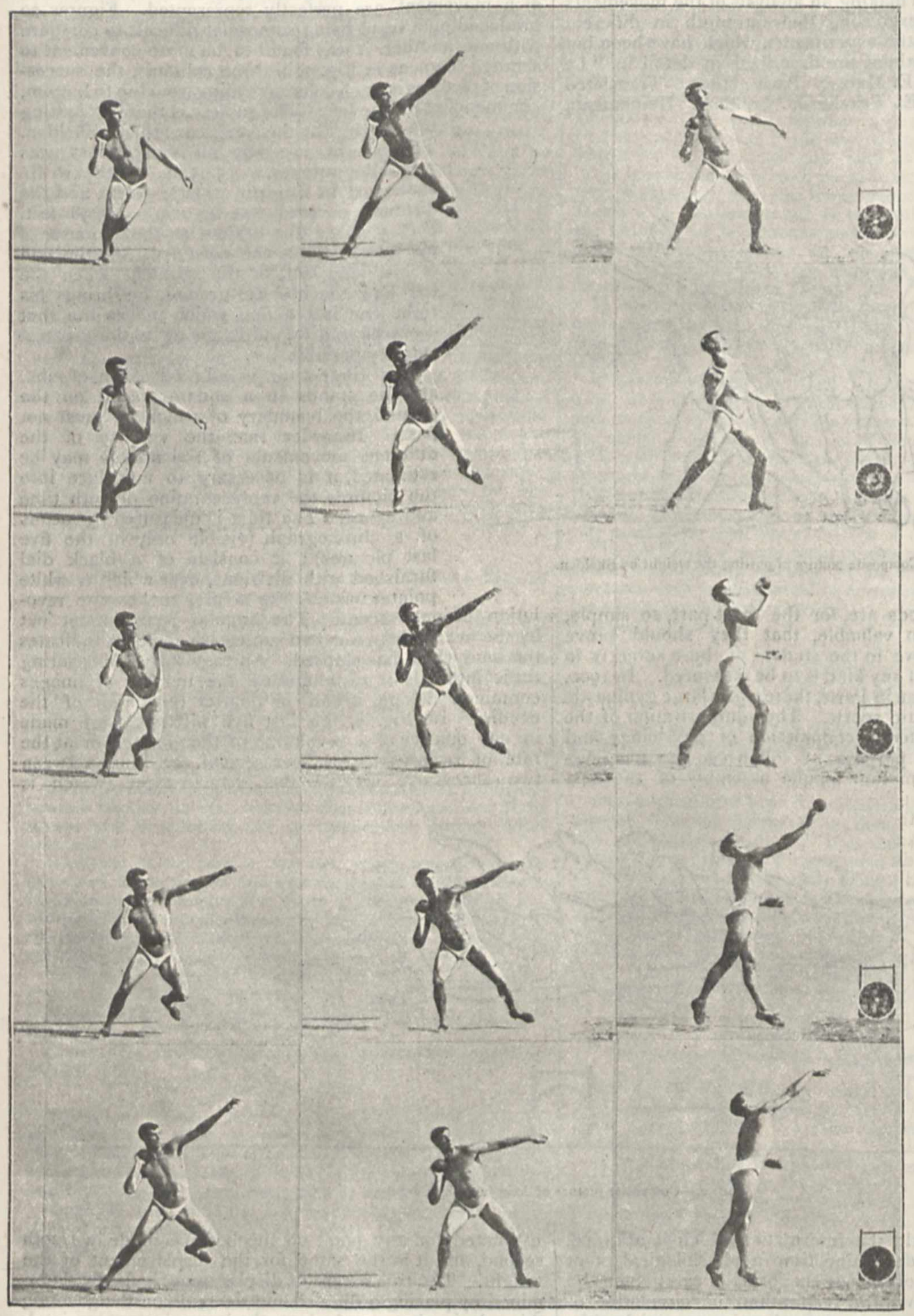

FIG. 3.—Putting the weight by Sheldon.

with care the contour of the body and limbs of the gymnast. This done, project the second figure of the series. In order to bring this image into its correct position, relative to the first, shift the paper until the ground line and the point of reference correspond with those points already marked on the paper. We shall see that the second image does not coincide with the first; since each part of the body has moved, trace the outline of the second image and repeat the operation for each image in the series. The result is a composite diagram, and by reference to the original pictures it is easily interpreted. In the composite diagram only every third image in the original has been used, otherwise the result would have been confusing. In Figs. 1 and 3 the movements of the athlete are put before us in series. He begins with a jump, which imparts a certain acceleration to the shot; during this period the arm is inactive, since the shot rests on the shoulder. Next is added a new acceleration, due to the arm. In order to discover, for example, the force acting on the shot at any instant, all the images of the shot must be represented (the figure of the man being left out, as it would complicate the diagram). After the successive positions of the shot have been traced on the paper, the accelerations can be determined and their curve traced; by means of this the work done by the athlete at any instant may be found. M. Marey's excellent work in chronophotography is again illustrated by the analysis of the long jump (Fig. 4). The columns are to be read from right to left and from top to bottom. As in the former diagram, a composite picture has been made from several consecutive images. In this instance, owing to the rapid movements of the jumper, the figures have less tendency to be confused by superimposition. By eliminating every other image, a clear and comprehensive representation of all the actions has been obtained — actions which no language could describe with sufficient accuracy. The means of determining the extent and the duration of these movements is as perfect as possible. The chronograph shows that the interval between the images is 1/14th second, whilst the metric scale gives the length of the jump as 4·69 m. The same method of measurement shows that the space traversed by the jumper in 1/14th second was 52 cm., giving him a velocity of 7·28 m. per second. If the detail of Fig. 2 is closely studied, it will be seen that different points of the jumper's body do not cover the same space in the same time. For example, the head is displaced with unequal velocities, because the arms and legs are at each successive moment in different positions. Several other analyses of the movements of celebrated athletes, French and American, were obtained, and in all cases much light has been thrown on the rapid movements of the limbs in the case of clearing hurdles in a race.

The evidence collected in each section of the inquiry instituted by the commission of physiology and hygiene should prove itself to be most interesting and valuable matter, since it should lead to a complete modification of the system of athletic training and establish it on the study of nature itself, instead of on theories devoid of experimental foundation and often contradictory. M. Marey's methods of time measurement are very excellent, simple and effective, and a study of his work, "Le Mouvement," ought to stimulate English experimentalists to work in the same direction, which should prove itself to be a fruitful field for research in a country in which athletic exercises of every kind are so vigorously practised by all classes.

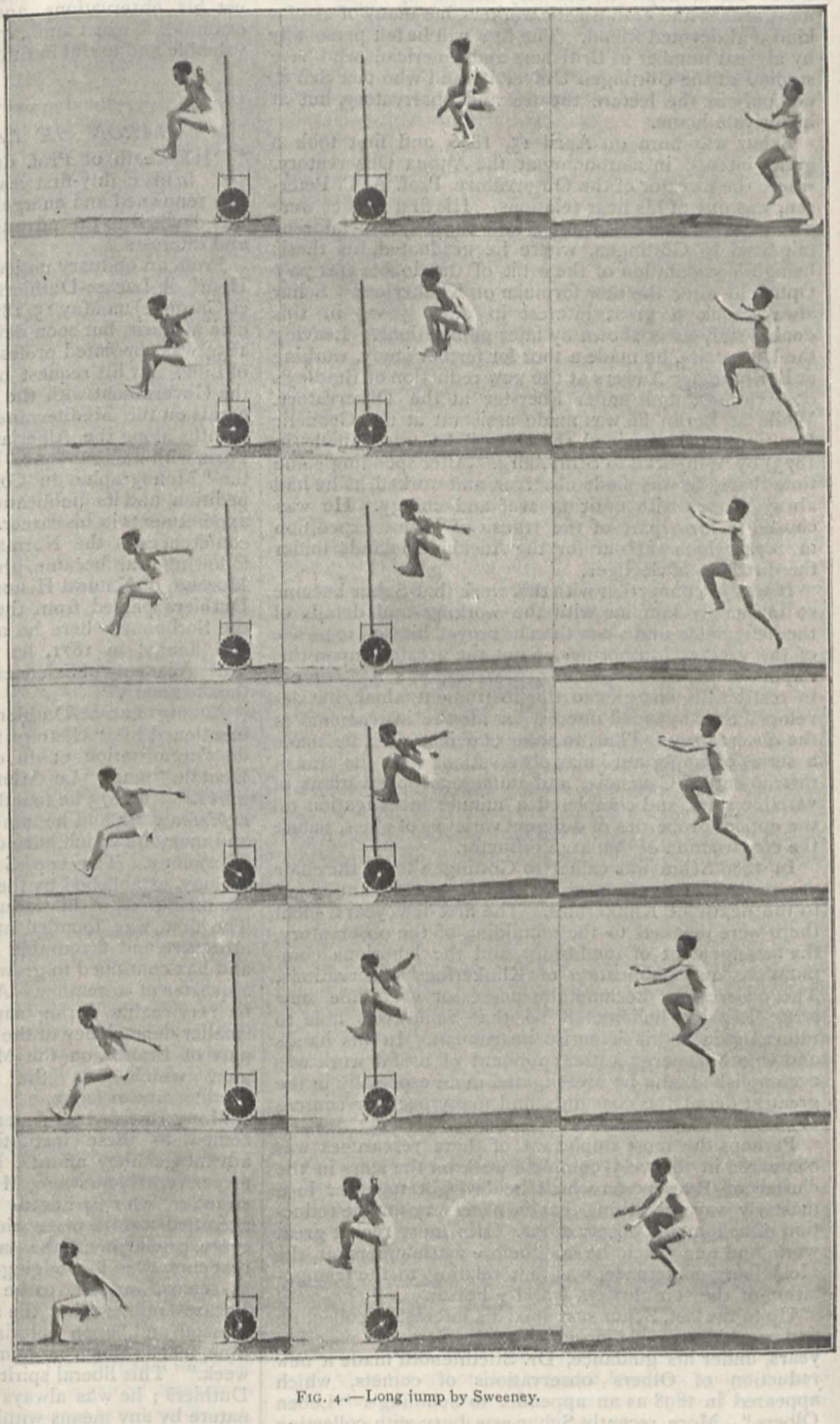

FIG. 4.—Long jump by Sweeney.

PROFESSOR WILHELM SCHUR.[1]

IT was with great regret that we had to announce last week the death of Prof. Wilhelm Schur, of Göttingen, a loss which deprives, not only astronomy of one of its most ardent and enthusiastic workers, but many of us of a kind and devoted friend. The loss will be felt personally by a great number of Britishers and Americans who have studied at the Göttingen University and who met Schur, not only in the lecture theatre and observatory, but at his private home.

Schur was born on April 15, 1846, and first took a great interest in astronomy at the Altona Observatory, where the director of the Observatory, Prof. A. C. Petersen, was one of his near relations. His first studies were commenced at Kiel in 1863, and three years later he migrated to Göttingen, where he graduated, his thesis being a computation of the orbit of the double star 70 *p* Ophiuchi after the new formulæ of Klinkerfues. Schur always took a great interest in after years in this double star, as is shown by later publications. Leaving the University, he made a tour for further study, working at Berlin under Auwers at the new reduction of Bradley's observations, and under Foerster at the Observatory. While at Berlin he was made assistant at the Geodetic Institute, and remained there until he was called (in 1873) by Winnecke to Strassburg. After spending some time there, he was made observer, and worked, as he had always done, with untiring zeal and energy. He was chosen to form part of the transit of Venus expedition in 1874, which set out for the Auckland Islands under the direction of Seeliger.

