THURSDAY, JULY 26, 1888.

SCIENTIFIC ASSESSORS IN COURTS OF JUSTICE.

PUBLIC attention has lately been called, by various incidents, to the system under which the trial of scientific cases, and especially those in which the respective rights of rival inventors are involved, is at present conducted in courts of justice. Last week Mr. Justice Kay decided a case in which the Edison-Swan United Electric Company were plaintiffs, which lasted twenty-one whole days, or about one-tenth of the legal year; and it is possible that it may occupy very much more time in the Court of Appeal, where every day is equivalent to three days in ordinary courts, because three judges sit here, and again in the House of Lords, if the litigants decide to proceed to extremities, as they very frequently do in cases of this magnitude and importance. At the same time, Mr. Justice Kekewich was engaged in trying another large electric patent case; the Court of Appeal had a similar case occupying it for several days, in the course of which Lord Justice Cotton, who presided, animadverted in somewhat severe terms on the length to which such cases are allowed to run. His Lordship, with the concurrence of the two Lords Justices who sat with him, attributed this to the manner in which counsel spun out their arguments, and urged more brevity and conciseness. Whatever may have been the circumstances in the case to which the Lord Justice adverted, it is certain that the addresses of the eminent counsel engaged in the Edison-Swan case were not responsible for the twenty-one days which it occupied before Mr. Justice Kay—not including seven or eight days for experiments;—by far the greater part of this time was occupied in hearing the contradictory and conflicting evidence of a score of scientific men, many of the greatest eminence, on the points in dispute between the parties. With these points we have absolutely nothing to do here. It is sufficient to say that the case involved the investigation and decision of matters of the utmost complexity respecting the applications of recent electrical discoveries to lighting, and also some obscure questions in the history of these applications. All these exceedingly complicated and difficult questions were tried before an eminent judge, who, as he said himself at the commencement of his judgment, "has not had the requisite scientific training." It was, in fact, necessary to begin by instructing the judge in the elements of electrical science; the propositions which scientific men accept as truisms, or as common knowledge in discussions amongst themselves, had here to be gone over *ab initio* in order to inform the judge's mind respecting the A B C of the problem which he had to solve. As to Mr. Justice Kay's success in the task of acquiring this information, we are quite willing to accept the opinion of one of the leading electrical papers, which says that "the manner in which the judge grasped the bearing of the technical evidence has been the subject of remark amongst everyone present in court."

We have no doubt that a judge, with his trained and experienced mind, would make a very apt pupil; but the process of obtaining knowledge, even in such cases, is not always a very smooth or pleasant one. It is trying to the calmest and most equable mind to be compelled constantly to reconsider information acquired with care and difficulty, to find the views inculcated by one eminent man of science totally contradicted by another equally eminent. It is not surprising that in the maze of conflicting opinions Mr. Justice Kay was unable of his own knowledge to find his way. We reproduced a painful incident in our columns at the time it occurred, with the view of exhibiting to our readers one of the evils of the present system for trying complicated cases, although the circumstance that the case was then *sub judice* precluded us from offering any comment on it. We did this with a view of suggesting, also, that whoever was wrong—the judge or the expert witness—a matter which it did not concern us to inquire into—it is not in the interests of science that scientific men of reputation should put themselves in the position of advocates, thus rendering such treatment possible. Judges are only human, and, so long as men with no scientific training are left to bear unaided the burden of trying cases like that in which the Edison-Swan Company were plaintiffs, with their conflicting evidence, their authoritative opinions one way flatly contradicted by equally authoritative opinions the other, their masses of facts on subjects unfamiliar to the judge, so long must scientific men who are concerned in such cases expect unpleasant *rencontres* of this description either with the perplexed and worried judge or with the counsel on one side or the other. To be a witness at any time in a court of justice is not pleasant; it is an experience we have all to go through, at one time or another, with more or less resignation, supported by the consciousness that we are doing our duty as citizens and aiding the course of justice. But to be a witness in a scientific case on a subject to which you have devoted your life, and with regard to which you have obtained a position of authority, it may be, amongst your fellows who are, of all men in the world, the most capable of judging, and to be compelled to undergo cross-examination of the usual type at the hands of a gentleman who made up his few meagre and jejune facts on the subject from his brief the night before, and who will forget all he knew by the next night—this is hard indeed. But we cannot see how men of science can get out of these inconveniences and unpleasantnesses any more than any other class of the community, so long as the trials of these cases are in the hands of men who know nothing of science, and who have no regular and systematic means of obtaining aid—judicial aid, that is—from those who do.

Lawyers appear to be as discontented with the present system as men of science have reason to be. The principal legal paper went so far the other day as to suggest the formation of a special court for the trial of patent cases. These have increased so much of recent years, consequent on the vast increase of scientific discoveries and their practical applications to the business of life, that the old machinery is no longer adequate to deal with the new situation. Other litigants suffer in their business and pockets; the courts become congested, and the judicial business of the country is seriously impeded. The present arrangements can be satisfactory to no one, except, perhaps, to the few lawyers who are making their fortunes by them. To our minds, no very revolutionary process is needed to render the courts equal to the work. A judge's time in such cases is mainly lost in acquiring the information necessary to enable him to understand the points at issue. On a famous occasion it was said that we should have to educate our masters; litigants in patent cases have to begin by educating their judges. During the course of the Edison case the judge found the evidence on one important point so conflicting, that he suggested the propriety of having experiments made by scientific men on both sides, in the presence of some disinterested man of science, who should report to him on the result. The suggestion was followed: Prof. Dewar and Dr. Hopkinson carried out the experiments on one side, Mr. Crookes and Prof. Silvanus Thompson on the other, the President of the Royal Society being the umpire. In the course of the judgment Mr. Justice Kay acknowledged that Prof. Stokes's report made that "obvious," which he could not previously understand. Prof. Stokes, in fact, was called *in quâ* that particular point as an assessor to the Court. Suppose he had been called in at the beginning, and had sat all through the case, how much time, labour, and unpleasantness would have been spared! How rapidly he would have enabled the judge to narrow down the points at issue, and to understand them! And if Prof. Stokes had been aided by some other independent and qualified man of science, how much sooner and more satisfactorily the whole business would have been concluded. We want, in fact, sworn scientific assessors in courts of justice to aid unscientific judges in arriving with reasonable despatch at reliable conclusions on matters which demand scientific knowledge. Patent cases invariably turn on the construction of a written document—namely, the specification—and this, like all other documents, is a matter for the Court, guided by the rules which apply generally. "But," says Lord Chancellor Chelmsford, "if the terms used require explanation as being terms of art or of scientific views, explanatory evidence must be given, and with this aid the Court proceeds to the office of construction." Now there are two processes already in operation in the High Court of Justice, which it seems to us might well be applied to the determination of these complicated scientific cases, or rather by which disinterested and unbiassed scientific aid might be given to the Court in the determination of cases such as the Edison and Swan case. One is by the system of "referring," the other by assessors. Reference is an every-day proceeding in the Courts in complicated cases. By the 57th section of the Judicature Act of 1873, the Courts are empowered "in any cause or matter requiring any prolonged examination of documents or accounts, or any scientific or local examination which cannot, in the opinion of the Court or a judge, conveniently be made before a jury, or conducted by the Court before its ordinary officers, the Court or judge may at any time, on such terms as may be thought proper, order any question or issue of fact, or any question of account arising therein to be tried either before an official referee, or before a special referee to be agreed on between the parties." The referee or umpire is armed with proper powers, and in due time reports to the Court, which thereupon proceeds to adjudicate upon the case, having got rid of a mass of technical details with which it was incompetent to deal by the instrumentality of the referee who was quite competent. Doubtless it was in pursuance of this power that Mr. Justice Kay referred a portion of the recent case to Prof. Stokes; but suppose the whole matter, the issues having been narrowed down to their real limits, had been referred at the beginning to Prof. Stokes, aided if necessary by some other independent expert, to report the result to the Court, about twenty days of valuable public time would have been spared, and in the end the decision would have commanded a confidence which the judgment of a wholly unscientific judge, however acute, cannot be expected to receive.

But it appears to us that the system of assessors, who sit with the judge in court, and who aid him with their scientific knowledge and experience, would be even more satisfactory. It is in daily use in Admiralty cases. The practice is thus laid down in Messrs. Williams and Bruce's "Admiralty Practice," second edition, p. 441:—"If the questions in the cause depend upon technical skill and experience in navigation or other nautical matters, the judge is usually assisted by two of the Elder Brethren of the Trinity House of Deptford Strond, who sit with him as assessors, and who, at the request of the judge, after hearing all the evidence on each side, advise him on all questions of a nautical character. But in all cases it is with the judge alone that the decision rests." An eminent judge of the Privy Council summed up the duty and position of assessors in these words:—"He (the judge) is advised and assisted by persons experienced in nautical matters; but that is only for the purpose of giving him the information he desires upon questions of professional skill; and having got that information from those who advise him, he is bound in duty to exercise his own judgment. . . . . The assessors merely furnish the materials for the Court to act upon." But what this comes to in practice, circumscribed though the duties of the assessors are in theory, we learn from a remark of the eminent Admiralty judge, Dr. Lushington: "I never yet pronounced a single decree, when I was assisted by Trinity Masters, in which I was not perfectly convinced that the advice they gave me was correct." The presence of the Trinity Masters is secured by either party filing a *præcipe* praying for their attendance. And now all Admiralty cases, in whatever Court, may be tried with the aid of nautical assessors, when this is considered desirable.

Although this system is, as a rule, confined to Admiralty cases in practice, all Courts are empowered to call in the aid of assessors, for by the 56th section of the Judicature Act of 1873, the High Court or Court of Appeal may in any cause or matter in which it thinks it expedient so to do, call in the aid of one or more assessors specially qualified, and try and hear such cause or matter wholly or in part with their assistance. If Prof. Stokes and some other qualified expert had sat with Mr. Justice Kay during the hearing of the recent lighting case, it is scarcely probable that it would have lasted twenty-one days, or that various unpleasantnesses inseparable from the hearing of such a case, which was nothing if not scientific, by a conscientious but unscientific judge, would not have been avoided. There are no reasons why a judge should not be aided in cases of this technical description by scientific experts, as Admiralty judges are by nautical experts; there are a great many why he should. The orderly and effective administration of justice, the weight which should be attached to judicial decisions, the economy of public time, and, we would add, the self-respect of scientific men, and the best interests of scientific discovery, all call loudly for some such reform as that here suggested.

LANGLEY'S NEW ASTRONOMY.

The New Astronomy. By Samuel Pierpoint Langley, Ph.D., LL.D. Illustrated. (Boston: Ticknor and Co., 1888.)

PROFESSOR LANGLEY'S beautiful book does not appeal merely to the intellect. The senses have their share in the gratification its perusal affords. Every turning of a page is a conscious luxury. Each touch of the paper, in which the thickness of vellum is combined with the polish of satin, flatters the finger-tips with a bland caress. In texture, it compares with the paper on which ordinary work-a-day scientific treatises are printed as does a velvet-pile with a Kidderminster carpet. The binding is in a corresponding style of lavish magnificence. The illustrations have obtained the last perfection of finish.

Yet the excellence of their execution is for the most part secondary to their intrinsic merit. Needless to say that photographs figure largely among them. There is a capital sunspot series by Rutherford; there are specimens of Pickering's stellar spectra; besides several coronal autographs, Mr. Common's inimitable Orion nebula, and Rutherford's scarcely yet surpassed print of the moon. Among visual delineations, we meet Bond's admirable views of Donati's comet, Trouvelot's elaborate Saturn, De la Rue's well-known Jupiter, above all, Prof. Langley's own exquisite solar drawings. The surface of the sun has probably never been so perfectly seen as by him; it has certainly never been depicted with such a wealth of trustworthy detail. Some insight into one of the sources of his success is afforded by the following paragraph (p. 17):—

"The surface of the sun," he tells us, "may be compared to an elaborate engraving, filled with the closest and most delicate lines and hatchings, but an engraving which during ninety-nine hundredths of the time can only be seen across such a quivering mass of heated air as makes everything confused and liable to be mistaken, causing what is definite to look like a vaguely seen mottling. It is literally true that the more delicate features are only distinctly visible even by the best telescope during less than one-hundredth of the time, coming out as they do in brief instants when our dancing air is momentarily still, so that one who has sat at a powerful telescope all day is exceptionally lucky if he has secured enough glimpses of the true structure to aggregate five minutes of clear seeing, while at all other times the attempt to magnify only produces a blurring of the image. This study, then, demands not only fine telescopes and special optical aids, but endless patience."

"Endless patience" is, indeed, a *sine quâ non* in nearly all departments of astronomy; but it is not always associated with the skill of eye and hand witnessed to by the representations before us. Nor could they have been brought to bear without instrumental accessories of a more than commonly high quality. The polarizing eyepiece made at Pittsburgh must be one of the best ever employed to blunt the keen edge of the solar rays. "By its aid," our author remarks, "the eye can be safely placed where the concentrated heat would otherwise melt iron. In practice I have often gazed through it at the sun's face without intermission from four to five hours, with no more fatigue or harm to the eye than in reading a book."

The object of the work before us is to advocate the claim of the "New Astronomy"—the astronomy which studies the constitution of the heavenly bodies, as opposed to that which determines their movements—to a larger share of public interest, sympathy, and benefactions than has hitherto been allotted to it. The appearance of the eight chapters of which it consists in the pages of the "Century" magazine, has doubtless already contributed to promote that end. They are written in an eminently popular style, and with much of that Transatlantic freshness by which many a jaded European palate is enticed to renewed enjoyment of wholesome literary fare. They profess to give only a sketch of the results so far attained; but it is a highly stimulating and suggestive one. Intelligible to all, they should be welcomed by readers of every grade of culture desiring to gain acquaintance, almost without an effort, with some of the most surprising encroachments ever yet made by the agile human mind upon the vast realms of the unknown.

The two most interesting, because the most original chapters in the book, are those dealing with the "Sun's Energy." Here Prof. Langley is more especially at home; his opinions carry all the weight that long meditation and laborious research can give them; yet they are expressed not only without dogmatism, but almost with diffidence. The higher value given to the "solar constant" by his inquiries into atmospheric selective absorption, have naturally obliged him to curtail the "life" of the sun. During no more than eighteen million years can the present rate of radiation—supposing it fed by the shrinkage through gravity of the sun's substance—have been maintained in the past. "We say 'present' rate of radiation," our author continues, "because, so long as the sun is purely gaseous, its temperature rises as it contracts, and the heat is spent faster; so that in early ages before this temperature was as high as it is now, the heat was spent more slowly, and what could have lasted 'only' eighteen million years at the present rate might have actually spread over an indefinitely greater time in the past; possibly covering more than all the æons geologists ask for."

This is of course perfectly true. There can be no reasonable doubt that the sun was, in the initial stages of its career, a comparatively murky luminary, rich in the promise of future possession, but scantily distributing, because scantily supplied from, stores of light and heat strictly tied up against the possibility of premature waste for the benefit of generations to come, its heirs by entail. But has there been no compensatory period of extravagance? Has our sun already passed through its "Sirian" phase—if a Sirian phase be indeed an inevitable "moment" in the existence of every star—or is it yet to come? The question cannot at present be answered; but until it is, estimates of the probable past duration, in its illuminative capacity, of the central body of our system, are evidently illusory. The actual radiation of the sun would be not improbably decupled by the sudden change of its atmospheric and photospheric constitution to that of Sirius or Vega. In other words, the stock of energy now sufficing for the expenditure of ten million years would then be dissipated in one million, with a corresponding abridgment in time of the heating and lighting efficacy thus vastly heightened in intensity. The same *caveat* applies—should it be concluded that the Sirian is a later than the solar stage—to attempts to assign a term for the inevitable exhaustion of the great fountain of vital possibilities. The objection is however evaded by Prof. Langley's statement (p. 100) that, *at the present rate*, "the sun's heat-supply is enough to last for some such time as four or five million years before it sensibly fails. It is certainly remarkable," he adds, "that by the aid of our science man can look out from this 'bank and shoal of time,' where his fleeting existence is spent, not only back on the almost infinite lapse of ages past, but that he can forecast with some sort of assurance what is to happen in an almost infinitely distant future, long after the human race itself will have disappeared from its present home. But so it is, and we may say—with something like awe at the meaning to which science points—that the whole future radiation cannot last so long as ten million years."

Our author is sanguine as to the prospect of economically applying the sun's heat to mechanical purposes. "From recent measures it appears that from every square yard of the earth exposed perpendicularly to the sun's rays, in the absence of an absorbing atmosphere, there could be derived more than one-horse power, if the heat were all converted into this use, and that even on such a little area as the island of Manhattan, or that occupied by the city of London, the noontide heat is enough, could it all be utilized, to drive all the steam-engines in the world" (p. 111). No wonder that, enticed by such calculations, "practical men" should devote attention to this unfathomable source of power; and we may well believe, with Prof. Langley, "that some of the greatest changes which civilization has to bring may yet be due to such investigations."

"Future ages may see the seat of empire transferred to regions of the earth now barren and desolated under intense solar heat—countries, which for that very cause, will not improbably become the seat of mechanical and thence of political power. Whoever finds the way to make industrially useful the vast sun-power now wasted on the deserts of North Africa or the shores of the Red Sea, will effect a greater change in men's affairs than any conqueror in history has done; for he will once more people those waste places with the life that swarmed there in the best days of Carthage and of old Egypt, but under another civilization, where man shall no longer worship the sun as a god, but shall have learned to make it his servant."

In his chapter on "Meteors," our author seems to view with a certain degree of favour the suggestion that some of these small bodies "may be the product of terrestrial volcanoes in early epochs, when our planet was yet glowing sunlike with its proper heat, and the forces of Nature were more active" (p. 193). He does not, however, stop to discuss the difficulties besetting this hypothesis; had he done so, he could scarcely have failed to conclude them insuperable. The resistance opposed by the atmosphere of the earth to the upward flight of projectiles from its surface has, for instance, never been sufficiently taken into account. It is quietly assumed that some unspecified and insignificant addition to the initial velocity needed to secure definitive escape in a vacuum, would have sufficed to overcome atmospheric hindrances; whereas the minimum swiftness at starting in the second case should be at least thrice, or quadruple that in the first. The effectiveness of the air in arresting motion is practically exemplified in the continuous meteoric bombardment against which it forms our sole shield. Yet the projectiles composing it possess far higher velocities than terrestrial volcanoes could, under any conceivable circumstances, be supposed to impart. And the few among them that meet the earth's surface are impelled towards it by gravity after their own movement has been wholly, or all but wholly destroyed. Instances must be very rare in which an aerolite has brought down with it in its fall any portion of its orbital speed. Moreover, our present atmosphere is doubtless rare and shallow compared with its pristine condition; while there is no certainty that volcanic action, of an explosive kind, was ever much more energetic than it now is.

Prof. Langley adopts, or rather admits the "temperature-classification" of stellar objects current at the time when his concluding chapter on "The Stars" was written. It speaks volumes for the rapidity with which the "new astronomy" progresses that, in a few short months, this scheme—to which there were always serious objections—should have fallen obsolete. Mr. Lockyer's recent investigations have at least had the effect of rendering a complete revision of ideas on the subject indispensable. The book with which we are just now concerned professes, however, not even to describe, but barely to mention, the various departments, photometric, spectroscopic, and photographic, of stellar physical astronomy, "on each of which," the author justly remarks (p. 248), "as many books, rather than chapters, might be written, to give only what is novel and of current interest. But these," he adds, "are themselves but a part of the modern work that has overturned or modified almost every conception about the stellar universe which was familiar to the last generation, or which perhaps we were taught in our youth."

An English edition of a work which we can recommend as corresponding with singular felicity and charm to the designs of the writer, is in preparation, and will shortly appear. Some photographs of the moon, too recent to be as yet generally known, will probably replace in it such of Mr. Nasmyth's lunar illustrations as figure in the American edition. A. M. CLERKE.

SOAPS AND CANDLES.

Soaps and Candles. Edited by James Cameron, F.I.C., Analyst in the Laboratory, Somerset House. "Churchill's Technological Hand-books." (London: J. and A. Churchill, 1888.)