It was in connection with this work that Schur became so intimately familiar with the working and details of the heliometer, and since then he proved himself to be one of the greatest authorities, if not the greatest, upon this important instrument. Schur, however, was not content to restrict his energies to this instrument alone, but developed a many-sided interest for all the instruments at the observatory. Thus, to take two instances, he made a series of important lunar observations with the transit instrument of Cauchoix, and numerous observations of variable stars, and completed a minute investigation on the optical properties of different varieties of glass, before the construction of the large refractor.

In 1886 Schur was called to Göttingen to fill the chair of practical astronomy, which had become vacant owing to the death of Klinkerfues. The first few years spent there were devoted to the rebuilding of the observatory, the arrangement of the library, and the laborious computations and publication of Klinkerfues' observations. The observatory became the possessor of a fine new large Repsold heliometer, so that Schur was able to return again to his favourite instrument. In his hands and with his energy a great amount of useful work was accomplished, and he investigated more especially in the greatest detail the constants and many peculiar sources of error of the instrument.

Perhaps the most important of these researches was contained in the very complete work on the stars in the cluster of Præsepe, in which he brought together in a masterly way everything that is necessary for the reduction of heliometer observations. His most recent great work, and one which he laid before astronomers at the Heidelberg conference, was that relating to the triangulation of the star clusters *h* and χ Persei.

Up to the last, Schur sustained his interest in collecting and working up old observations, and in the past few years, under his guidance, Dr. Sticthtenoth made a new reduction of Olbers' observations of comets, which appeared in 1898 as an appendix to Schilling's "Leben Olbers." More recently Schur was busy with collecting material of astronomical work done by astronomers in the province of Hanover, and the results of this study are already completed, but not yet published.

Although Schur was not among the favoured few to whose name some epoch-making discovery could be attached, yet his observations and reductions will endure as examples of exact and careful work and will prove both valuable and useful in future investigations.

WILLIAM J. S. LOCKYER.

[1] For most of the details in this notice I am indebted to information given in the *Astronomische Nachrichten* (No. 3731).—W. J. S. L.

BARON DE LACAZE-DUTHIERS.

THE death of Prof. de Lacaze-Duthiers on July 21, in his eighty-first year, deprives the world of science of a renowned and energetic naturalist whose active life was devoted to the advancement of scientific knowledge and interests.

From an obituary notice in *La Nature* we learn that Henri de Lacaze-Duthiers was born at Montpezat (Lot-et-Garonne) on May 15, 1821. He began the study of medicine at Paris, but soon devoted himself to zoology, and in 1854 was appointed professor of zoology in the University of Lille. At his request he was afterwards entrusted by the Government with the task of studying the nature of corals on the Mediterranean coasts. He spent several months along the Algerian coast, and then returned to Paris with an abundance of material. His great work, the "Monographie du Corail," was the result of this expedition, and its publication inaugurated a new stage of appointments in his career. He was appointed maître de conférences at the Normal School in 1864, and in the following year became professor of zoology at the Paris Museum of Natural History. Three years later Lacaze-Duthiers passed from the Natural History Museum to the Sorbonne, where he accepted the chair of zoology, and finally, in 1871, he was elected a member of the Paris Academy of Sciences, and later became president of the Academy.

Among Lacaze-Duthiers' published volumes may be mentioned his "Histoire naturelle du corail," "Histoire de l'organisation et du développement des mœurs du Dentale" and "Le Monde de la mer et ses laboratoires." In 1873 he founded the *Archives de la zoologie expérimentale*, and he was the author of numerous papers and memoirs which have contributed to the development of zoology. The two Government stations of marine biology, established by the exertions of Lacaze-Duthiers, are memorials of his influence upon zoological science. The first was founded at Roscoff, in one of the most attractive and favourable collecting regions in Brittany, and has continued to grow in importance for more than a quarter of a century. As this station, however, could be serviceable during summer only, it gave rise to a smaller dependency of the Sorbonne in the southernmost part of France, on the Mediterranean, at Banyuls-sur-mer, which has the additional advantage of a Mediterranean fauna.

Many British and American students have been welcomed to these institutions and have enjoyed the advantages they afford. Describing the Roscoff laboratory several years ago, Mr. Bashford Dean said: "The stranger who writes to Prof. de Lacaze-Duthiers is accorded a work place which entitles him gratuitously to every privilege of the laboratory—his microscope, his reagents, even his lodging-room should a place be vacant. It seems, in fact, to be a point of pride with Prof. Lacaze-Duthiers that the stranger shall be welcomed to Roscoff and, upon entering the laboratory for the first time, feel as much at home as if he had been there a week." This liberal spirit was a characteristic of Lacaze-Duthiers; he was always ready to facilitate the study of nature by any means within his power, and right up to the time of his death he occupied himself with investigations of scientific problems. As a tribute of admiration for the good and useful work done by him in zoology, his pupils presented him with a magnificent engraved portrait of himself in 1887; and at a dinner given in his honour by the Scientia Club in 1890, M. Charles Richet, who presided, referred to him as "the conqueror of the sea and apostle of zoology." His pupils and colleagues were, in fact, deeply sensible of his great services to science, and lost no opportunity of expressing their esteem.

Lacaze-Duthiers worked in his laboratory at Banyuls up to a few days of his death, and almost up to his last hour his faculties were engaged in the extension of scientific knowledge. He was the animating spirit of French zoology and the mentor of many living naturalists. He devoted his life and his means to science, and worked for her interests without regard for fatigue or considerations of age. In announcing his death to the Paris Academy of Sciences, which adjourned the meeting of July 22 to show regard for him, M. Fouqué, the president, remarked:—"Son esprit était ouvert à toutes les nouveautés scientifiques, sa parole claire et facile, son enseignement plein d'entrain. Il aimait la discussion et savait en faire jaillir la lumière. Il laisse parmi nous le souvenir d'un Confrère érudit et laborieux, doué d'une prodigieuse activité, habile à résoudre les problèmes compliqués que soulève l'organisation du règne animal."

Not only France, but the whole scientific world is poorer by the death of so great a naturalist.

NOTES.

WE regret to see the announcement that Prof. Baron von Nordenskjöld, the renowned Arctic explorer, died at Stockholm on August 12.

ACCORDING to the Copenhagen correspondent of the *Temps*, the two Nobel scientific prizes of 200,000f. have been awarded to Prof. Finsen, of Copenhagen, for his treatment of lupus by light, and the Russian physiologist, M. Pawloff, for his works on nutrition.

THE Fifth International Congress of Zoology was opened at Berlin on Monday in the buildings of the Reichstag, the interior of which has been arranged for the convenience of the members of the congress. In the absence of the Crown Prince, who is the patron of the congress, the foreign delegates were welcomed by Prof. Moebius, the president, who moved that the assembly should send a telegram expressing profound sympathy and regret to the Emperor of Germany. This proposal was seconded by Prof. E. Perrier, of Paris, and was unanimously adopted. A telegram expressing thanks for the sympathy was received from the Emperor on Tuesday. Other speakers at the opening meeting were the Chief Burgomaster of Berlin, Herr Kirchner, and the Rector of Berlin University, Prof. Harnack. The meetings will be held throughout this week, and the congress will be concluded on Sunday with a visit to the biological station on Heligoland.

THE annual awards of prizes by the Reale Accademia dei Lincei, of Rome, are as follows:—The Royal prize for chemistry has been adjudged to the late Prof. Amerigo Andreocci for his researches on heterocyclic compounds and on the santonine group, and other papers. The Royal prize for philosophy and moral science has been adjudged to the late Prof. Carlo Giussani. In political science and jurisprudence no award has been made, and the same is true of the Santoro prize relating to agricultural zoology. The two prizes instituted by the Minister of Public Instruction in favour of teachers in secondary schools for work in natural science have been divided, awards being given to Profs. Liberto Fantappiè (Viterbo), Antonio Neviani (Rome), De Toni (Venice), and Giacomo Trabucco (Florence). Two "Ministerial" prizes of a similar character for philosophical and social sciences are awarded to Profs. Luigi Einaudi (Turin) and Aurelio Covotti (Palermo). At the special meeting of the Accademia at which these awards were made, an obituary discourse on the late Prof. Angelo Messedaglia was given by Signor Luigi Luzzatti, and an address was read by Signor Gerolamo Boccardo on science and social progress. A list of Prof. Messedaglia's writings is appended to the former discourse in the *Rendiconti delle Sedute solenni* containing the report of the meeting.

THE twelfth annual general meeting of the Institution of Mining Engineers will be held at Glasgow on September 3-6 under the presidency of Sir W. T. Lewis, Bart.

A REUTER telegram from Geneva states that a meeting of the International Association of Botanists was held in the University there on August 7. A number of foreign universities and societies, including the Universities of Oxford, Cambridge and Glasgow, and Trinity College, Dublin, were represented.

THE Paris correspondent of the *Chemist and Druggist* states that with a view to give an impetus to the study of applied chemistry in Paris, it has been decided to build additional laboratories at the Conservatoire des Arts et Métiers. The initial expense is estimated at 500,000f. (20,000*l.*), and the annual upkeep at something over 3000*l.* The laboratories will also be used for experiments in physics and mechanics.

THE *Times* records that the German South Polar expedition sailed from Kiel on Sunday by the steamer *Gauss*. Herr Rothe, Imperial Under-Secretary of State for the Interior, thanked the members of the expedition in the name of the Emperor and of Germany, and hoped that their labours would meet with complete success. Prof. von Drygalski, the leader of the expedition, replied on behalf of the expedition.

THE balloon in which M. Santos Dumont made his recent trial trips has met with an accident which has placed it beyond repair, so a new one is being constructed and will be ready by September 1. The new balloon will have nearly the same volume as the one that came to grief on August 8—34 metres in length and 6 metres in diameter in the centre—but, instead of being cylindrical, it will be ellipsoidal in shape, and the *ballonet*, instead of being at one end, will be placed in the middle.

THE wireless telegraph station established on the Nantucket lightship by the *New York Herald* enables passengers by incoming vessels equipped with the Marconi instruments to enter into communication with the American Continent and through it with the whole world from fourteen to sixteen hours earlier than is the case at present. The installation of the station is rapidly approaching completion. The *Lucania*, which sailed from Liverpool on Saturday last, will be the first Transatlantic liner to greet the New World with a wireless message sent from a ship at sea.

THE *Pioneer Mail* of Allahabad states that as a consequence of the continued fall in prices, the area under indigo in the North-West Provinces of India is rapidly falling. In 1900 there was a slight and temporary recovery, but during the present year there has again been a very marked decline. According to the preliminary statement received from the village accountants, the total area sown with indigo up to the middle of April this year amounts to 119,313 acres, as compared with 188,645 acres returned last year; while that reported to be irrigated from canals up to the end of May last is 78,894 acres, against 162,298 acres returned last year. The decrease in the former area amounts to about 37 per cent., in the latter to 50 per cent.

THE Society of German Engineers has decided to prepare and publish the trilingual technical dictionary proposed a year ago, and circulars inviting cooperation have been sent to technical societies and engineers likely to assist the project with suggestions and lists of words. Dr. Hubert Jansen has been appointed editor of this "Technolexicon," and an editorial office has been established at Berlin (N. W. 7), 49, Dorotheenstrasse. The dictionary will appear in three volumes, namely: vol. 1, German-English-French; vol. 2, English-German-French; and vol. 3, French-German-English. To make the work as complete as possible, it is hoped that many collaborators will collect technical words and expressions and send to the editor those which do not occur in an ordinary dictionary. A note-book for setting down such uncommon words and expressions which crop up in connection with engineering work will be sent to persons who are willing to assist the project. These words are acceptable even if the equivalents in the two other languages are not known. The editor would also be glad to receive references to, or copies of, good special dictionaries, technological text-books, price-lists and catalogues referring to any branches of industry or handicraft. We suggest that the printed pocket-books used by electricians, engineers, surveyors, architects and others contain a large number of technical terms for which equivalents in French and German are difficult to find. It is not clear from the prospectus whether the dictionary will include technical terms used in physics and chemistry as well as those which belong to engineering. If not, it will sometimes be difficult to distinguish between scientific and engineering terms. For instance, electrochemistry is an industry, so its technical terms will be included in the dictionary; but it is also a science, and its scientific terms should also be included. If the scope of the dictionary is made sufficiently broad to cover physical as well as engineering science, the work should be of value to students of foreign scientific literature.