THE object of this hand-book, as stated in the preface, is to add to the articles originally published in Cooley's "Cyclopædia" additional information from various scattered sources, so as to present, in as small a compass as possible, information which it is hoped may be found useful to technological students and others interested in the industries described. Compression of bulk being a main object, it is assumed that the reader has some degree of acquaintance with various points connected with theoretical and practical chemistry and certain analytical processes, so that details in such cases may be omitted without interfering seriously with the usefulness of the book. In carrying out the work of compilation, the same necessity for economizing space has rendered imperative considerable care in selecting and "boiling down" the matter, derived from some two dozen different sources in the way of English bibliography, for the most part published within the last few years; amongst which may be more particularly mentioned the works on soap-making, candle-manufacture, and allied industries by Morfit, Kurten, Dussauce, Christiani, Ott, Lant Carpenter, and Watt; and the Cantor Lectures of Field ("Solid and Liquid Illuminating Agents") and of Alder Wright ("Toilet Soaps"). References to Continental literature and patents, though comparatively infrequent, are also to be found at intervals throughout the book.

On the whole, it must be admitted that the author has carried out the work of selection and excision, compilation, abstraction, and general editing with great judgment, and that he has succeeded in getting into very small compass not only a large amount of general information, but also a valuable epitome of most, if not all, of the various advances in manufacture and the additions to scientific knowledge that have been made up to the present date in connection with the industries treated of, comprising not merely the production of soap and candles, but also the intimately associated manufacture of glycerin. This latter is quite a modern offshoot from the parent industries, neither of which, however, can claim as high an antiquity as some of the metallurgical operations; for, whilst the property of certain oils and animal fats to become converted into a saponaceous mass by treatment with the lye of wood ashes was known in the first century in an incomplete way, as evidenced by the writings of Pliny, no authentic information is extant leading to the belief that anything of the nature of true soap was known at any much earlier period; the materials referred to by the Old Testament writers as *borith*, and translated "soap" (or, in early editions, "sope"), appearing to have been simply alkaline matter, without any oil or fatty ingredient combined therewith. On the other hand, the manufacture of candles, *i.e.* a wick surrounded by a *solid* fusible matter capable of combustion under such circumstances like oil in a lamp, does not appear to have been practised among the ancients, lamps burning *fluid* oil being their usual source of artificial illumination: probably torches, or thick wicks impregnated with oil, pitch, &c., and sufficiently stiff to be handled, were the earliest form of candle. Not until the fourth century of our era, however, does this crude device appear to have developed into anything approaching the modern form of candle, wax being then used as the combustible matter in the finer kinds, and tallow or other solid animal fat in the coarser descriptions.

The researches of the yet living M. Chevreul, made in the early part of the present century, cleared up the chemical constitution of oils and fats generally, and largely helped to bring about great improvements both in the manufacture of soap and in that of candles: they demonstrated that oils and fatty matters in general are, for the most part, compounds analogous to mineral salts, being produced by the union of a "fatty acid" and an organic compound of weak basic character, *glycerin*, in the same way that a mineral acid and a strong base or metallic oxide will saturate one another to form a salt of the ordinary type; and that soaps are the alkaline salts of the fatty acids contained in the oil, &c., used, the process of "saponification" being simply the elimination of the organic basic constituent, glycerin, by the more powerful alkali employed, potash usually forming a "soft" soap, and soda a "hard" one. By treating the soaps thus formed with mineral acids, the "fatty acids" are similarly displaced from combination with the alkalies, and substances are thus obtained usually less fusible than the original fatty matter, but, like it, capable of being burnt in conjunction with a wick, and frequently with less liability to smoking and charring the wick. The leading developments of the candle industry thence resulting have accordingly been in the direction of producing the fatty acids by saponification (or cheaper processes substantially equivalent thereto), and expression of the more fluid constituents (usually, though somewhat unsystematically, termed *oleine*), so as to render the solid residue, or *stearine*, of higher melting-point, and therefore better suited to form candles not apt to bend in summer or in hot climates; and the use of mineral solid hydrocarbons (paraffin-wax and allied materials from paraffin-oil, petroleum, ozokerite, &c.) as ingredients in combination with, and sometimes to the exclusion of, the stearines thus formed. The more solid fats (tallow, suet, and certain solid vegetable fats) are naturally the substances most largely employed, as furnishing the greatest yield of solid stearine suitable for candle-making; but several oils and semi-fluid products (like palm and cocoa-nut oils), when chilled and pressed, yield a notable quantity of more solid constituents equally available for the purpose. The fluid fatty acids, or "oleines," obtained as by-products in the candle industry, are either neutralized directly by aqueous caustic alkalies, thus forming soaps, or, according to the recent process of *Radisson*, are fused with caustic alkalies (preferably, but not necessarily, potash), whereby oleic acid becomes converted into solid palmitic acid, of sufficiently high melting-point to be capable of employment for making candles.

For the manufacture of soaps, scarcely any fatty matter, whatever its source or lack of purity, comes amiss; it being of course obvious that the coarser kinds are only available for the cheapest scouring soaps, and that only the better kinds can be employed in the production of superior classes of soaps, especially those intended for toilet soaps of high quality (which term by no means applies to all in the market). Recovered greases from wool-scouring and fulling operations, fœtid animal fats from the carcasses of horses, bones, and by-products of glue-manufacture and tanning, &c., greasy matters extracted from dead cats and dogs netted in the rivers and streams, and even that obtained from the scum of sewage, represent some of the least attractive of the sources of oleaginous matter dealt with by the soap-boiler; whilst more or less damaged or rancid oils, unfit for other use, and "foots" (residues containing much impurity, which separate during the processes of refining various kinds of oils), together with the somewhat impure oily matters obtained by the aid of solvents (*e.g.* carbon disulphide) from the marcs or cakes obtained in olive and seed-oil crushing, cocoa-nut and other rank vegetable oils, and animal tallows, lards, suets, &c., imported from abroad, and obtained by treatment usually of such a nature as to render the product more or less malodorous, represent a better class of raw material, suitable, after more or less purification, for the ultimate production of the ordinary kind of household and laundry soaps. The finest varieties of lard, &c., and purified almond and other comparatively choice vegetable oils, and such like superfine materials, constitute the substances actually used in the manufacture of some of the best varieties of toilet soap, and *supposed* to be employed in the production of all such more delicate varieties.

The author briefly but clearly describes the leading processes and methods by means of which useful and even superior qualities of soaps are manufactured in bulk from the more ordinary materials, and the finer kinds from the choicest sources, usually on a smaller scale. Numerous analyses of various sorts of soaps are quoted, and the methods of production of "filled" (*i.e.* adulterated and watered) soaps, and of the composite scouring materials containing silicate of soda and analogous alkaline compounds together with true soap, are adverted to. It might, perhaps, be considered that sufficient stress has hardly been laid on the enormous extent to which such admixture is sometimes carried on in the case of certain articles still sold under the name of soap. When a scouring material contains only one-seventh of its weight of actual soap (mostly from cocoa-nut oil), and about as much silicate of soda and inert soda salts added to "harden" the mass, the balance being water pure and simple; or when a so-called "toilet soap" contains less than two-fifths of its weight of true soap, and nearly as much water, the balance being simply sugar and a more or less marked excess of corrosive alkaline matter (both calculated to act most injuriously on tender and delicate skins), it would be supposed by many that the limit of honest trading and proper description of quality has been pretty closely approached, if not a long way passed, by describing and selling such articles as "soap" at all. In the description of the manufacture of transparent toilet soaps by the process of solution of previously made soap (mostly yellow or resin soap) in alcohol, the author states that "most makers also add a certain proportion of glycerin." It would be more correct to say that in the great bulk of such soap actually sold a very considerable quantity of *sugar* is present; whilst glycerin, although frequently professedly a constituent, is usually conspicuous by its entire absence from the composition—a difference by no means to the advantage of the consumer, if troubled with a sensitive skin, although not of any great consequence to the fortunate possessor of a stout healthy epidermis not easily affected by external influences.

C. R. ALDER WRIGHT.

INDIA IN 1887.

India in 1887. By Robert Wallace, Professor of Agriculture and Rural Economy in the University of Edinburgh. With plates and illustrations. (London: Simpkin, Marshall and Co. Calcutta and Bombay: Thacker, Spink and Co., 1888.)

PROFESSOR WALLACE has evidently thrown his heart as well as his brains into his self-imposed task. He wished to know the effect of his own teaching, and that of the college to which he was attached, upon the development of Indian agriculture—and he went to see for himself. Let us hope that Prof. Wallace will have his reward for so unselfish a motive. The key to his position lies in the fact that Indian Government scholarships have been for many years bestowed at Cirencester upon Indian native graduates who have been selected for this purpose, with a view to their subsequent employment in the Agricultural and Forestry Departments of India. His object, as he himself expresses it, is "to induce the Government to alter its plans as regards the Indian Agriculture Department, and to see that ground which has been lost by inexperienced officers is yet capable of being regained by efforts made in the right direction." Quixotic as any attempt may appear to cause a Government department to alter itself, or to quietly submit to alteration, no doubt the best plan is to appeal to the public, and this is what Prof. Wallace has done. He has, no doubt, to some extent courted contradiction and hostile criticism from those already engaged in agricultural improvement in India. His book is not wanting in denunciation of the existing system, the strength of which lies in the strongly practical bias of the writer, who sympathizes with the farmer and his ways, whether found in the stalwart son of the soil in England or Scotland, or in the ryot of India. Their methods are proved methods, their opinions are the result of thousands of years of mental evolution. Prof. Wallace clearly shows an inherent dislike to that kind of innovation which springs from superficial knowledge gained in one part of the globe and thrust upon those who are engaged under totally different circumstances of soil and climate. He insists most properly, we think, that it is a delusion to imagine that any man, however able, can gain a thorough or adequate knowledge of the science and practice of agriculture in two years. Without in the least detracting from the value of two years spent in study at an agricultural college, he insists that the first step is *the study of native agricultural practices* "by men who have been trained in agriculture from their early youth in this country, and who have subsequently acquired a sound knowledge of the sciences bearing on the subject."

In the same spirit he inveighs heavily against the almost universal employment as model farm managers of men who have had no truly agricultural training, either practical or scientific, and who have no intimate knowledge of the native methods of cultivation. The result of this system has been that "many failures have destroyed the confidence of Government; and anything agricultural, that is now being done, is reduced to the merest *minimum*, with a chance any moment of being utterly abandoned."

While these views are forcibly expressed and abundantly illustrated, Prof. Wallace has not forgotten to widen the scope and interest of his very valuable book by copious information as to the products, the agriculture, the cattle, the instruments of husbandry, the habits, and the customs of India. He has placed on record an immense number of facts which must render his book valuable for purposes of reference as well as interesting to the general reader. With reference to the liberal display of photographic representations, executed by Waterston and Sons, the author looks upon them as instructive rather than artistic. The photographs from which they were taken were executed by himself, often under difficulties, but they are none the less accurate, and therefore trustworthy.

With regard to the present arrangement of the book, the first 300 pages are devoted to descriptive matter relating to the cattle and other domesticated animals, the soils, implements of husbandry, and crops of India. Much of the matter may be left by the busy reader, who will find the special views and conclusions of the author reserved for the concluding chapters.

The book is an honest and able attempt to place the peculiarities of Indian agriculture fairly before the British public, and the views of the author with reference to the best methods for developing the agricultural sources of the Indian Empire will, we hope, receive the attention they deserve.

OUR BOOK SHELF.

Incwadi Yama: or Twenty Years' Personal Experience in South Africa. By J. W. Matthews, M.D. (London: Sampson Low, 1887.)

DR. MATTHEWS left England in 1864, soon after he had taken his medical degree. He settled, in the first instance, at Verulam, in Natal, where he was appointed a district surgeon. Afterwards he became familiar with many different parts of South Africa, and especially with the Diamond Fields, the inhabitants of which twice returned him at the head of the poll to represent them in the councils of their country. He is not a very skilful writer, but any one who will take the trouble to read his long and somewhat elaborate narrative will be rewarded by obtaining a great amount of solid and more or less interesting information. He has naturally much to say about the population of the Diamond Fields, and about the process of diamond mining, and on these subjects he speaks with the authority of one who presents the results of direct personal observation. He has also brought together a good many curious and instructive facts about the native tribes; and his descriptions of scenery, if not brilliant from a literary point of view, at any rate suffice to convey a general impression of some of the districts he has visited. The work will be of considerable service to Englishmen who think of settling in South Africa.

First Elements of Experimental Geometry. By Paul Bert. (London: Cassell and Co., 1888.)

THE book of which this is a translation was M. Paul Bert's last work, and, like his earlier books of a similar kind, it is written in a style that cannot fail to interest children. His aim is to go straight to the goal, and, as he tells us in the preface, the goal of experimental geometry in elementary schools is, not a knowledge of the properties of different figures, but the power of measuring objects round about us. By the time the pupil has reached the third or fourth lesson he has learnt how to measure the height of a tree, and by so doing has done a practical piece of work, and begins to take an interest in the subject.

The book is divided into nine parts, containing in all about forty lessons. The measurement of straight lines, plane areas, solids, lengths of curved lines, &c., are dealt with in the first seven parts; the eighth shows the methods of constructing various geometrical figures and the instruments employed; Part 9 consists of the elements of land surveying and of plan drawing.

The illustrations and diagrams are numerous and well chosen throughout, and the work has been well translated. At the end of the volume exercises have been added for the use of teachers which are not found in the French version, the translator telling us that "the extraordinary character of our table of weights and measures has made it almost impossible to reproduce with the neatness and clearness of the original the numerous examples which are based upon the metrical system."

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.*]

The Renewed Irruption of *Syrrhaptes*.

THANKS to your kindness in printing a note of mine a few weeks since (p. 103), I have received from your correspondents a large amount of help in the task I have undertaken; but there is, to me at least, a complete blank as regards observations of *Syrrhaptes* this year in France. It is almost impossible for the invasion to have missed that country, since Italy and Spain even have been visited in greater force than upon any one of the former occasions, yet not a word of the birds being seen in France on the present occasion has come to me, notwithstanding the inquiries I have made of French ornithologists. I would ask such of your readers as may be in that country to send me any tidings they may obtain. In 1863 there were at least a dozen French localities recorded, and in some of them large flocks were seen. I can hardly suppose that it has been otherwise this year. ALFRED NEWTON.

Magdalene College, Cambridge, July 23.

Dr. Romanes' Article in the *Contemporary Review* for June.

MY attention has been directed to an article entitled "Recent Critics of Darwinism," by Dr. Romanes in the June number of the *Contemporary Review*. While the anonymous writer of a recent article in the *Edinburgh Review* is rightly exposed for quoting what he believes to be the opinions of men whose writings he can never have read, or at least can never have understood, it is somewhat unfortunate that Dr. Romanes should have fallen into the similar error of not making himself acquainted with views which he professes to express. He states (on page 841) that while Cope, Semper, Geddes, and Seebohm have argued "that any proof of natural selection as an operating principle opens up the *more ultimate problem* as to the *causes* of the variations on the occurrence of which this principle depends," Weismann and Poulton, on the other hand, "have not so much concerned themselves with this more ultimate problem." As it is unlikely that Dr. Weismann will have the opportunity of replying to this statement, it is only right to point out that this eminent zoologist has most certainly concerned himself very earnestly with this ultimate problem, and that his original and important theories upon the subject will be found in two of his recent papers, viz. "Die Continuität des Keimplasma's als Grundlage einer Theorie der Vererbung," Jena, 1885, and "Die Bedeutung der sexuellen Fortpflanzung für die Selektions-Theorie," Jena, 1886.

I should not have troubled to write this reply on account of the allusion to myself, and I agree with Dr. Romanes in the belief that my work does not throw any light upon the causes of variation. There are however many zoologists who believe that it has such a bearing, and indeed it seems only natural that writers (such as Dr. Romanes himself) who retain the Lamarckian conception of the direct influence of surroundings in causing the variations of the higher animals, should believe (as I think wrongly) that they see evidence for the soundness of their views in the results of experiments in which the colours of insects have been completely modified in a single generation by the action of environment. EDWARD B. POULTON

Oxford, July 15.

The Thunder-Axe.

THOSE who are interested in the study of anthropology need no reminder as to the European belief in a connection between ancient stone weapons and thunder. It would be mere waste of time if I quoted instances of this connection; but it may not be devoid of interest to some of your readers if I bring to their notice a modern account of the thunder-weapon, as described to-day by a New Zealander. The account may also be of service to those studying another branch of anthropology—that concerning the influence and value of ancient and modern creeds warring in the minds of semi-civilized peoples. I shall make no comment of my own, but proceed to give a translation of a tale printed (in Maori only) in the pages of the native newspaper, the *Korimako*. The few words in it which were not understood by those acquainted with the ordinary Maori speech, I referred to old men well versed in the dialect of that part of New Zealand.

"*The finding of Te Awhiorangi.*

"The tribes of this island have hitherto only heard of Te Awhiorangi, but have not seen it. We, Ngarauru—that is, the people descended from Rangitaupea, our ancestor who hid the axe—have never seen it until now . . . One of our settlements, called Okutuku, is near Waitotara. Twenty natives from this settlement proceeded in a party for the purpose of gathering the edible fungus (Hăkekăkeka) for the purpose of sale. With the party went a young woman whose name was Tomairangi (Dew of Heaven), the wife of Te Potonga Kaiawha. This girl was a perfect stranger in the district: she did not know where the sacred (tapu) places were; she belonging to the Ngaitahu (a South Island tribe), but her father was of us, the Ngarauru. The girl wandered away by herself, looking here and there, searching for trees on which the fungus grew. She saw a tree on which there was fungus, and laid her hand on it, but suddenly there came the flash of the Axe. Following with her eyes the direction of the flash, she saw the Axe close against the foot of a Pukatea tree; a cry of terror broke from her, and she fled screaming. At the same time the thunder roared, the lightning flashed, and blinding hail burst forth in sudden storm, increasing her terror almost to madness. Her husband heard her cries as she flew along: but an old man, called Te Rangi Whakairione, directly he heard her shrieks, understood the reason of the outcry, so he began to chant an incantation, and the fury of the storm abated. When the party had assembled together in the open land, the old priest asked which of them had been to Tieke; whereupon the girl asked 'Where is Tieke?' The old man answered that it was beyond the turn at Waione. Tomairangi replied, 'I have been there, but I did not know it was a sacred place: I saw something that looked like a spirit, and I am full of great fear.' Then all the party went to ascertain what it was, and then they found that it was indeed the lost sacred Axe, Te Awhiorangi. After Te Rangi Whakairione had chanted another incantation over it, they all took hold of the Axe, and wailed over it. When the crying had ceased, they brought the Axe back to the settlement. All the tribe knew that the Axe was somewhere in that vicinity, for our ancestor Rangitaupea had passed the secret on to his children in the words, 'Te Awhiorangi is at Tieke on the plain close above the Cave of the Dead.' Until now that place has been unvisited, being entirely sacred till this day, the 10th of December, 1887. Then gathered all Ngarauru and some of the Whanganui and Ngatiapa tribes, in number 300 persons, and at dawn the next day the sacred thing was hung up on a tree that all might see it. The priests, Kapua Tautahi and Werahiko Taipuhi were at the head of the procession as they approached the place: they reciting charms and incantations as they moved along with the people following. All the people carried green branches in their hands as an offering to Te Awhiorangi. When the concourse drew near the place, *successive peals of thunder and flashes of lightning rent the air*; then came down a dense fog, making it dark as night. The Tohunga (priests) stopped the thunder and dispersed the darkness by their incantations. When the light again appeared, the people offered the green branches, together with a number of Maori mats, &c.; then they made lamentations, and sang the old songs in which the ancient Axe was spoken of by their forefathers."

Thus far the native account. Then follows an enumeration of the articles offered up as propitiation; then a description of the axe, which appears to be a huge and beautiful specimen of the stone weapon, so highly polished that the face of the beholder may be seen reflected in it. Afterwards, the pedigree, or rather the mythological history, of the axe, showing how (name by name) it had been handed down from the first Maori chief who came to New Zealand (Turi), and that it had descended to him, through the great god Tane, from the primæval pair, Heaven and Earth (Rangi and Papa). But our chief interest in it is the thunder heralding its finding.

EDWARD TREGEAR.

Wellington, N.Z., June 11.

The Dispersion of Seeds and Plants.

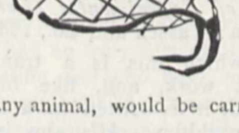
I HAVE read with much interest Mr. Morris's communication on the above subject (NATURE, vol. xxxvii. p. 466), and can corroborate most of what he states from personal observation. I can also remove his doubt respecting the germination of the seeds of the *Guava* and *Passiflora*, to which may also be added the *Tomato*.

I have adopted the "earth system" in my w.c., and from the place where the earth is deposited may always be gathered fine young plants of the three genera named above.