THE *Meteorologische Zeitschrift* for July contains a very interesting and comprehensive article by Prof. H. Ebert, of Munich, on the phenomena of atmospheric electricity, considered from the standpoint of the theory of ions, or carriers of positive and negative electricity, generated by the medium of radiation. The electrification of a gas has, especially since the discovery of the Röntgen rays, become a subject of fundamental importance, and has occupied the attention of several physicists, more particularly Messrs. Elster and Geitel, of Wolfenbüttel, and Mr. Wilson, of Cambridge, who have independently arrived at important and very similar results. They have also greatly improved the necessary apparatus and methods of measurement, by which means they have been able to show the connection between the electric conductibility of the air and artificially ionised gases. The following are some of the results deduced from the ionic theory. (1) The greater the solar radiation the less is the electric potential generally observed. (2) The ions generated at a great altitude are maintained for a certain time in the air and participate in its movements. (3) Dust, and especially aqueous vapour, obstruct the mobility of the ions, and therefore diminishes the conductibility of the air. (4) Negative ions move at greater speed than the positive. (5) The ions form condensation nuclei which, in the case of supersaturated damp air, are exhibited as fog or cloud; hence the negative ions are more suitable for forming nuclei than the positive. The subject of the condensation properties of ionised air has been carefully investigated by Mr. Wilson, and some of the results have been published in the *Philosophical Transactions* and other scientific papers.

MR. W. L. MOORE, chief of the U.S. Weather Bureau, has given an official opinion upon the value of cannonading as a means of preventing the fall of hail. The following extracts from the *Monthly Weather Review* show that he does not attach any importance to the Stiger method of bombardment, now so widely adopted in Italy, southern Austria and southern France:—"It consists essentially in sending vortex rings of smoke and air upward toward the clouds; but the most powerful Stiger cannon that have yet been employed do not send these rings higher than 1200 feet above the ground, and, therefore, utterly fail to reach the clouds. On this account the distinguished Austrian meteorologist, J. M. Pernter, has maintained that if there is any virtue whatever in the idea, the experimenters must use much more powerful apparatus. But there is no satisfactory evidence that the cannonading or the vortices had any influence whatever on the hail. Both theory and practice agree in this conclusion. Theoretically it was imagined by Mr. Stiger that hail is formed in quiet spots in the atmosphere where the atmospheric moisture could crystallise out in large crystals in a manner analogous to the formation of large crystals of salt in liquid solution. But this is a very foolish notion; there are no such quiet spots in the atmosphere, and hailstones are not crystals, but masses of ice, with only a feeble or partial crystalline structure. Even the perfect crystals of the snowflakes are formed in the midst of rapidly-moving air, so that the whole theoretical basis for hailstorm cannonading falls to the ground. . . . After examining all that has been published during the past two years, my conviction is that we have here to do with a popular delusion as remarkable as is the belief in the effect of the moon on the weather. The uneducated peasantry of Europe seem to be looking for something miraculous. They would rather believe in cannonading as a means of protection and spend on it abundance of money, time and labour, than adopt the very simple expedient of mutual insurance against the losses that must inevitably occur."

NO. 169 of the *Bulletin* of the French Physical Society contains a brief note on some experiments by Mr. L. Benoist on the transparency of bodies for Röntgen rays. The method adopted consists in plotting curves in which abscissæ represent atomic weights and ordinates represent the corresponding transparencies. In this way it is possible to establish the existence of a functional relation between the atomic weight and the transparency, and, further, to discriminate between different kinds of rays which give different curves.

Bulletin No. 98 of the U.S. Department of Agriculture consists of reports by Drs. Atwater and Sherman and by Mr. R. C. Carpenter on food consumption and metabolism, and on the mechanical efficiency of bicyclists. The experiments were made during a six days' bicycle race, and consisted in analytical determinations of the heat equivalent of the food consumed on the one hand, and estimates of the work done as deduced from calculations of air resistance and wheel resistance on the other hand. The experiments show, among other results, the great amount of easily-digested food required by the competitors, the greatly increased metabolism of nitrogen, the large amount of work done per day by the athletes in this competition, which averaged in one case more than ten million foot-pounds, or more than five times the average daily work of a man as estimated by Dr. Thurston, and, lastly, the high efficiency of the human subject as a motor, for which the authors obtain estimates ranging as high as 45 and 60 per cent. In regard to the accuracy of the determinations, a good deal of uncertainty must exist as to the amount of energy derived from combustion of body tissue by the bicyclists, and also as to the actual resistance overcome, which latter could best be determined by dynamometer observations. The determinations of the efficiency of the human subject have an interesting bearing on the question as to whether organic life is subject to the second law of thermodynamics or Maxwell's "demons" actually exist in the animal kingdom. We should also like to see dietary studies taken in periods of exceptional brain activity, as, for example, on subjects sitting for a competitive examination.

AN interesting and useful pamphlet has recently been issued by Mr. A. Hilger, containing full description and details of manipulation of the Michelson Echelon Grating. Many of the principal Universities of Europe have been provided with this very powerful means of spectroscopic determination, and the experience gained has been sufficient to permit the designing of a standard type of instrument. In this the thickness of each plate is 10 mm., and the width of each step 1 mm. The progressive precision in the working of the plates has enabled Mr. Hilger to avoid the considerable loss of light which was caused, in the original instruments, by the plates not being mechanically clamped together. They are now held in position by a screwed frame, which can be so adjusted that no distortion is perceptible, while the increase in brilliancy of the spectra is very noticeable.

WIRELESS telegraphy is in use upon ships engaged in the naval manœuvres, and it enables a battleship to communicate with a cruiser fifty or sixty miles away with greater ease than the same ship could be communicated with at a distance of ten miles in clear weather a year or two ago. But the *Times* special correspondent with one of the fleets remarks that the method, although independent of the weather, is still subject to one very serious drawback. The communication is not, and cannot be, a private or exclusive one, except so far as the messages are transmitted in cipher. Even so, every ship within range which is fitted with the necessary apparatus can take in the message, and if an enemy's ship is within range she can, by setting her own apparatus at work, break up the message and render it unintelligible. It is perhaps more politic to take it in clandestinely and work out the cipher—a thing which it is seldom very difficult to do and never altogether impossible if sufficient cipher material be obtained and sufficient time be devoted to the task. The moral is to employ as difficult a cipher as possible and to change it as soon as there is any reason to suspect the enemy has discovered it. But, even so, wireless telegraphy as at present practised is full of limitations and pitfalls which only experience can eliminate. It will never be quite satisfactory for war purposes until the transmitting instrument can be so adjusted as to emit vibrations of different pitch at the will of the operator and the receiving instrument rendered sensitive only to vibrations of a given pitch at a given moment. In that case, every ship in a fleet could have its own pitch and be sensitive only to messages addressed to itself in that particular pitch, while, unless an enemy within range happened to be attuned to the same pitch at the moment—a very unlikely contingency if the pitch were changeable at will—he would be powerless to intercept the message.

THE electrolytic dissociation theory of Arrhenius is severely criticised by Prof. Kahlenberg in a paper in the *Bulletin* of the University of Wisconsin (No. 47, February 1901), in which a great deal of experimental evidence in contradiction to the theory is brought forward. Prof. Kahlenberg has measured the conductivity of a number of electrolytes at 0° and 95° and calculated the degree of dissociation from these measurements as well as from determinations of the lowering of the freezing point and rise of the boiling point. The two sets of results he has thus obtained are far from concordant, from which he concludes that the dissociation theory is incorrect and doomed to early extinction. This theory, even though it has not met with universal acceptance, is not, we think, to be so easily overthrown, especially until some more satisfactory and fruitful alternative hypothesis is put forward to take its place. It is interesting to note that another American professor, Prof. H. C. Jones, of the Johns Hopkins University, is now contributing a series of valuable "Chapters in Electrochemistry" to the *Electrical Review* of New York, in which the subject is treated entirely from the point of view of the ionic theory, of which Prof. Jones is a vigorous adherent.

THE *Times* correspondent at Simla states that since the Pasteur Institute at Kasauli was opened a year ago, 321 patients have been treated, including 96 from the British Army and 50 European civilians. Not a single failure has occurred among the Europeans, but two natives died. Both of the latter had been badly bitten and arrived too late to be saved. The complete success of the Institute, which is under the charge of Major Semple, of the Army Medical Service, means a great saving to the Government, as soldiers need no longer be sent to Paris for treatment. It is hoped that funds will be provided to make possible the preparation of anti-toxins for enteric, snakebite and tetanus.

IT is a matter for regret when familiar names like Octopus have to disappear from the effective list, yet, according to Mr. Hoyle (*Manchester Memoirs*, xlv. No. 9), this must be replaced by Polypus on the ground of priority. In the same communication, the question is raised whether the name Histiopsis is preoccupied by Histiops—a point on which experts differ. In No. 4 of the same serial, Mr. Hoyle gives an instance of the danger of making genera and species on imperfect specimens. Part of a cuttlefish taken from a sperm-whale's stomach was referred to a new genus on account of its being apparently covered with regularly arranged quadrangular scales. Specimens recently acquired suggest that the appearance in question was due to decomposition.

THE secretary of the British South Africa Company has sent us a copy of the "Reports on the Administration of Rhodesia, 1898–1900," issued by the Company. One section is devoted to "Notes on the Fauna and Flora of North-eastern Rhodesia," by Mr. C. P. Chesnaye. From this we learn that the prospect of the survival in considerable numbers of the larger mammals and reptiles in the district to the west of Loangwa and in the swamps of Bangweolo and Mweru is very hopeful. The elephant is still met with in large herds, owing to its living for the greater part of the year in almost inaccessible swamps. The formation of a game-reserve to the east of Lake Mweru will probably largely aid in the preservation of this and other species, as it is believed that the elephants now hunted by Swahili traders to the south of Tanganyika will gradually retire to the reserve. Rhinoceroses are still fairly numerous, while hippopotamuses abound. The rinderpest which swept over the country in 1893 decimated the buffalo, eland and lichi antelope, but the country is gradually recovering from the scourge, and most districts are now very rich in game of all kinds, especially roan antelope, eland, Lichtenstein's hartebeest, puku, lichi and zebra. A few of the beautiful sable antelope still survive in the Mweru district, and around the north end of the lake the swamp-loving sitatunga antelope is plentiful. The rare sassabi hartebeest is restricted to a small area west of Lake Bangweolo. The dreaded tsetse-fly is stated to be prevalent in the valley of the Loangwa from the Zambesi to the confines of the Nyasa plateau, as well as in one other district, but to be absent from the greater portion of the Bangweolo country. Whether the latter part of the statement is true requires confirmation, but most of the territory seems free from "fly."

WE have received from the New Mexico College of Agriculture *Bulletin* No. 37, containing "Notes on the Food of Birds," by Mr. T. D. A. Cockerell. This is chiefly of local interest.

IN the *Bollettino* of the Italian Geographical Society, Signor Cesare Cipolletti continues his papers on the Argentine Republic, dealing with the regions of the Rio Negro and the Rio Colorado. Appended to a note on the Italian sphere of influence in Africa is a map showing the boundaries of the colony of Eritrea, compiled from official sources.

A PAPER by Herr S. Puchleitner in the *Mittheilungen* of the Vienna Geographical Society, on the glacial period in the Southern Carpathians, gives an excellent summary of recent research in this region, and more especially of de Martonne's valuable work on cirques. Dr. Kurt Hassert publishes an account of his journey through Montenegro during the summer of 1900, in the same number.

Petermann's Mittheilungen contains an article on the magnetic work to be undertaken by the German South Polar Expedition, by Dr. Bidlingmaier, the meteorologist and magnetician of the expedition. It includes the official programme of observations on the term days, and of the international scheme of cooperation, whereby it is hoped to obtain synoptic charts showing the magnetic condition of the whole globe on these days. Dr. Hans Gazert, the doctor of the Expedition, also contributes a paper on the bacteriological problems to be investigated.

A NUMBER of the *Abhandlungen* of the Vienna Geographical Society, just issued, contains a paper on the contrasts in climate on the east and west coast regions of continents in extra-tropical latitudes, by Dr. Ludwig Coellen. The author arranges the results of observations, chiefly obtained from tables published by Buchan, Hann and Woeikof, in such a way as to clearly bring out the salient points of difference; but it may be doubted if the selection of individual stations on which his generalisations are based is always satisfactory. We note that the direct influence of ocean currents is properly relegated to a secondary place.

IN a former paper on barisâl guns, &c., in the province of Umbria (*Boll. Soc. Sismol. Ital.*, vol. iii. 1897, pp. 222–234), Dr. Cancani attributes these phenomena to endogenous causes. He continues the subject in the last number of the same journal (vol. vii. 1901, pp. 23–47), describing similar noises which have been observed in the districts round Isernia and Cosenza and in Umbria and Latium. In the latter case he argues that the sounds were neither of artificial nor of atmospheric origin; and, as slight tremors were noticed in some instances to accompany them, his views receive considerable support from the recent observations.

MEMOIRS and notes upon many aspects of polar exploration are included in the "Antarctic Manual" prepared for the use of the members of the British Antarctic expedition. Mr. George Murray, F.R.S., is the editor of the manual, and Sir Clements Markham, K.C.B., contributes a preface in which he surveys the contents, and remarks that the volume "is presented to the expedition by the president and council of the Royal Geographical Society," so that the Royal Society is not officially concerned with the work. Among the subjects of papers in the volume are:—ice nomenclature, astronomical data, tidal observations, pendulum observations, terrestrial magnetism, climate, wave observations, the aurora, atmospheric electricity, chemical and physical notes, geology, volcanoes and volcanic action, ice observations, the collection of rocks and minerals, zoology, botany, sledge-travelling, geography, and an Antarctic bibliography. The manual thus contains in a compact form practically all that is known about South Polar regions, and also records of experience in Arctic exploration.

THE additions to the Zoological Society's Gardens during the past week include a Crab-eating Raccoon (*Procyon cancrivorus*) from South America, presented by Mr. George Lancefield; a Wild Swine (*Sus scrofa*) from Persia, presented by Mr. B. T. Ffinch; a Cardinal Grosbeak (*Cardinalis virginianus*), two Bluebirds (*Sialia wilsoni*) from North America, presented by Colonel Ashburner; a Golden Eagle (*Aquila chrysaëtos*) from Scotland, presented by Mr. J. Monro Walker; two Stone Curlews (*Œdicnemus scolopax*), British, presented by Mr. A. E. Chaplin; an Orange-cheeked Waxbill (*Estrelda melpoda*) from West Africa, presented by Mr. W. S. Primley; a Kinkajou (*Cercoleptes caudivolvulus*) from South America, deposited; a Hoffmann's Sloth (*Cholopus hoffmanni*) from Panama, purchased.

OUR ASTRONOMICAL COLUMN.

ENCKE'S COMET.—A telegram sent out from Harvard College Observatory announces that the first observation of this periodic comet was made by Prof. Wilson at Northfield, on Monday evening, August 5.

The determination of position was as follows:—

$$\left.\begin{array}{l}\text{R.A.} = 6\text{h. } 2\text{m. } 2{\cdot}8\text{s.}\\ \text{Decl.} = +31^\circ\ 42'\ 30''\end{array}\right\}(1901).\quad \begin{array}{c}\text{August 5d. 9h. 25m. 3s.}\\ \text{G.M.T.}\end{array}$$

OBSERVATIONS OF MARS.—In the *Bulletin de la Soc. Astronomique de France* (1901, pp. 345–355), MM. Flammarion and Antoniadi give an account of their new observations of the planet Mars made at the Juvisy Observatory during the period 1900 October 23 and 1901 July 6. Two charts are given, one showing the northern hemisphere as a polar projection, the other giving the zone from +80° to −50° lat. on Mercator's projection.

Tables are given showing the varying dimensions of the North Polar snow-cap, which at the summer solstice had a diameter of about twenty degrees. The charts are described in detail, showing the differences from former observations. Attention is again drawn to the half-tone shading which apparently extends over the northern hemisphere from the pole to latitude 45°, limited towards the south by the region containing the canali.

At Juvisy, fifty canali have been seen, forty-six of which agree with the observations of Schiaparelli, and one from the list of Cerulli. Only three cases of gemination have been noticed, the most prominent being Cerberus and Casius, which were visible without difficulty. The Styx was also suspected of duplicity, but the components were not sharply separated.

VARIATIONS OF THE MAGNETIC NEEDLE.—M. Souleyre commences a discussion of the possible causes of the variations of the magnetic needle, and in his first article outlines the production of currents and other disturbances in the solar corona by the action of the planets, these reacting on the supposed electrical constitution of the corona and other solar surroundings. The extension of the theory to explain the periodicity of sunspots, terrestrial magnetic storms and auroræ is then presented, special attention being given to the effect of planetary disturbance (*Bull. Soc. Ast. de France*, 1901, pp. 362–370).

VARIATION OF EROS.—Supplementing his recent note, M. André furnishes a few further particulars concerning the form of light-curve and amplitude of the determined variation, in *Comptes rendus* (cxxxiii. pp. 324–326). When observed on the same evening, the minima of two orders were not quite identical. The form of the light-curve in the neighbourhood of the minima did not sensibly change during the observations, but a considerable degree of change has occurred about the points of maxima. A table is included showing the amplitudes of the variation observed on nineteen evenings during February, March and April, 1901, ranging from 2·0 magnitudes to zero.

ORBITS OF ALGOL VARIABLES, RR PUPPIS AND V PUPPIS.—Dr. A. W. Roberts has computed the characteristic features of the orbits of these two variables from observations secured at his private observatory, Lovedale, South Africa. Of the two variables, V Puppis is specially interesting from the fact that it is a spectroscopic binary, so that more refined measurements in the line of sight may possibly enable the absolute masses of the system to be determined.

RR Puppis.—

$$\left.\begin{array}{l}\text{R.A.} = 7\text{h. } 43\text{m. } 31\text{s.}\\ \text{Decl.} = -41^\circ\ 7'{\cdot}6\end{array}\right\}(1900{\cdot}0).$$

This star has been under observation for nearly twelve months, and some 200 measures obtained. The period adopted is

6d. 10h. 19·6m.,

and the light-curve based on this value is given, with an enlarged diagram of the part near minimum. The curve is almost identical in form with that of S Velorum. Other details are as follows:—

Limits of variation are 9·1 and 10·8 magnitude.
Duration of increasing or decreasing phase = 4h. 15m.
Stationary period at minimum = 8h. 30m.

The system thus apparently consists of two bodies, one of which is *three* times the diameter of the other. The smaller star is nearly twice as bright as the larger one, and the distance between their circumferences is about two-thirds of the radius of the orbit. The density of the system is probably not more than one-sixth that of the sun.

V Puppis.

R.A. = 7h. 55m. 22s. } (1900·0).
Decl. = − 48° 58′·4 }

This star differs from the preceding one in that it consists of two bodies of about equal size and brightness. The mean period, as deduced from the light variation, is

1d. 10h. 54m. 26·7s.

The light-curve of this star is strikingly similar to that of U Pegasi, showing double and *unequal minima*, and double and *equal maxima*.

Prof. Pickering, however, from spectroscopic determinations, deduces a period of

3d. 2h. 46m.

From the peculiarity of there being no stationary period at either maximum, Dr. Roberts infers that the two component stars revolve around each other *in actual contact*. Under such conditions, both bodies would most probably undergo distortion. The value derived for the density of V Puppis is 0·07 that of the sun, the orbit being circular.

POLISH.[1]

THE lecture commenced with a description of a home-made spectroscope of considerable power. The lens, a plano-convex of 6 inches aperture and 22 feet focus, received the rays from the slit, and finally returned them to a pure spectrum formed in the neighbourhood. The skeleton of the prism was of lead; the faces, inclined at 70°, were of thick plate-glass cemented with glue and treacle. It was charged with bisulphide of carbon, of which the free surface (of small area) was raised above the operative part of the fluid. The prism was traversed twice, and the effective thickness was 5½ inches, so that the resolving power corresponded to 11 inches, or 28 cm., of CS_2. The liquid was stirred by a perforated triangular plate, nearly fitting the prism, which could be actuated by means of a thread within reach of the observer. The reflector was a *flat*, chemically silvered in front.

So far as eye observations were concerned, the performance was satisfactory, falling but little short of theoretical perfection. The stirrer needed to be in almost constant operation, the definition usually beginning to fail within about twenty seconds after stopping the stirrer. But although the stirrer was quite successful in maintaining uniformity of temperature as regards *space*, *i.e.* throughout the dispersing fluid, the temperature was usually somewhat rapidly variable with *time*, so that photographs requiring more than a few seconds of exposure showed inferiority. In this respect a grating is more manageable.

The lens and the faces of the prism were ground and polished (in 1893) upon a machine kindly presented by Dr. Common. The flat surfaces were tested with a spherometer, in which a movement of the central screw through 1/100000 inch could usually be detected by the touch. The external surfaces of the prism faces were the only ones requiring accurate flatness. In polishing, the operation was not carried as far as would be expected of a professional optician. A few residual pittings, although they spoil the appearance of a surface, do not interfere with its performance, at least for many purposes.

In the process of grinding together two glass surfaces, the particles of emery, even the finest, appear to act by *pitting* the glasses, *i.e.* by breaking out small fragments. In order to save time and loss of accuracy in the polishing, it is desirable to carry the grinding process as far as possible, using towards the close only the finest emery. The limit in this direction appears to depend upon the tendency of the glasses (6 inches diameter) to *seize*, when they approach too closely, but with a little care it is easy to attain such a fineness that a candle is seen reflected at an angle of incidence not exceeding 60°, measured as usual from the perpendicular.