Thousands of acres of pasturage have been destroyed in this island by the distribution by birds of the *Lantana*, which was unfortunately introduced here by the first Roman Catholic missionaries, to form a hedge for their property at St. Louis or Conception. The "*Gendarme* plant" (an *Asclepiad*) was brought here in a pillow by a *gendarme* from Tahiti. It was a seed attached to a wing of silk cotton. The *gendarme* shook out his pillow; the wind carried the seed to a suitable spot, and now it vies with the *Lantana* in destroying our pastures.

I have shot the Great Fruit Pigeons of Fiji and this island with several seeds of the *Canarium* (?) in their crops, as Mr. Morris says, as big as hen's eggs. The seeds of water-plants are conveyed, with the eggs of fresh-water Mollusca, to vast distances, adhering to the hairs and feathers of the legs of water birds—ducks, herons, and waders of all sorts. In London the basins of the fountains in Trafalgar Square were peopled by *Lymnea* brought thither from the Serpentine, attached to the feathers of the sparrows who bathed, first in one, and then in the other.

Another plant which occurs to me as being largely indebted to man for its distribution, is that known as the "Cape Gooseberry," which is a native of South America (I forget its botanical name). The Kaffirs call it the "White man's plant," and say it follows the white man everywhere. I know it is found in India, Ceylon, Africa, Fiji, New Caledonia, New Hebrides. I really believe boiling it into jam does not destroy the vitality of the seeds. We have just got a plant here, bearing a lovely flower, but whence it comes no one knows. It has hard wooden seed capsules, each furnished with two hooks as hard as steel and as sharp as needles, this size and shape. These, hooking



into the hide of any animal, would be carried for days until forcibly dislodged.

The "Bathurst burr" (*Xanthium spinosum*) was introduced into the Cape in a cargo of wool wrecked at Cape Lagulhas, and spread out to dry, first there, and then at Simon's Town, at both of which places the "burr" sprang up. I believe and hope I destroyed the first and last plant of it that sprang up in New Zealand some twenty-five years ago. The seed had been brought in the living fleece of a fine merino ram. The owner of the pasture was cherishing the "wonderful new plant," and was not a little horrified when I took out my knife and carefully cut it down. He was more horrified when I told him what it was.

The seeds of some of the Indian banians, I believe, require to pass through the bodies of birds to enable them to germinate. A minute bird (*Diceum*) feeds on them, and is so small that its dropping cannot fall clear of the branch on which it sits, consequently it is glued to the bark and takes root. Sometimes this takes place on a palm tree; the roots then run down the trunk, and finally smother their host.

British Consulate, Noumea, May 15. E. L. LAYARD.

Indian Life Statistics.

ALTHOUGH Mr. Hill (in NATURE of July 12, p. 250) refers to the *Holi* festival as among possible influences in causing variations of births, he does not say whether he considers lucky and unlucky months and years, which so largely affect marriages in India, as incidents which may have an effect.

HYDE CLARKE.

TIMBER, AND SOME OF ITS DISEASES.[1]

X.

IN the months of April and May, the younger needle-like leaves of the Scotch pine are occasionally seen to have assumed a yellow tinge, and on closer examination this change in colour, from green to yellow, is seen to be due to the development of what look like small orange-coloured vesicles standing off from the surface of the epidermis, and which have in fact burst through from the interior of the leaf (Fig 31). Between these larger orange-

FIG. 31.—To the left is a pair of leaves of the Scotch pine, with the blister-like *Æcidia*, *a*, of *Peridermium Pini* (var. *acicola*) projecting from their tissues: these blisters are orange-yellow in colour, and contain spores, as shown in Fig. 33. Between the blisters are the minute *spermogonia*. *b* To the right is a small branch, killed at *a a a* by *Peridermium Pini* (var. *corticola*), the blister-like yellow *Æcidia* of the fungus being very conspicuous. (Reduced, after Hartig.)

yellow vesicles the lens shows certain smaller brownish or almost black specks. Each of the vesicular swellings is a form of fungus-fructification known as an *Æcidium*, and each of the smaller specks is a fungus-structure called a *Spermogonium*, and both of these bodies are developed from a mycelium in the tissues of the leaf. I must employ these technical terms, but will explain them more in detail shortly: the point to be attended to for the moment is that this fungus in the leaf has long been known under the name of *Peridermium Pini* (var. *acicola*, *i.e.* the variety which lives upon the needle-like leaves).

On the younger branches of the Scotch pine, the Weymouth pine, the Austrian pine, and some others, there may also be seen in May and June similar but larger bladder-like orange vesicles (*Æcidia*) bursting through the cortex (Fig. 31); and here, again, careful examination shows the darker smaller *Spermogonia* in patches between the *Æcidia*. These also arise from a fungus-mycelium in the

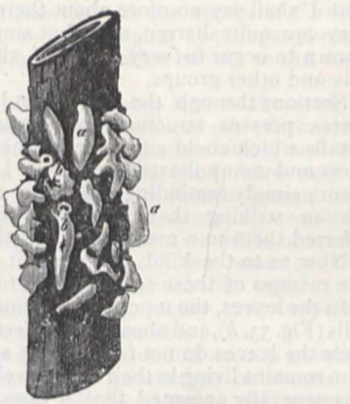


FIG. 32.—Blisters (*Æcidia*) of *Peridermium Pini* (var. *corticola*) on a branch of the Scotch pine: some of the *Æcidia* have already burst at the apex and scattered their spores, *b*, *b*; the others are still intact. (Natural size, after Hess)

tissues of the cortex, whence the fungus was named *Peridermium Pini* (var. *corticola*). It is thus seen that the fungus *Peridermium Pini* was regarded as a parasite of pines, and that it possessed two varieties, one inhabiting the leaves and the other the cortex: the "varieties" were so considered, because certain trivial differences were found in the minute structure of the *Æcidia* and *Spermogonia*.

If we cut thin vertical sections through a leaf and one of the smallest *Æcidia*, and examine the latter with the microscope, it will be found to consist of a mass of spores

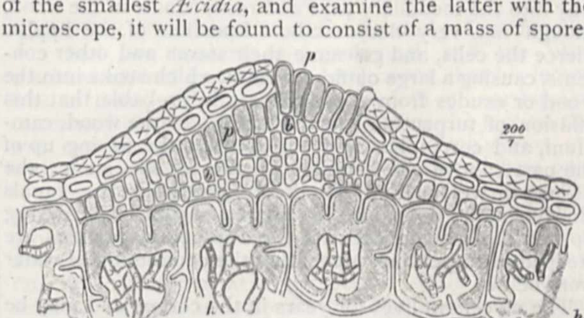


FIG. 33.—Vertical section through a very young *Æcidium* of *Peridermium Pini* (var. *acicola*), with part of the subjacent tissue of the leaf. *h*, the mycelium of the parasitic fungus running between the cells of the leaf: immediately beneath the epidermis of the leaf, the ends of the hyphæ give rise to the vertical rows of spores (*b*), the outermost of which (*p*) remain barren, and form the membrane of the blister-like body. The epidermis is already ruptured at *p* by the pressure of the young *Æcidium*. (After R. Hartig: highly magnified.)

arranged in vertical rows, each row springing from a branch of the mycelium: the outermost of these spores—*i.e.* those which form a compact layer close beneath the epidermis—remain barren, and serve as a kind of membrane covering the rest (Fig. 33, *p*). It is this membrane which protrudes like a blister from the tissues. The hyphæ of the fungus are seen running in all directions between the cells of the leaf-tissue, and as they rise up and form the vertical chains of spores, the pressure gradually forces up the epidermis of the leaf, bursts it, and the mass of orange-yellow powdery spores protrude to the exterior enveloped

[1] Continued from p. 272.

in the aforesaid membrane of contiguous barren spores. If we examine older *Æcidia*, it will be found that this membrane bursts also at length, and the spores escape.

Similar sections across a *Spermogonium* exhibit a structure which differs slightly from the above. Here also the hyphæ in the leaf turn upwards, and send delicate branches in a converging crowd beneath the epidermis; the latter gives way beneath the pressure, and the free tips of the hyphæ constrict off very minute spore-like bodies. These minute bodies are termed *Spermatia*, and I shall say no more about them after remarking that they are quite barren, and that similar sterile bodies are known to occur in very many of the fungi belonging to this and other groups.

Sections through the *Æcidia* and *Spermogonia* on the cortex present structures so similar, except in minute details which could only be explained by lengthy descriptions and many illustrations, that I shall not dwell upon them; simply reminding the reader that the resemblances are so striking that systematic mycologists have long referred them to a mere variety of the same fungus.

Now as to the kind and amount of damage caused by the ravages of these two forms of fungus.

In the leaves, the mycelium is found running between the cells (Fig. 33, *h*), and absorbing or destroying their contents: since the leaves do not fall the first season, and the mycelium remains living in their tissues well into the second year, it is generally accepted that it does very little harm. At the same time, it is evident that, if very many leaves are being thus taxed by the fungus, they cannot be supplying the tree with food materials in such quantities as if the leaves were intact. However, the fungus is remarkable in this respect—that it lives and grows for a year or two in the leaves, and does not (as so many of its allies do) kill them after a few weeks. It is also stated that only young pines are badly attacked by this form: it is rare to find *Æcidia* on trees more than twenty years or so old.

Much more disastrous results can be traced directly to the action of the mycelium in the cortex. The hyphæ grow and branch between the green cells of the true cortex, as well as in the bast-tissues beneath, and even make their way into the medullary rays and resin-canals in the wood, though not very deep. Short branches of the hyphæ pierce the cells, and consume their starch and other contents, causing a large outflow of resin, which soaks into the wood or exudes from the bark. It is probable that this effusion of turpentine into the tissues of the wood, cambium, and cortex, has much to do with the drying up of the parts above the attacked portion of the stem: the tissues shrivel up and die, the turpentine in the canals slowly sinking down into the injured region. The drying up would of course occur if the conducting portions are steeped in turpentine, preventing the conduction of water from below.

The mycelium lives for years in the cortex, and may be found killing the young tissues just formed from the cambium during the early summer: of course the annual ring of wood, &c., is here impoverished. If the mycelium is confined to one side of the stem, a flat or depressed spreading wound arises; if this extends all round, the parts above must die.

When fairly thick stems or branches have the mycelium on one side only, the cambium is injured locally, and the thickening is of course partial. The annual rings are formed as usual on the opposite side of the stem, where the cambium is still intact, or they are even thicker than usual, because the cambium there diverts to itself more than the usual share of food-substances: where the mycelium exists, however, the cambium is destroyed, and no thickening layer is formed. From this cause arise cancerous malformations which are very common in pine-woods (Fig. 34).

Putting everything together, it is not difficult to explain the symptoms of the disease. The struggle between the mycelium on the one hand, which tries to extend all round in the cortex, and the tree itself, on the other, as it tries to repair the mischief, will end in the triumph of the fungus as soon as its ravages extend so far as to cut off the water-supply to the parts above: this will occur as soon as the mycelium extends all round the cortex, or even sooner if the effusion of turpentine hastens the blocking up of the channels. This may take many years to accomplish.

So far, and taking into account the enormous spread of this disastrous disease, the obvious remedial measures seem to be, to cut down the diseased trees—of course this should be done in the winter, or at least before the spores come—and use the timber as best may be; but we must first see whether such a suggestion needs modifying, after learning more about the fungus and its habits. It appears clear, at any rate, however, that every diseased tree removed means a source of Æcidiospores the less.

Probably everyone knows the common groundsel, which abounds all over Britain and the Continent, and no doubt many of my readers are acquainted with other species of the same genus (*Senecio*) to which the groundsel belongs, and especially with the ragwort (*Senecio Jacobæa*). It has long been known that the leaves of these plants, and of several allied species, are attacked by a fungus, the mycelium of which spreads in the leaf-passages, and gives rise to powdery masses of orange-yellow spores, arranged in vertical rows beneath the stomata: these powdery masses of spores burst forth through the epidermis, but are not clothed by any covering, such as the *Æcidia* of *Peridermium Pini*, for instance. These groups of yellow spores burst forth in irregular powdery patches, scattered over the under sides of the leaves in July and August: towards the end of the summer a slightly different form of spore, but similarly arranged, springs from the same mycelium on the same patches. From the differences in their form, time of appearance, and (as we shall see) functions, these two kinds of spores have received different names. Those first produced have numerous papillæ on them, and were called *Uredospores*, from their analogies with the uredospore of the rust of wheat; the second kind of spore is smooth, and is called the *Teleutospore*, also from analogies with the spores produced in the late summer by the wheat-rust. The fungus which produces these uredospores and teleutospores was named, and has been long distinguished as, *Coleosporium Senecionis* (Pers.). We are not immediately interested in the damage done by this parasite to the weeds which it infests, and at any rate we might well be tempted to rejoice in its destructive action on these garden pests: it is sufficient to point out that the influence of the mycelium is to shorten the lives of the leaves, and to rob the plant of food material in the way referred to generally in my last article.

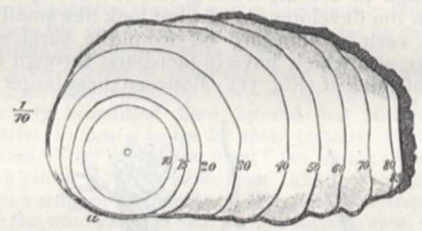


FIG. 34.—Section across an old pine-stem in the cancerous region injured by *Peridermium Pini* (var. *corticola*). As shown by the figures, the stem was fifteen years old when the ravages of the fungus began to affect the cambium near *a*. The mycelium, spreading in the cortex and cambium on all sides, gradually restricted the action of the latter more and more: at thirty years old, the still sound cambium only extended half-way round the stem—no wood being developed on the opposite side. By the time the tree was eighty years old, only the small area of cambium indicated by the thin line marked 80 was still alive; and soon afterwards the stem was completely "ringed," and dead, all the tissues being suffused with resin. (After Hartig.)

What we are here more directly interested in is the following. A few years ago Wolff showed that if the spores from the *Æcidia* of *Peridermium Pini* (var. *acicola*) are sown on the leaf of *Senecio*, the germinal hyphæ which grow out from the spores *enter the stomata of the Senecio leaf, and there develop into the fungus called Coleosporium Senecionis*. In other words, the fungus growing in the cortex of the pine, and that parasitic on the leaves of the groundsel and its allies, are one and the same: it spends part of its life on the tree and the other part on the herb.

If I left the matter stated only in this bald manner, it is probable that few of my readers would believe the wonder. But, as a matter of fact, this phenomenon, on the one hand, is by no means a solitary instance, for we know many of these fungi which require two host-plants in order to complete their life-history; and, on the other hand, several observers of the highest rank have repeated Wolff's experiment and found his results correct. Hartig, for instance, to whose indefatigable and ingenious researches we owe most that is known of the disease caused by the *Peridermium*, has confirmed Wolff's results.

It was to the brilliant researches of the late Prof. De Bary that we owe the first recognition of this remarkable phenomenon of *heterœcism*—*i.e.* the inhabiting

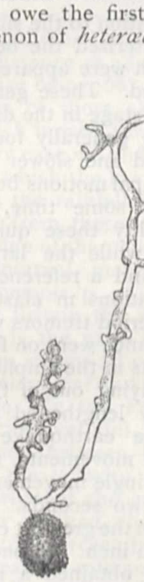


FIG. 35.—A spore of *Peridermium Pini* germinating. It puts forth the long, branched germinal hyphæ on the damp surface of a leaf of *Senecio*, and one of the branches enters a stoma, and forms a mycelium in the leaf: after some time, the mycelium gives rise to the uredospores and teleutospores of *Coleosporium Senecionis*. (After Tulasne: highly magnified.)

more than one host—of the fungi. De Bary proved that the old idea of the farmer, that the rust is very apt to appear on wheat growing in the neighbourhood of berberry-bushes, was no fable; but, on the contrary, that the yellow *Æcidium* on the berberry is a phase in the life-history of the fungus causing the wheat-rust. Many other cases are now known, *e.g.* the *Æcidium abietinum*, on the spruce firs in the Alps, passes the other part of its life on the Rhododendrons of the same region. Another well-known example is that of the fungus *Gymnosporangium*, which injures the wood of junipers: Oersted first proved that the other part of its life is spent on the leaves of certain Rosaceæ, and his discovery has been repeatedly confirmed. I have myself observed the following confirmation of this. The stems of the junipers so common in the neighbourhood of Silverdale (near Morecambe Bay) used to be distorted with *Gymnosporangium*, and covered with the *teleutospores* of this fungus every spring: in July all the hawthorn hedges in the neighbourhood had their leaves covered with the Æcidium form (formerly called *Ræstelia*), and it was quite easy to show that the fungus on the hawthorn leaves was produced by sowing the *Gymnosporangium* spores on them. Many other well-established cases of similar heterœcism could be quoted.

But we must return to the *Peridermium Pini*. It will be remembered that I expressed myself somewhat cautiously regarding the *Peridermium* on the leaves (var. *acicola*). It appears that there is need for further investigations into the life-history of this form, for it has been thought more than probable that it is not a mere variety of the other, but a totally different species.

Only so lately as 1883, however, Wolff succeeded in infecting the leaves of *Senecio* with the spores of *Peridermium Pini* (*acicola*), and developing the *Coleosporium*, thus showing that both the varieties belong to the same fungus.

It will be seen from the foregoing that in the study of the biological relationships between any one plant which we happen to value because it produces timber, and any other which grows in the neighbourhood there may be (and there usually is) a series of problems fraught with interest so deep scientifically, and so important economically, that one would suppose no efforts would be spared to investigate them: no doubt it will be seen as time progresses that what occasionally looks like apathy with regard to these matters is in reality only apparent indifference due to want of information.

Returning once more to the particular case in question, it is obvious that our new knowledge points to the desirability of keeping the seed-beds and nurseries especially clean from groundsel and weeds of that description: on the one hand, such weeds are noxious in themselves, and on the other they harbour the *Coleosporium* form of the fungus *Peridermium* under the best conditions for infection. It may be added that it is known that the fungus can go on being reproduced by the *uredospores* on the groundsel-plants which live through the winter.

H. MARSHALL WARD.

(*To be continued.*)

EARTHQUAKES AND HOW TO MEASURE THEM.[1]

PROF. EWING explained that the study of earthquakes had two aspects, one geological and the other mechanical, and it was of the latter alone that his lecture was to treat. The mechanical student of earthquakes concerned himself with the character of the motion that was experienced at any point on the earth's crust, and with the means by which an earthquake spread from point to point by elastic vibration of rock and soil. The first problem in seismometry was to determine exactly how the ground moved during an earthquake, to find the amount and direction of every displacement, and the velocity and rate of acceleration at every instant while the shaking went on. He was to deal with the solution of that problem, and to describe some of the results which had been obtained in the measurement of earthquakes in Japan, where earthquakes happened with a frequency sufficient to satisfy the most enthusiastic seismologist. Most early attempts to reduce the observing of earthquakes to an exact science had failed because they were based on a false notion of what earthquake motion was. It had been supposed that an earthquake consisted of a single or at least a prominent jerk, or a few jerks, easily distinguishable from any minor oscillations that might occur at the same time. The old column seismometer, for instance, recommended in the Admiralty Manual of Scientific Inquiry, attempted to measure what was called the intensity of the shock by means of a number of circular columns of various diameters which were set to stand upright like ninepins on a level base. It was expected that the shock

[1] Abstract of a Lecture delivered at the Royal Institution on Friday evening, June 1, by Prof. J. A. Ewing, F.R.S.

would overthrow the narrower columns, the broadest that fell serving to measure its severity, and that the columns would fall in a direction which would point to the place of origin of the disturbance. In fact, however, such columns fell most capriciously when they fell at all, and it was impossible to learn anything positive from their behaviour in an earthquake. The reason was that there was no single outstanding impulse: an earthquake consisted of a confused multitudinous jumble of irregular oscillations, which shifted their direction with such rapidity that a point on the earth's surface wriggled through a path like the form a loose coil of string might take if it were ravelled into a state of the utmost confusion. The mechanical problem in seismometry was to find a steady-point—to suspend a body so that some point in it, at least, should not move while this complicated wriggling was going on. The steady-point would then serve as a datum with respect to which the movement of the ground might be recorded and measured. The simple pendulum had often been suggested as a steady-point seismometer, but in the protracted series of oscillations which made up an earthquake the bob of a pendulum might, and often did, acquire so much oscillation that, far from remaining at rest, it moved much more than the ground itself. The lecturer illustrated this by showing the cumulative effect of a succession of small impulses on a pendulum when these happened to agree in period with the pendulum's swing. The fault of the pendulum, from the seismometric point of view, was its too great stability, and its consequently short period of free oscillation. To prevent the body whose inertia was to furnish a steady-point from acquiring independent oscillation, the body must be suspended or supported astatically; in other words, its equilibrium must be very nearly neutral. Methods of astatic suspension which had been used in seismometry were described and illustrated by diagrams and models, in particular the ball and block seismometer of Dr. Verbeck, the horizontal pendulum, and a method of suspension by crossed cords based on the Tchebicheff straight-line link-work.