The fineness necessary, in order that a surface may reflect and refract regularly without diffusion, viz. in order that it may appear *polished*, depends upon the wave-length of the light and upon the angle of incidence. At a grazing incidence all surfaces behave as if polished, and a surface which reflects red light pretty well may fail signally when tested with blue light at the same angle. If we consider incidences not too far removed from the perpendicular, the theory of gratings teaches that a regularly corrugated surface behaves as if absolutely plane, provided that the *wave-length* of the corrugations is less than the wave-length of the light, and this without regard to the *depth* of the corrugations. Experimental illustrations, drawn from the

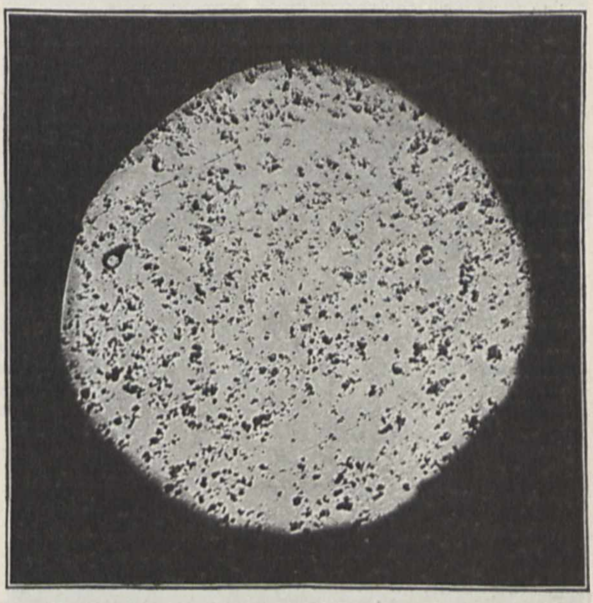

FIG. 1.

sister science of acoustics, were given. The source was a bird-call from which issued vibrations having a wave-length of about 1·5 cm., and the percipient was a high-pressure sensitive flame. When the bird-call was turned away, the flame was silent, but it roared vigorously when the vibrations were reflected back upon it from a plate of glass. A second plate, upon which small pebbles had been glued so as to constitute an ideally rough surface, acted nearly as well, and so did a piece of tin plate suitably corrugated. In all these cases the reflection was *regular*, the flame becoming quiet when the plates were turned out of adjustment through a very small angle. In another method of experimenting the incidence was absolutely perpendicular, the flame being exposed to both the incident and the reflected waves. It is known that under these circumstances the flame remains quiescent at the *nodes* and flares most vigorously at the *loops*. As the reflector is drawn slowly back, the flame passes alternately through the nodes and loops, thus executing a cycle of changes as the reflector moves through *half* a wave-length. The effects observed were just the same whether the reflector were smooth or covered with pebbles, or whether the corrugated tin plate were substituted. All surfaces were smooth *enough* in relation to the wave-length of the vibration to give substantially a specular reflection.

Finely ground surfaces are still too coarse for perpendicular specular reflection of the longest visible waves of light. Here the material may be metal, or glass silvered chemically on the

[1] A discourse delivered at the Royal Institution on Friday, March 29, by the Right Hon. Lord Rayleigh, F.R.S.

face subsequently to the grinding. But experiment is not limited by the capabilities of the eye; and it seems certain that a finely ground surface would be smooth enough to reflect without sensible diffusion the longest waves, such as those found by Rubens to be nearly 100 times longer than the waves of red light. An experiment may be tried with radiation from a Leslie cube containing hot water, or from a Welsbach mantle (without a chimney). In the lecture the latter was employed, and it fell first at an angle of about 45° upon a finely ground flat glass silvered in front. By this preliminary reflection, the radiation was purified from waves other than those of considerable wave-length. The second reflection (also at 45°) was alternately from polished and finely ground silvered surfaces of the same size, so mounted as to permit the accurate substitution of the one for the other. The heating-power of the radiation thus twice reflected was tested with a thermopile in the usual manner. Repeated comparisons proved that the reflection from the ground surface was about 0·76 of that from the polished surface, showing that the ground surface reflected the waves falling upon it with comparatively little diffusion. A slight rotation of any of the surfaces from their proper positions at once cut off the effect. It is probable that the device of submitting radiation to preliminary reflections from one or more merely ground surfaces might be found useful in experiments upon the longest waves.

the emery is backed by a hard surface, *e.g.* of glass, while during the polishing the powder (mostly rouge in these experiments) is imbedded in a comparatively yielding substance, such as pitch. Under these conditions, which preclude more than a moderate pressure, it seems probable that no pits are formed by the breaking out of fragments, but that the material is worn away (at first, of course, on the eminences) almost molecularly.

The progress of the operation is easily watched with a microscope, provided, say, with a ¼-inch object-glass. The first few minutes suffice to effect a very visible change. Under the microscope it is seen that little facets, parallel to the general plane of the surface, have been formed on all the more prominent eminences.[1] The facets, although at this stage but a very small fraction of the whole area, are adequate to give a sensible specular reflection, even at perpendicular incidence. On one occasion five minutes' polishing of a rather finely ground glass surface was enough to qualify it for the formation of interference bands, when brought into juxtaposition with another polished surface, the light being either white or from a soda flame; so that in this way an optical test can be applied almost before the polishing has begun.[2]

As the polishing proceeds, the facets are seen under the microscope to increase both in number and in size, until they occupy much the larger part of the area. Somewhat later the

FIG. 2.

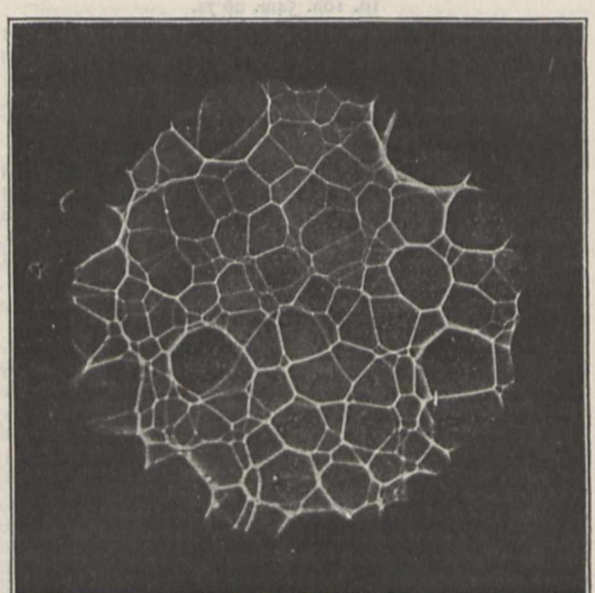

FIG. 3.

In view of these phenomena we recognise that it is something of an accident that polishing processes, as distinct from grinding, are needed at all; and we may be tempted to infer that there is no essential difference between the operations. This appears to have been the opinion of Herschel,[1] whom we may regard as one of the first authorities on such a subject. But although, perhaps, no sure conclusion can be demonstrated, the balance of evidence appears to point in the opposite direction. It is true that the same powders may be employed in both cases. In one experiment a glass surface was polished with the same emery as had been used effectively a little earlier in the grinding. The difference is in the character of the backing. In grinding,

[1] "Enc. Met.," Art. Light, p. 477, 1830: "The intensity and regularity of reflection at the external surface of a medium is found to depend, not merely on the nature of the medium, but very essentially on the degree of smoothness and polish of its surface. But it may reasonably be asked how any regular reflection can take place on a surface polished by art, when we recollect that process of polishing is, in fact, nothing more than grinding down large asperities into smaller ones by the use of hard gritty powders, which, whatever degree of mechanical comminution we may give them, are yet vast masses, in comparison with the ultimate molecules of matter, and their action can only be considered as an irregular tearing up by the roots of every projection that may occur in the surface. So that, in fact, a surface artificially polished must bear somewhat of the same kind of relation to the surface of a liquid, or a crystal, that a ploughed field does to the most delicately polished mirror, the work of human hands."

parts as yet untouched by the polisher appear as pits, or spots, upon a surface otherwise invisible. Fig. 1 represents a photograph of a surface at this stage taken with the microscope. The completion of the process consists in rubbing away the whole surface down to the level of the deepest pits. The last part of the operation, while it occupies a great deal of time and entails further risk of losing the "truth" of the surface, adds very little to the effective area or to the intensity of the light regularly reflected or refracted.

Perhaps the most important fact taught by the microscope is that the polish of individual parts of the surface does not improve during the process. As soon as they can be observed at all, the facets appear absolutely structureless. In its subsequent action the polishing tool, bearing only upon the parts already polished, extends the boundary of these parts, but does not enhance their quality. Of course, the mere fact that no structure can be perceived does not of itself prove that pittings may not be taking place of a character too fine to be shown by

[1] The interpretation is facilitated by a thin coating of aniline dye which attaches itself mainly to the hollows.

[2] With oblique incidence, as in Talbot's experiments (see *Phil. Mag.*, xxviii. p. 191, 1889), achromatic bands may be observed from a surface absolutely unpolished, but this disposition would not be favourable for testing purposes.

a particular microscope or by any possible microscope. But so much discontinuity, as compared with the grinding action, has to be admitted in any case that one is inevitably led to the conclusion that in all probability the operation is a molecular one, and that no coherent fragments containing a large number of molecules are broken out. If this be so, there would be much less difference than Herschel thought between the surfaces of a polished solid and of a liquid.

Several trials have been made to determine how much material is actually removed during the polishing of glass. In one experiment a piece 6 inches in diameter, very finely ground, was carefully weighed at intervals during the process. Losses of ·070, ·032, ·045, ·026, ·032 gm. were successively registered, amounting in all to ·205 gm. Taking the specific gravity of the glass as 3, this corresponds to a thickness of $3 \cdot 6 \times 10^{-4}$ cm., or to about 6 wave-lengths of mean light, and it expresses the distance between the original *mean* surface and the final plane. But the polish of this glass, though sufficient for most practical purposes, was by no means perfect. Probably the 6 wave-lengths would have needed to be raised to 10 in order to satisfy a critical eye. It may be interesting to note for comparison that, in the grinding, one charge of emery, such as had remained suspended in water for seven or eight minutes, removed a thickness of glass corresponding to 2 wave-lengths.

In other experiments the thickness removed in polishing was determined optically. A very finely ground disc was mounted in the lathe and polished locally in rings. Much care was needed to obtain the desired effect of a ring showing a continuously increasing polish from the edges inwards. To this end it was necessary to keep the polisher (a piece of wood covered with resin and rouge) in constant motion, otherwise a number of narrow grooves developed themselves.

The best ring was about half an inch wide. When brought into contact with a polished flat and examined at perpendicular incidence with light from a soda flame, the depression at its deepest part gave a displacement of three bands, corresponding to a depth of $1\frac{1}{2}\lambda$. On a casual inspection this central part appeared well polished, but examination under the microscope revealed a fair number of small pits. Further working increased the maximum depth to $2\frac{1}{2}\lambda$, when but very few pits remained. In this case, then, polish was effected during a lowering of the mean surface through 2 or 3 wave-lengths, but the grinding had been exceptionally fine.

It may be well to emphasise that the observations here recorded relate to a *hard* substance. In the polishing of a soft substance, such as copper, it is possible that material may be loosened from its original position without becoming detached. In such a case pits may be actually filled in, by which the operation would be much quickened. Nothing suggestive of this effect has been observed in experiments upon glass.

Another method of operating upon glass is by means of hydrofluoric acid. Contrary to what is generally supposed, this action is extremely regular, if proper precautions are taken. The acid should be weak, say one part of commercial acid to two hundred of water, and it should be kept in constant motion by a suitable rocking arrangement. The parts of the glass not intended to be eaten into are, as usual, protected with wax. The effect upon a polished flat surface is observed by the formation of Newton's rings with soda light. After perhaps three-quarters of an hour, the depression corresponds to half a band, *i.e.* amounts to $\frac{1}{4}\lambda$, and it appears to be uniform over the whole surface exposed. Two pieces of plate glass, 3 inches square, and flat enough to come into fair contact all over, were painted with wax in parallel stripes and submitted to the acid for such a time, previously ascertained, as would ensure an action upon the exposed parts of $\frac{1}{4}\lambda$. After removal of the wax, the two plates, crossed and pressed into contact so as to develop the colours, say of the second order, exhibited a chess-board pattern. Where two uncorroded, or where two corroded, parts are in contact, the colours are nearly the same, but where a corroded and an uncorroded surface overlap, a strongly contrasted colour is developed. The combination lends itself to lantern projection, and the pattern upon the screen [shown] is very beautiful, if proper precautions are taken to eliminate the white light reflected from the first and fourth surfaces of the plates.