The complete analysis of the ground's motion was effected by a seismograph which resolved it into three components, two horizontal and one vertical, and recorded each of these separately, with respect to an appropriate steady-point, by means of a multiplying lever, on a sheet of smoked glass which was caused to revolve at a uniform rate by clock-work. The clock was started into motion by the action of the earliest tremors of the earthquake on a very delicate electric seismoscope, the construction of which was shown by a diagram. In this way a record was deposited upon the revolving plate which gave every possible particular regarding the character of the earth's motion at the observing-station. A complete set of the instruments as now manufactured by the Cambridge Scientific Instrument Company was shown in action. Prof. Ewing also described his duplex pendulum seismograph, which draws on a fixed plate of smoked glass a magnified picture of the horizontal motion of the ground during an earthquake. Apparatus was shown for testing the accuracy of the seismographs by means of imitation earthquakes, which shook the stand of the instrument, and drew two diagrams side by side upon the glass plate—one the record given by the seismograph itself, and the other the record derived from a fixed piece which was held fast in an independent support. The agreement of the two records with one another proved how very nearly motionless the "steady-point" of the seismograph remained during even a prolonged shaking resembling an earthquake. This test was applied to the instruments on the table, and the close agreement of the two diagrams was exhibited by projecting them on the lantern-screen. A large number of autographic records of Japanese earthquakes were thrown on the screen, including several which have been already reproduced in this journal (NATURE, vol. xxx. p. 174, vol. xxxi. p. 581, vol. xxxvi. p. 107); and particulars were given of the extent of the motion, and the velocity and rate of acceleration, in some representative examples. To determine the rate of acceleration was of special interest, because it measured the destructive tendency of the shock. The lecturer explained that some of the seismograms exhibited on the screen had been obtained since he had left Japan by his former assistant, Mr. Sekiya, who now held the unique position of Professor of Seismology in the Imperial Japanese University. Prof. Sekiya had recently taken the pains to construct a model representing, by means of a long coil of copper wire carefully bent into the proper form, the actual path pursued by a point on the earth's surface during a prolonged and rather severe shaking. This model of an earthquake had been made by combining the three components of each successive displacement as these were recorded by a set of seismographs like those upon the lecture-table. The appearance of Prof. Sekiya's model (a description of which will be found in NATURE, vol. xxxvii. p. 297) was shown to the audience by means of the lantern.

Prof. Ewing drew attention to the small tremors of high frequency which characterized the beginnings of earthquake motion, and which were apparent in a number of the diagrams he exhibited. These generally disappeared at a comparatively early stage in the disturbance. In the early portion they were generally found at first alone, preceding the larger and slower principal motions; and then when the principal motions began, small tremors might still be seen for some time, superposed upon them. In all probability these quick-period tremors were normal vibrations, while the larger motions were transverse vibrations; and a reference to the theory of the transmission of vibrations in elastic solids served to explain why the quick-period tremors were the first to be felt. The whole disturbance went on for several minutes, with irregular fluctuations in the amplitude of the motion, and with a protracted dying out of the oscillations, the period of which usually lengthened towards the close. The record of a single earthquake comprised some hundreds of successive movements, to and fro, round fantastic loops. Each single movement usually occupied from half a second to two seconds. Earthquakes were quite perceptible in which the greatest extent of motion was no more than 1/100 of an inch. In one case, on the other hand, Prof. Sekiya had obtained a record in which the motion was as much as an inch and three-quarters. Even that was in an earthquake which did comparatively little damage, and there was therefore reason to expect that in a severely destructive shock (such as had not occurred since the present system of seismometry was developed) the motion might be considerably greater.

Prof. Ewing concluded his lecture by pointing out that seismographs might find practical application in measuring the stiffness of engineering structures. He exhibited, by the lantern, seismographic records he had recently taken on the new Tay Bridge, to examine the shaking of the bridge during the passage of trains. The instrument had been placed on one of the great girders, two-thirds of a mile from the Fife end, at a place where there was reason to expect the vibration would be a maximum. The extent of motion was remarkably small. It was less than an eighth of an inch, even while the train was passing the seismograph—a fact which spoke well for the stiffness of the structure. Nevertheless, by watching the index of the seismograph he had been able to tell whenever a train came on at the Dundee end of the bridge, a distance of 1⅓ mile from the place where the instrument was standing. One could then detect a vibratory motion, the extent of which was probably not more than 1/500 of an inch. This began in the longitudinal direction, and for some time longitudinal vibration only could be seen. As the train came nearer, lateral vibration also began, and the amplitude of course increased. It reached a maximum when the train was close to the seismograph, and continued visible until the train had passed off the bridge at the other end.

DOES PRECIPITATION INFLUENCE THE MOVEMENT OF CYCLONES?

IN Prof. Elias Loomis's first "Contribution to Meteorology," in the *American Journal of Arts and Science*, he examined the distribution of rain around 152 storms (cyclones) in the United States, in order to determine whether there exists any relation between the velocity of a storm's progress and the extent of the accompanying rain area. He found that "the average extent of the rain area on the east side of the storm's centre is 500 miles; and when the rain area extends more than 500 miles, the storm advances with a velocity greater than the mean; but when the extent of the rain area is less than 500 miles, the storm advances with a velocity less than the mean." In his twelfth "Contribution" he examined 39 storms which moved with exceptional velocity (1000 miles or more per day) and found that "the rain area generally extended a great distance in advance of the storm centre, the average distance being 667 miles." Finally, Loomis examined 29 cases of those abnormal cyclones in the United States which moved toward the west. He says:—"In nearly every case we find a fall of rain or snow in the region toward which the low centre advanced, and in most of the cases the rainfall was unusually great. . . . It may be inferred from these comparisons that the fall of rain or snow is one of the most important causes which determine the abnormal movements of areas of low pressure" (ninth memoir, p. 44). Ley and Abercromby state that in Great Britain the relation of the weather to the cyclone centre is the same whatever the path of the cyclone; thus when storms advance toward the west the greatest cloud development and rainfall is to the west of the cyclone centre. In the Proceedings of the Royal Meteorological Society, vol. xliii., Abercromby gives a table showing the relation between the intensity of "trough phenomena" and the velocity of cyclones. This table indicates very clearly that the greater the velocity of the cyclone the more marked the "trough phenomena." Hence, according to Abercromby's definition of "trough phenomena" the heaviest rain and cloud areas are massed toward the front of rapidly advancing cyclones, while immediately after the passage of the line of minimum pressure the sky begins to show signs of clearing. This is especially well marked in cyclones passing off the north-east coast of the United States. When the cyclones are moving with unusual rapidity, not only all the rain, but almost all of the cloud area is confined to the front half of the cyclone.

Loomis suggested that the excess of rain in front of rapidly advancing cyclones was one of the causes of the rapid advance; but when investigating heavy rainfalls in the United States he concludes that "the forces which impart that movement to the air which is requisite to an abundant precipitation of vapour, instead of deriving increased strength from the great volume of rain, rapidly expend themselves and become exhausted;" and after examining certain cyclones which were accompanied by no rain he adds: "So that it seems safe to conclude that rainfall is not essential to the formation of areas of low barometer, and is not the principal cause of their formation or of their progressive movement." Hann arrives at similar conclusions from investigations in Europe. After investigating an especially heavy rainfall which occurred in Austria and vicinity in August 1880, he concludes thus:—"The appearance of a barometric minimum in Hungary occasioned abnormal and extended precipitation on the west and north-west side of this barometric depression. The reaction of this precipitation on the position of the centre of the depression is scarcely perceptible. . . . We find, therefore, through the investigation of the relative lowest barometer reading in its behaviour to rainfall, that our former conclusions are confirmed" (lxxxii. *Bunde d. Wiss.* ii. Ab., November 1880). This investigation does not necessarily prove that precipitation does not appreciably influence the movements of cyclones in general, but at least suggests that in the first cases mentioned above the unequal distribution of rain around rapidly moving cyclones was not the cause, but the result of the cyclone's advance. In cyclones which move very slowly, as do tropical cyclones, the air ascends almost uniformly around the centre; but when cyclones have a more rapid progressive motion, the air in the rear, which has not only to enter, but to follow the cyclone, is more retarded by friction than the air in front, and hence does not enter the cyclone so freely, so that the formation of cloud and rain in the rear is retarded; while, on the other hand, a larger volume of new air enters the progressing cyclone in front, and increases the amount of precipitation. Thus, between February 12 and 14, a cyclone passed across the American continent with the exceptionally high velocity of 58 miles per hour. During its passage the highest wind velocity reported on any of the United States Signal Service morning weather maps was 40 miles per hour, occurring immediately in the rear of the cyclone at Father Point, Can., on the morning of the 14th. At none of the other 130 stations did the maps show a wind velocity exceeding 30 miles per hour during the passage of the cyclone. This is an example of many similar cases which show that in rapidly moving cyclones the air in the rear near the earth's surface does not move as rapidly as the cyclone itself. Hence, it seems evident that the air near the surface immediately in the rear of these cyclones is not air which has followed the cyclone near the surface, but air which has descended from above. Espy showed many years ago that, on account of mechanical heating by compression, no descending air can be accompanied by precipitation; and an explanation is thus afforded why there is none, or but little cloud and precipitation in the rear of rapidly moving cyclones. On the other hand, in order that a cyclone may advance rapidly, there must be a rapid decrease in pressure, and consequently a rapid removal of the air, in front of the advancing depression. Since, according to the normal circulation of a cyclone, there is an inward movement near the earth's surface and an upward and outward movement near the top, this upward and outward movement is necessarily increased in unusually rapid-moving cyclones, and hence also the cloudiness and precipitation are increased.

Hourly observations of cloud movements made during the day hours for nearly two years at Blue Hill Observatory indicate that the velocity of storm movement, and especially the variability of the weather, are intimately connected with the velocity of movement of the general atmosphere.