In illustration of the action of hydrofluoric acid, photographs[1]

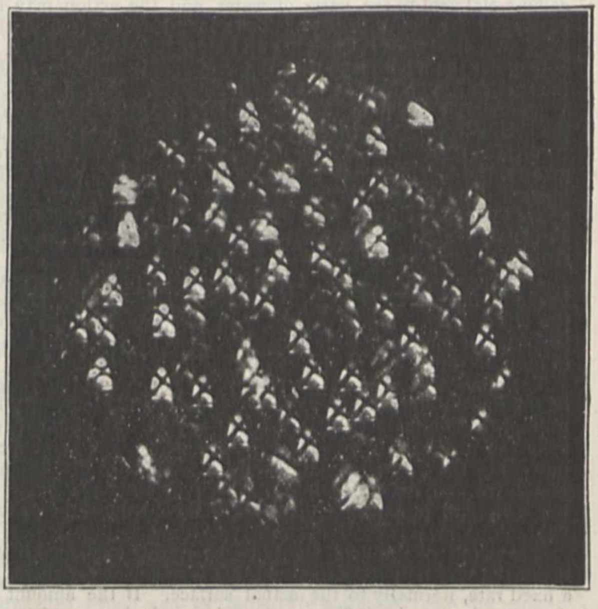

FIG. 4.

were shown of interference bands as formed by soda light between glass surfaces, one optically flat and the other ordinary plate, upon which a drop of dilute acid had been allowed to stand (Fig. 2) Truly plane surfaces would give bands straight, parallel and equidistant.

Hydrofluoric acid has been employed with some success to correct ascertained errors in optical surfaces. But while im-

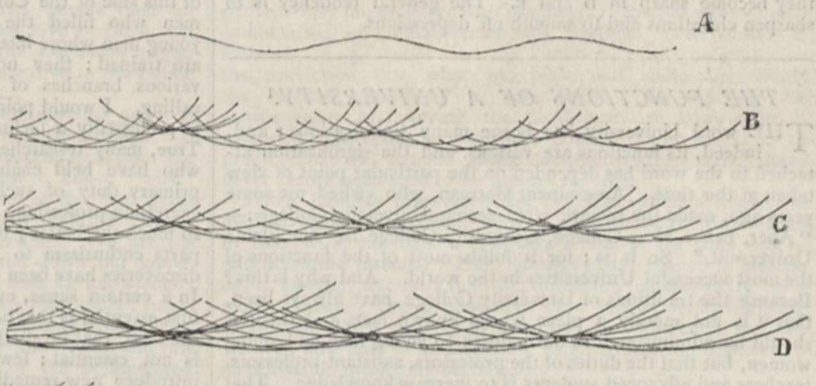

FIG. 5.

provements in actual optical performance have been effected, the general appearance of a surface so treated is unprepossessing. The development of latent scratches has been described on a former occasion.[2]

A second obvious application of hydrofluoric acid has hitherto been less successful. If a suitable stopping could be

[1] The plates were sensitised in the laboratory with cyanine.
[2] *Proc.* Roy. Inst., March, 1893.

found by which the deeper pits could be protected from the action, corrosion by acid could be used in substitution for a large part of the usual process of polishing.

In connection with experiments of this sort, trial was made of the action of the acid upon finely ground glass, such, for example, as is used as a backing for stereoscopic transparencies, and very curious results were observed. For this purpose the acid may conveniently be used much stronger, say one part of commercial acid to ten parts of water, and the action may be prolonged for hours or days. The general appearance of the glass after treatment is smoother and more translucent, but it is only under the microscope that the remarkable changes which the surface has undergone become intelligible. Fig. 3 is from a photograph taken in the microscope, the focus being upon the originally ground surface itself. The whole area is seen to be divided into cells. These cells increase as the action progresses, the smaller ones being, as it were, eaten up by the bigger. The division lines between the cells are *ridges*, raised above the general level, and when seen in good focus appear absolutely sharp. The general surface within the cells shows no structure, being as invisible as if highly polished.

That each cell is, in fact, a concave lens, forming a separate image of the source of light, is shown by slightly screwing out the object-glass. Fig. 4 was taken in this way from the same surface, the source of light being the flame of a paraffin lamp, in front of which was placed a cross cut from sheet-metal.

The movement required to pass from the ridge to the image of the source, equal to the focal length (f) of the lens, may be utilised to determine the depth (t) of a cell. In one experiment the necessary movement was ·005 inch. The semi-aperture (y) of the "lens" was 0015 inch, whence by the formula $y^2 = ft$, we find $t =$ ·00045 inch. This represents the depth of the cell, and it amounts to about 8 wave-lengths of yellow light.

The action of the acid seems to be readily explained if we make the very natural supposition that it eats in everywhere, at a fixed rate, normally to the actual surface. If the amount of the normal corrosion after a proposed time be known, the new surface can be constructed as the "envelope" of spheres having the radius in question and centres distributed over the old surface. Ultimately, the new surface becomes identified with a series of spherical segments having their centres at the deeper pits of the original surface. The construction is easily illustrated in the case of two dimensions. In the figure (Fig. 5) A is supposed to be the original surface; B, C, D, E surfaces formed by corrosion, being constructed by circles having their centres on A. In B the ridges are still somewhat rounded, but they become sharp in D and E. The general tendency is to sharpen elevations and to smooth off depressions.

THE FUNCTIONS OF A UNIVERSITY.[1]

THE word University has borne many significations; and, indeed, its functions are various, and the signification attached to the word has depended on the particular point of view taken at the time. An eminent German, who visited me some years ago, made the remark after seeing University College:—"Aber, lieber Herr College, University College ist eine kleine Universität." So it is; for it fulfils most of the functions of the most successful Universities in the world. And why is this? Because the traditions of University College have always been, that it is not merely a place where known facts and theories should be administered in daily doses to young men and young women, but that the duties of the professors, assistant-professors, teachers and advanced students is to increase knowledge. That is the chief function of a University—to increase knowledge. But it is not the only one.

A University has always been regarded as a training school for the "learned professions," *i.e.* for theology, law and medicine. The terms of our charter have excluded the first of these branches of knowledge. Founded as it was in the '20's, when admission to Oxford or Cambridge involved either belief in the tenets of the Church of England or insincerity, it was not possible to provide courses in theology which should be acceptable to Nonconformists, Jews and others who desired education. On the whole, it appears to me better that a subject about which so much difference of opinion exists should be taught in a separate institution. There are many branches of knowledge which can be adequately discussed without intruding into any sphere of religious controversy; and, indeed, it would be difficult, I imagine, to treat mathematics or chemistry from a sectarian standpoint. I at least have never tried. There are subjects which may be placed on the border-line, for example, philosophy; but such subjects, and they are few in number, might well form part of the curriculum of the theological college, if thought desirable. It is a thousand pities that instead of founding King's College a theological college had not been established in the immediate neighbourhood of University College; it would have strengthened us, and it would have tended, too, to the advantage of the Church of England. However, what is done can't be undone; and let us wish all prosperity to our sister College, and a long and a useful life. We are now friends, and have been friends for many years. May that friendship long continue!

Dismissing the faculty of theology, therefore, as out of our power, as well as beyond our wishes, let us turn to the remaining two learned professions. University College, I believe, was the first place in England where a systematic legal education could be obtained. Our chairs of Roman law, constitutional law and jurisprudence were the first to be established in England, although such chairs had for long been known on the Continent, and in Scotland. "Imitation is the sincerest flattery," and in the fulness of time the Inns of Court started a school of their own. Our classes, which used to be crowded, dwindled, and our law-school is certainly not our strongest feature. I am not sufficiently acquainted with English legal education to pronounce an opinion as to whether methods of training as they at present exist in England are the most effective; I have heard rumours that they are not. That must be left to specialists to decide. But arguing from the experience of another faculty, in which the apprenticeship system once existed, and which has changed that system with a view to reform, and judging, too, from the experience abroad and in Scotland, I venture to think that some improvement in legal education is possible. If that opinion is correct, it is surely not too much to hope that the claims of University College may be considered as having made the first attempt to systematise legal education in England.

The faculty of medicine has existed in a flourishing state since the inception of University College. Not long after the College was built, the Hospital buildings, of which we have the last unsightly remains still before our eyes, were erected. One of my predecessors on a similar occasion to this has given you an entrancing account of the early history of this side of the College, and has discoursed on the eminent men who filled the chairs in the medical faculty. Here young men whose intention it is to enter the medical profession are trained; they now receive five years' instruction in the various branches of knowledge bearing on their important calling. I would point out that this function of a University is professedly a technical one—the training of medical men. True, many researches have been made by the eminent men who have held chairs in this faculty; but that is not the primary duty of such men; their duty is to train others to exercise a profession. If they advance their subject in doing so, so much the better; it increases the fame of the school, it imparts enthusiasm to their students, and in many cases their discoveries have been of unspeakable benefit to the human race. In a certain sense, every medical man is an investigator; the first essential is that he shall be able to make a correct diagnosis; the next, that he shall prescribe correct treatment. But novelty is not essential; few men evolve new surgical operations or introduce new remedies, and though we have in the past had not a few such, they are not essential for a successful medical school, the object of which is to train good practical working physicians and surgeons. The teaching staff of the medical faculty must of necessity be almost all engaged in practice, and, indeed, it would be unfortunate for their students if they were merely theoretical teachers. Let me again recapitulate my point; the medical faculty is essentially a technical faculty; the hospital is its workshop.

In England, of recent years, schools of engineering have been attached to the Universities. Abroad and in America they are separate establishments, and are sometimes attached to large engineering shops, where the pupils pursue their theoretical and practical studies together, taking the former in the morning, the latter in the afternoon. Here again the subject is a professional

[1] Oration delivered at University College, London, on June 6, by Prof. W. Ramsay, F.R.S.

one. The object of the student is to become a practical engineer, and all his work is necessarily directed to that end. Like other workers in different fields, his aim is the acquisition and utilisation of "power," but in his case it is his object to direct mechanical and electrical power so as to add to the convenience of the public. A machine is an instrument for converting heat or electrical energy into what is termed "kinetic energy," and it is with the laws and modes of this conversion that he has to deal. Such abstract sciences as chemistry, physics and geology, therefore, are studied as means to an end, not for their own sakes. They afford him a glimpse of the principles on which his engineering practice is based; and mathematics is essential in order that he may be able to apply physical principles to the practical problems of his profession.

We see, then, that a University, as it at present exists, provides, or may provide, technical instruction for theologians, for lawyers, for medical men and for engineers. It is, in fact, an advanced technical school for these subjects.

But it is more, and I believe that its chief function lies in the kind of work which I shall attempt now to describe. The German Universities possess what they term a "philosophical faculty"; and this phrase is to be accepted in the derivational meaning of the word—a faculty which befriends wisdom or learning. The watchword of the members of this faculty is research; the searching out the secrets of nature, to use a current phrase, or the attempt to create new knowledge. The whole machinery of the philosophical faculty is devised to achieve this end; the selection of the teachers, the equipment of the laboratories and libraries, the awarding of the degrees.

What are the advantages of research? Much is heard nowadays regarding the necessity of State-provision for its encouragement, and the Government places at the disposal of the Royal Society a sum of no less than 4000*l*. a year, which is distributed in the form of grants to applicants who are deemed suitable by committees appointed to consider their claims to assistance.

There are two views regarding the advantage of research which have been held. The first of these may be termed the utilitarian view. You all know the tale of the man of science who was asked the use of research and who parried with the question—What is the use of a baby? Well, I imagine that one school of political economists would oppose the practice of child-murder on the ground that potentially valuable property was being destroyed. These persons would probably not be those who stood to the baby in a parental relation. Nor are the most successful investigators those who pursue their inquiries with the hope of profit, but for the love of them. It is, however, a good thing, I believe, that the *profanum vulgus* should hold the view that research is remunerative to the public—as some forms of it undoubtedly are.

The second view may be termed the philosophical one. It is one held by lovers of wisdom in all its various forms. It explains itself, for the human race is differentiated from the lower animals by the desire which it has to know "why." You may have noticed, as I have, that one of the first words uttered by that profound philosopher, a small child, is "why." Indeed, it becomes wearisome by its iteration. We are the superiors of the brutes in that we can hand down our knowledge. It may be that some animals also seek for knowledge; but at best it is of use to themselves alone; they cannot transmit it to their posterity, except, possibly, by the way of hereditary faculties. We, on the contrary, can write and read; and this places us, if we like, in the possession of the accumulated wisdom of the ages.

Now the most important function, I hold, of a University is to attempt to answer that question, "why?" The ancients tried to do so; but they had not learned that its answer must be preceded by the answer to the question, "how?" and that in most cases—indeed in all—we must learn to be contented with the answer to "how?" The better we can tell *how* things are, the more nearly shall we be able to say *why* they are.

Such a question is applicable to all kinds of subjects; to what our forerunners on this earth did; how they lived; if we go even further back, what preceded them on the earth. The history of these inquiries is the function of geology, palæontology and palæontological botany; it is continued through archæology, Egyptian and Assyrian, Greek and Roman; it evolves into history, and lights are thrown on it by languages and philology; it dovetails with literature and economics. In all these, research is possible; and a University should be equipped for the successful prosecution of inquiries in all such branches.

Another class of inquiries relates to what we think and how we reason; and here we have philosophy and logic. A different branch of the same inquiry leads us to mathematics, which deals with spatial and numerical concepts of the human mind, geometry and algebra. By an easy transition we have the natural sciences; those less closely connected with ourselves as persons, but intimately related to our surroundings. Zoology and botany, anatomy, physiology and pathology deal with living organisms as structural machines, and they are based on physics and chemistry, which are themselves dependent on mathematics.

Such inquiries are worth making for their own sakes. They interest a large part of the human race, and not to feel interested in them is to lack intelligence. The man who is content to live from day to day, glad if each day will but produce him food to eat and a roof to sleep under, is but little removed from an uncivilised being. For the test of civilisation is *prevision*; care to look forward; to provide for to-morrow; the to-morrow of the race, as well as the to-morrow of the individual; and he who looks furthest ahead is best able to cope with nature, and to conquer her.

The investigation of the unknown is to gather experience from those who have lived before us, and to secure knowledge for ourselves and for those who will succeed us. I see, however, that I am insensibly taking a utilitarian view; I by no means wish to exclude it, but the chief purpose of research must be the acquisition of knowledge, and the second its utilisation.

I will try to explain why this is so, and here you must forgive me if I cite well-known and oft-quoted instances.

If attempts were made to discover only useful knowledge (and by useful I accept the vulgar definition of profitable, *i.e.* knowledge which can be directly transmitted into its money equivalent) these attempts would, in many, if not in most, cases fail of their object. I do not say that once a principle has been proved and a practical application is to be made of it that the working out of the details is not necessary. But that is best done by the practical man, be he the parson, the doctor, the engineer, the technical electrician or the chemist, and best of all on a fairly large scale. If, however, the practical end is always kept in view, the chances are that there will be no advance in principles. Indeed, what we investigators wish to be able to do, and what in many cases we can do, although perhaps very imperfectly, is to prophesy, to foretell what a given combination of circumstances will produce. The desire is founded on a belief in the uniformity of nature; on the conviction that what has been will again be, should the original conditions be reproduced. By studying the consequences of varying the conditions our knowledge is extended; indeed, it is sometimes possible to go so far as to predict what will happen under conditions, all of which have never before been seen to be present together.

When Faraday discovered the fact that when a magnet is made to approach a coil of wire an electric current is induced in that wire, he made a discovery which at the time was of only scientific interest. That discovery has resulted in electric light, electric traction and the utilisation of electricity as a motive power; the development of a means of transmitting energy, of which we have by no means seen the end; nay, we are even now only at its inception, so great must the advance in its utilisation ultimately become.

When Hofmann set Perkin as a young student to investigate the products of oxidation of the base aniline, produced by him from coal-tar, it would have been impossible to have predicted that one manufactory alone would possess nearly 400 large buildings and employ 5000 workmen, living in its own town of 25,000 inhabitants, all of which is devoted to the manufacture of colours from aniline and other coal-tar products. In this work alone at least 350 chemists are employed, most of whom have had a University training.

Schönbein, a Swiss schoolmaster interested in chemistry, was struck by the action of nitric acid on paper and cotton. He would have been astounded if he had been told that his experiments would have resulted in the employment of his nitro-celluloses in colossal quantity for blasting, and for ordnance of all kinds, from the 90-ton gun to the fowling-piece.

But discoveries such as these, which lead directly to practical results, are yet far inferior in importance to others in which a general principle is involved. Joule and Robert Mayer, who proved the equivalence of heat and work, have had far more influence on succeeding ages than even the discoverers above mentioned, for they have imbued a multitude of minds with a correct understanding of the nature of energy and the possibility of converting it economically into that form in which it is most directly useful for the purpose in view. They have laid the basis of reasoning for *machines;* and it is on machines, instruments for converting unavailable into available energy, that the prosperity of the human race depends.

You will see from these instances that it is in reality "philosophy" or a love of wisdom which, after all, is most to be sought after. Like virtue, it is its own reward; and as we all hope is the case with virtue too, it brings other rewards in its train, not, be it remarked, always to the philosopher, but to the race. Virtue, pursued with the direct object of gain, is a poor thing; indeed, it can hardly be termed virtue if it is dimmed by a motive. So philosophy, if followed after for profit, loses its meaning.

But I have omitted to mention another motive which makes for research; it is a love of pleasure. I can conceive no pleasure greater than that of the poet—the maker—who wreathes beautiful thoughts with beautiful words; but next to this I would place the pleasure of discovery, in whatever sphere it be made. It is a pleasure, not merely to the discoverer, but to all who can follow the train of his reasoning. And after all, the pleasure of the human race, or of the thinking portion of it, counts for a good deal in this life of ours.

To return. Attempts at research, guided by purely utilitarian motives, generally fail in their object, or at least are not likely to be so productive as research without ulterior motive. I am strengthened in this conclusion by the verdict of an eminent German who has himself put the principle into practice; who after following out a purely theoretical line of experiment, which at first appeared remote from profit, has been rewarded by its remunerative utilisation. He remarked, incidentally, that the professors in polytechnika—(what we should term technical colleges, intended to prepare young men for the profession of engineering and technical chemistry)—were less known for their influence on industry than University professors. The aim is different in the two cases; the polytechnika train men for a profession, the philosophical faculty of German Universities aims at imparting a love of knowledge; and, as a matter of fact, the latter *pay* in their influence on the prosperity of the nation better than the former. And this brings me to the fundamental theme of my oration. It is this:—That the best preparation for success in any calling is the training of the student in methods of research. This should be the goal to be clearly kept in view by all teachers in the philosophical faculties of Universities. They should teach with this object:—to awaken in their students a love of their subject and a consciousness that if he persevere, he, too, will be able to extend its bounds.

Of course, it is necessary for the student to learn, so far as is possible, what has already been done. I would not urge that a young man should not master, or at all events learn, a great deal of what has been already discovered before he attempts to soar on his own wings. But there is all the difference in the world between the point of view of the student who reads in order to qualify for an examination, or to gain a prize or a scholarship, and the student who reads because he knows that thus he will acquire knowledge which may be used as a basis of new knowledge. It is that spirit in which our Universities in England are so lamentably deficient; it is that spirit which has contributed to the success of the Teutonic nations, and which is beginning to influence the United States. For this condition of things our examinational system is largely to blame; originally started to cure the abuses of our Civil Service, it has eaten into the vitals of our educational system like a canker, and it is fostered by the further abuse of awarding scholarships as the results of examinations. The pauperisation of the richer classes is a crying evil; it must some day be cured. Let scholarships be awarded to those who need them, not to those whose fathers can well afford to pay for the education of their children. "Pot-hunting" and philosophy have absolutely nothing in common.

It follows that the teachers in the philosophical faculty should be selected only from those who are themselves contributing to the advancement of knowledge; for if they have not the spirit of research in them, how shall they instil it into others? It is our carelessness in this respect (I do not speak of University College, which has always been guided by these principles, but of our country as a whole) which has made us so backward as compared with some other nations. It is this which has made the vast majority of our statesmen so careless, because so ignorant, of the whole frame of mind of the philosopher, and which has made it possible for a man high in the political estimation of his countrymen to address on a recent occasion the remarks which he did to graduates of our University. It is true that one of the functions of a University is to "train men and women fit for the manifold requirements of the Empire;" that we should all heartily acknowledge; but no man who has any claim to University culture can possibly be contented if the University does not annually produce much work of research. It is its chief excuse for existence; a University which does not increase knowledge is no University; it may be a technical school, it may be an examining board, it may be a coaching establishment, but it has no claim to the name University. The best way of fitting young men for the manifold requirements of the Empire is to give them the power of advancing knowledge.

It may be said that many persons are incapable of exhibiting originality. I doubt it. There are many degrees of originality, as there are many degrees in rhyming, from the writer of doggerel to the poet, or many degrees of musical ear, from the man who knows two tunes, the tune of "God Save the King" and the *other* tune, to the accomplished musician. But in almost all cases, if caught young the human being can be trained, more or less, and, as a matter of fact, natural selection plays its part. Those young men and women who have no natural aptitude for such work—and they are usually known by the lack of interest which they take in it—do not come to the University. My experience is that the majority, or at least a fair percentage of those who do come, possess germs of the faculty of originating, germs capable of development, in many instances, to a very high degree. It is such persons who are of most value to the country; it is from them that advance in literature and in science is to be expected, and many of them will contribute to the commercial prosperity of the country. We hear much nowadays of technical education; huge sums of money are being annually expended on the scrappy scientific education in evening classes of men who have passed a hard day in manual labour, men who lack the previous training necessary to enable them to profit by such instruction. It may be that it is desirable to provide such intellectual relaxation; I even grant that such means may gradually raise the intellectual level of the country; but the investment of money in promoting such schemes is not the one likely to bear the most immediate and remunerative fruit. The Universities should be the technical schools; for the man who has learned to investigate can bring his talents to bear on any subject brought under his notice, and it is on the advance, and not the mere dissemination, of knowledge that the prosperity of a country depends. To learn to investigate requires a long and hard apprenticeship; the power cannot be acquired by an odd hour spent now and again; it is as difficult to become a successful investigator as a successful barrister or doctor, and it requires at least as hard application and as long a period of study.

I do not believe that it is possible for young men or women to devote sufficient time during the evening to such work. Those who devote their evening hours to study and investigation do not bring fresh brains to bear on the subject; they are already fatigued by a long day's work; and, moreover, it is the custom in most of the colleges which have evening classes to insist upon their teachers doing a certain share of day work; they, too, are not in a fit state to direct the work of their pupils or to make suggestions as to the best method of carrying it out. Moreover, the official evening class is from 7 to 10 o'clock, and for investigation in science a spell of three hours at a time is barely sufficient to carry out successfully the end in view; indeed, an eight hours' day might profitably be lengthened into a twelve hours' day, as it not infrequently is. It is heartrending in the middle of some important experiment to be obliged to close and postpone it till a future occasion, when much of the work must necessarily be done over again.

These are some of the reasons why I doubt whether University education, in the philosophical faculty at least, can be successfully given by means of evening classes.

Although my work has lain almost entirely in the domain of science, I should be the last man not to do my best to encourage research in the sphere of what is generally called "arts." In Germany of recent years a kind of institution has sprung up which is termed a *Seminar*. The word may be translated a "literary laboratory." I will endeavour to give a short sketch on the way in which these literary laboratories are conducted. After the student has attended a course of lectures on the subjects to which he intends to devote himself and is ripe for research, he enters a Seminar, in which he is provided with a library, paper, pens and ink and a subject. The method of using the library is pointed out to him, and he is told to read books which bear on the particular subject in question; he is made to collate the information which he gains by reading, and to elaborate the subject which is given him. Naturally his first efforts must be crude, but "*c'est le premier pas qui coûte.*" It probably costs him blame at the hands of his instructor; after a few unsuccessful efforts, however, if he has any talent for the particular investigation to which he has devoted himself, his efforts improve and at last he produces something respectable enough to merit publication. Thus he is exposed to the criticism of those best competent to judge, and he is launched in what may be a career in historical, literary or economic research.

Such a Seminar is carried on in philological and linguistic studies, in problems of economy involving statistics, in problems of law involving judicial decision, and of history in which the relations between the development of the various phases in the progress of nations is traced. The system is borrowed from the well-known plan of instruction in a physical or chemical laboratory. Experiments are made in literary style. These experiments are subjected to the criticism of the teacher, and thus the investigator is trained. But it may be objected that the youths who frequent our Universities have not a sufficient knowledge of facts connected with such subjects to be capable of at once entering on a training of this kind. That may be so; if it is the case, our schools must look to it that they provide sufficient training. Even under present circumstances, however, I do not think I am mistaken in supposing that a young man or woman who enters a University at the age of eighteen years with the intention of spending three years in literary or historical studies will not at the end of the second year be more benefited by a course at the Seminar, even though it should result in no permanent addition to literature or history, than if he were to spend his time in mere assimilation. It is not the act of gaining knowledge which profits, it is the power of using it, and while in order to use knowledge it is necessary to gain it, yet a training in the method of using knowledge is much more important and profitable than a training in the method of gaining it. I do not know whether there exists in this country a single example of the continental Seminar; there was some talk of founding such a literary laboratory in University College, but, as usual, the attempt was frustrated by a lack of funds; the attempt would also have been frustrated by the requirements of the present system of examination in the University of London; but there is, fortunately, good hope of changing that system and of developing the minds of students on those lines which have proved so fruitful where they have been systematically followed.

Many, I suppose, who are at present listening to me would be disappointed were I not to refer to the functions of a University with reference to examinations. A long course of training, lasting now for the best part of seventy years, has convinced the population of London that the chief function of a University is to examine. Believe me, the examination should play only a secondary part in the work of a University. It is necessary to test the acquirements of the students whom the teachers have under their charge, but the examination should play an entirely subordinate part. To aim at success in examinations is, unfortunately, too often the goal which the young student aims at, but it is one which all philosophical teachers deprecate. To infuse into his pupils a love of the subject which both are at the same time teaching and learning is the chief object of an enthusiastic teacher; there should be an atmosphere of the subject surrounding them—an umbra—perhaps I should call it an aura; for it should exert no depressing influence upon them. The object of both classes of students (for I count the teacher a student) should be to do their best to increase knowledge of the subject on which they are engaged. That this is possible many teachers can testify to by experience; and it is the chief lesson learned by a sojourn in a German laboratory. Where each student is himself engaged in research, interest is taken by the students in each others' work; numerous discussions are raised regarding each questionable point; and the combined intelligence of the whole laboratory is focussed on the elucidation of some difficult problem. There is nothing more painful to witness than a dull and decorous laboratory, where each student keeps to his own bench, does not communicate with his fellow-students, does not take an interest in their work and expects them to manifest no interest in his. It is only by friction that heat can be produced, and heat, by increasing the frequency of vibration, results, as we know, in light.

The student should look forward to his examination, not as a solemn ordeal which he is compelled to go through with the prospect of a degree should he be successful, but as a means of showing his teacher and his fellows how much he has profited by the work which he has done; those who pursue knowledge in this spirit and those, be it remarked, who examine in this spirit will look forward to examination with no apprehension; not, perhaps, with joy, for after all it is a bore to be examined and perhaps a still greater bore to examine, but it is a necessary step for the student in gaining self-assurance and the conviction of having profited by his exertions, and for the teacher as a means of ensuring that his instruction has not been profitless to his student. In this connection I cannot refrain from remarking that that genius for competition which has overridden our nation of England appears to me to be misplaced. Far too much is thought of the top man; very likely the second or even the tenth, or it may be the fiftieth, has a firmer grasp of his subject and in the long run would display more talent. Let us take comfort, however, in the thought that the day of examinations, for the sake of examinations, is approaching an end.

It may surprise many to learn that the suggestion that in England teachers do not usually examine their own pupils for degrees is, abroad, received in a spirit of surprise not unmixed with incredulity. Americans and Germans to whom I have mentioned this state of matters cannot realise that the teacher is not considered fit to be trusted to examine his own pupils, and, singular to state, they maintain that no one else can possibly do so with any attempt at fairness; it appears to them, as it appears to me, an altogether untenable position to hold that a man selected to fill an important professorship, after many years' trial in a junior position, should be suspected of such (shall I say) ambiguous ideas regarding common honesty that he will always arbitrate unfairly in favour of his own pupils. Such a supposition is an insult to the professor, and the exclusion of the teacher elevates examination to the position of a fetish; it is that, together with the spirit of emulation and competition, which has done so much to ruin our English education. The idea of competitive examination is so ingrained in the minds of Englishmen that it is difficult for them to realise that the object of a University is, not primarily to examine its pupils, but to teach them to teach themselves; and also they have still to acquire the conviction that students should be found, not merely among the *alumni* of the University, but also among all members of the staff. The spirit which should prevail with us should be the spirit of gaining knowledge—gaining knowledge, not for the satisfaction of one's own sense of acquisitiveness, but in order to be able to increase the sum total of what is known. All should work together, senior and junior staff, graduates and undergraduates, in order to diminish man's ignorance.

To sum up. As it exists at present, a University is a technical school for theology, law, medicine and engineering. It ought to be also a place for the advancement of knowledge, for the training of philosophers, of those who love wisdom for its own sake; and while as a technical school it exercises a useful function in preparing many men and women for their calling in life, its philosophical faculty should impart to those who enter its halls that faculty of increasing knowledge which cannot fail to be profitable, not only to the intellect of the nation, but also to its industrial prosperity. I regard this as the chief function of a University.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

THE doctorates conferred by American Universities during the academic year lately concluded, and the subjects of the theses presented, are summarised in *Science* of August 2. The degree of doctor of philosophy was conferred on 253 candidates—a number which is probably greater than that of any previous year. Of these degrees 122 were given for subjects belonging to the humanities, and 131 for science subjects. Harvard and Yale have this year given as many degrees in the sciences as in the humanities, whereas in previous years the humanities have predominated, as the sciences have at Johns Hopkins and Cornell. There was a relative excess in the number of degrees in chemistry at Johns Hopkins; in physics at Cornell and Johns Hopkins; in mathematics at Yale; in zoology at Chicago; in psychology at Clark, Yale and Harvard, and in geology at Johns Hopkins and Harvard. Taking all the Universities together, the six subjects in which the most doctorates were conferred are:—chemistry, 28; physics, 23; mathematics, 18; zoology, 15; psychology, 13; geology, 10. The remaining 24 degrees were divided among twelve sciences.

SPECIAL courses of evening lectures for teachers and advanced students have been arranged by the London Technical Education Board at University College, King's College and Bedford College. The courses of instruction will afford an opportunity to students who can study only in the evenings to obtain instruction in well-equipped laboratories, and will make available to evening students the same advantages as are enjoyed by University day students, but they are only intended for those who are practically engaged during the day in some trade, business or occupation. At University College, Prof. J. A. Fleming, F.R.S., will give a course of ten lectures, followed by laboratory demonstrations, on advanced electrical measurements. Prof. Carus Wilson will give a course of lectures on the electric motor, with special reference to its employment in electric tram-car traction. In connection with these two courses, a special course of about twenty lectures on alternating currents will be given at King's College by Prof. E. Wilson, followed by a class for practical work. Prof. D. S. Capper will give about twenty lectures upon steam and gas engines, accompanied by laboratory work, and Prof. J. D. Cormack will lecture upon properties and testing of materials of construction. A course of civil engineering will also be given by Prof. Robinson. A course of twelve lectures on the recent developments of chemical theory will be given, under the direction of Prof. Ramsay, at University College, and a course of eight lectures dealing with the methods of spectroscopy, especially in connection with the photography of the spectrum, will be given by Mr. E. C. C. Baly. Saturday morning courses have been arranged for teachers; they include lectures on the teaching of mathematics, by Prof. Hudson, F.R.S.; physics, by Prof. W. Grylls Adams, F.R.S., and Mr. S. A. F. White; practical physiology, by Prof. Halliburton, F.R.S.; and a course on the teaching of elementary chemistry, by Mr. H. Crompton, at Bedford College.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, August 5.—M. Fouqué in the chair.—On Poisson's theorem and on a recent theorem of M. Buhl, by M. Paul Appell. The theorem of Buhl is a particular case of Poisson's theorem.—The law of pressures in cannon, by M. Vallier.—New method of preparing aniline and its analogues, by MM. Paul Sabatier and J. B. Senderens. A mixture of hydrogen and nitrobenzene vapour is passed over reduced copper kept at a temperature of from 300°-400° C., the yield of aniline being nearly theoretical. If nickel is employed instead of the copper, the reaction goes farther even at 200°, benzene and ammonia being produced.—On the luminous variation of the planet Eros; curves of light; amplitude of the variation, by M. Ch. André.—On the infinitely small deformation of a spherical elastic envelope, by MM. Eugène and Francois Cosserat.—On a relation which probably exists between the characteristic angle of deformation of metals and the Newtonian coefficient of restitution, by M. G. Gravaris. The characteristic angle of deformation (a), and the Newtonian constant of restitution (e), appear to be related according to the equation $\pi e = 2a$.—Critical study of the general theory of mechanisms, by M. G. Kœnigs.—On disruptive discharge in electrolytes, by M. K. R. Johnson.—Remarks on a communication of MM. A. Broca and Turchini.—The electric capacity of the human body, by M. G. de Metz. It follows from the experiments described that it is illusory to compare the electric capacity of the human body with that of an ellipsoidal conductor. The same person may possess several capacities according to the conditions under which he is placed. The average figure found is about 0·00011 microfarad.—The difference of potential and the deadening of the electric spark with oscillatory character, by M. F. Beaulard.—On the transmission of Hertzian waves through conducting liquids, by M. Charles Nordmann. For the liquids studied (solutions of sulphuric acid, common salt, potassium chloride and magnesium sulphate), the maximum thickness which could be traversed by the waves employed, that is to say, the transparencies for the waves, varies in the same sense as the resistances, but not in proportion.—The vapour tension of solutions. The hypothesis of Arrhenius, by M. A. Ponsot.—An attempt at an immediate analysis of nervous tissue, by M. N. Alberto Barbieri.—On the cycloplasmic maturation, by M. Yves Delage.—Carboniferous goniatites in the Sahara, by M. Collot. The discovery of goniatites in the carboniferous layers of the Sahara points to an age a little more recent than that deduced by M. Ficheur, and it shows further that there were several levels, amongst which that which furnished the goniatites may be contemporaneous with the layers observed by Foureau in the Tassli Adzjer.—A physiological photometer, by M. G. M. Stanoïévitch.

CONTENTS.