The writer is hence led to believe that the main cause of rapid cyclone progression is an unusually rapid drifting of the atmosphere over large regions; and the unequal distribution of rain around the cyclone is due to the rapid progress of the cyclone.

H. HELM CLAYTON.

Blue Hill Observatory, Boston, June 18.

NOTES.

MR. JOHN WHITEHEAD returned to Labuan in safety from his second expedition to Kina Balu, and is daily expected in England. He ascended the mountain to its summit, and attained to an altitude of 13,500 feet. His collection will contain many novelties, the small portion sent by him in advance to Mr. Bowdler Sharpe exhibiting many curious features. The new species will be described by Mr. Sharpe in the forthcoming number of the *Ibis*, and four genera and twelve species appear to be quite new to science. Mr. Whitehead spent altogether eight months on the mountain of Kina Balu, and is at present known to have discovered thirty-one new species of birds. On his last expedition he met with fifteen different kinds of rodents, and his collections of reptiles and insects are also very large.

MR. ALFRED EVERETT, the well-known explorer of Borneo and the Philippine Islands, has had to return to England to recruit his health, sorely shattered by his nineteen years' residence in the tropics. He has brought with him a collection of birds and animals, amongst which are apparently many interesting species. He also discovered in the Brunei district the nest of *Machærhamphus alcinus*, the curious crepuscular Honey-Kite of the East, but unfortunately the tree in which it was placed proved to be inaccessible. This remarkable genus of Hawks occurs in the Malayan peninsula, Borneo, and again in New Guinea. It has an Ethiopian representative, *M. anderssoni*, which inhabits Damara Land and Madagascar.

THE summer meeting of the Institution of Mechanical Engineers will be held in Dublin on Tuesday, 31st inst., and the two following days, under the presidency of Mr. Edward H. Carbutt. An influential Committee has been formed for the reception of the Institution, under the chairmanship of Lord Rosse, F.R.S. On Friday, August 3, a visit will be paid to Belfast, on the invitation of a local Committee presided over by the Mayor, Sir James H. Haslett.

THE half-yearly general meeting of the Scottish Meteorological Society was held in the hall of the Royal Scottish Society of Arts, Edinburgh, on Monday, July 23, at two p.m. The following was the "business":—(1) Report from the Council of the Society; (2) the temperature of the air and surface-water of the North Atlantic, by H. N. Dickson; (3) the climate of the Isle of Man, by A. W. Moore; (4) note on earth currents on Ben Nevis, in connection with anticyclones, by R. T. Omond; (5) St. Elmo's fire observed at the Ben Nevis Observatory, by A. Rankin. Photographs of clouds, &c., from Ben Nevis were exhibited.

THE Berlin Academy has granted to Dr. R. von Lendenfeld the sum of 1000 marks to aid him in investigating the physiological functions, chiefly the digestion, of sponges.

A HUNGARIAN deputy, M. Hlavka, has given a sum of 200,000 florins towards the establishment of a Czeck Academy of Science at Prague.

THE death of Prof. H. Carvill Lewis, in the full vigour of manhood and of work, will be a painful surprise to many friends on both sides of the Atlantic. He died of typhoid fever at Manchester on July 21, a few days after landing in England, at the beginning of a journey undertaken in continuance of his investigations into the glacial deposits of Europe.

THE death is announced of Dr. Ludwig Julius Budge, the eminent physiologist and anatomist. He was born at Wetzlar, September 6, 1811, and died at Greifswald on July 14.

THE Geologists' Association have issued the programme of a long excursion to the Forest of Dean, Wye Valley, and South Wales, from August 6 to 11.

THE *Revue Internationale*, published at Rome, contains a description of the eighth centenary of the University of Bologna, and a dignified reply to the criticisms of the correspondent of the *Times*. The correspondent maintained that all delegates of foreign Universities, including American Colleges, ought to have received honorary degrees, without saying what the number and what the value of such distinctions would have been. The honorary degree was given "*agli scienziati saliti in altissima fama*," and this would hardly apply to all the chosen or self-constituted representatives of the world's Universities. We quote the folowing words from the article in the *Revue Internationale* for July:—"Il a paru dans le *Times* quelques correspondances très acerbes, sans grande portée cependant, étant donné le caractère du journal. En lisant le *Times*, la pensée du lecteur se reporte souvent instinctivement à ce Sir John Davenne, qui, au dire de Ruffini, était un parfait galant homme, un vrai gentilhomme, mais auquel il pouvait arriver—un peu par l'effet de son caractère individuel, un peu par l'effet du caractère national—de ne pas se montrer trop impartial, trop juste, ni trop tempéré dans ses jugements."

DESPATCHES have been received from Dr. Nansen announcing the safe departure of his expedition for Greenland from the Isa Fjord, in Iceland, on board the steam whaler *Jason*.

AN astronomical observatory is about to be erected within the walls of the Foreign College at Pekin.

A CORRESPONDENT of an English newspaper published in China furnishes the following account of the new foreign College being erected at Tientsin by the Viceroy Li Hung Chang:—"In coming up the Peiho to Tientsin, the first object of importance that will now strike the eye of a stranger is the new College building which is being erected just outside the mud rampart by the Viceroy, for the instruction of Chinese youth in the mysteries of the English language and of foreign science. This is a massive edifice, two stories high, built around the four sides of a square which forms a large interior court not less than one hundred feet on either side, around which, on the inner sides of the buildings, are spacious verandas. The construction of the building, under the careful supervision of a capable foreign engineer, is all that could be desired. If the educational results are equal to what has been accomplished by brick and mortar, the Viceroy will have great occasion to be proud that he has been privileged to start such an institution. It was hoped that the College would be ready for opening this autumn, but there seems little prospect that it can be opened before next spring."

IT is reported from China that Dr. Dudgeon, of Pekin, has published in Chinese a work on anatomy which he has had in preparation for some years; that a companion work on materia medica is in the press, with treatises on physiology and photography, in the latter of which the dry process is explained. Dr. Dudgeon is also preparing bi-lingual vocabularies of medical and anatomical terms.

WE are glad to learn that the Mikado of Japan has been pleased to bestow the Order of the Rising Sun on Prof. John Milne, of the Imperial University of Tokio, the well-known investigator of seismic phenomena.

VOL. II. Part 1 of the Journal of the College of Science of the Japanese Imperial University, contains an important summary by Prof. Sekiya of the results of seismometric observations in Tokio during two years, from September 1885 to September 1887, with special reference to the measurements of vertical motion. The observations recorded by Prof. Sekiya were for the most part made with Prof. Ewing's seismographs, some on the soft marshy ground of the lower part of the city, and some on the stiff soil of the upper parts. Particulars are recorded very fully for 119 earthquakes in a table setting forth the greatest horizontal and vertical motion, the period of the motion, the maximum velocity and rate of acceleration, the duration of the disturbance, and the approximate locality of the origin. At the end of the paper the results are collated, and averages are deduced, from which it appears that the greatest horizontal motion is about six times the greatest vertical motion in those earthquakes in which vertical motion was sensible. These, however, formed only 28 per cent. of the whole number recorded. The period of the vertical motion was little more than half that of the horizontal. In only 18 per cent. of the recorded shocks was the extent of motion greater than one millimetre. The paper forms the most extensive collection of data in absolute seismometry that has yet been published, and is a very valuable contribution to seismology.

ACCORDING to a telegram sent through Reuter's agency from Yokohama on July 18, a volcanic eruption had occurred at Makamats (? Takamatsu). Four hundred persons are reported to have been killed and 1000 injured.

IN our issue of the 6th October last (vol. xxxvi. p. 546) we drew attention to the useful work of Mr. Wragge, the Government meteorologist of Queensland, in issuing daily weather charts for Australasia. The entire meteorological observing-system of that colony is in course of reconstruction, upon the lines adopted by the Meteorological Office in London and other similar institutions abroad, and Mr. Wragge invites attention to the new series of weather charts now prepared at 9h. a.m. daily (except Sundays and holidays), files of which are kept at the Meteorological Office and at the office of the agent for Queensland, both in Victoria Street. The charts, which are on a large scale, contain observations received by wire from seventy-two selected observatories distributed over the Australian continent, Tasmania, and New Zealand, show very clearly the general atmospherical conditions, and contain besides collated information from about 300 smaller stations. A prominent feature in the new meteorological service is the preparation of a complete digest of the meteorological conditions of each colony, together with forecasts, which are issued about 5h. p.m. to the press. These publications have, of course, a special value to men of science generally, while to those interested in agricultural and shipping pursuits they have a practical bearing hitherto unequalled in Australia.

THE Pilot Chart of the North Atlantic Ocean for July shows that no severe cyclonic storms entirely crossed that ocean in June, but two or three depressions were formed in the mid-Atlantic, and caused gales off the Irish coast from the 8th to the 12th inclusive. Much fog was experienced off the American coast, north of Hatteras, and in the English Channel, and in the early part of the month fog-banks were frequently met with east of the 40th meridian. Icebergs and field ice have been encountered, principally off the eastern and southern coasts of Newfoundland. A few bergs, however, have been seen as far south as the 43rd parallel, in longitude 43° west. The chart also contains valuable information with reference to the West India hurricanes which are now likely to be encountered.

IN the Berlin *Meteorologische Zeitschrift* for June, Dr. Hann gives an interesting account of the winter temperature of Werchojansk (Siberia), deduced from several years' observations. The town, which lies in the valley of the Jana, about 9 feet above the level of the river, in latitude 67° 34′ N., longitude 133° 51′ E., and at a height of about 350 feet above the sea, has the greatest winter cold that is known to exist upon the globe. Monthly means of − 58° F. occur even in December, a mean temperature which has been observed nowhere else in the Polar regions; and minima of − 76° are usual for the three winter months (December–February). In the year 1886 March also had a minimum − 77°, and during that year December and January never had a minimum above − 76°, while in January, 1885, the temperature of − 89° was recorded. These extreme readings are hardly credible, yet the thermometers have been verified at the St. Petersburg Observatory. To add to the misery of the inhabitants, at some seasons the houses are inundated by the overflow of the river. The yearly range of cloud is characteristic of the climate; in the winter season the mean only amounts to about three-tenths in each month.

A NEW base has been discovered in tea by Dr. Kossel, of Berlin. It appears to be an isomer of theobromine, the well-known base present in cocoa-beans, possessing the same empirical formula, $C_7H_8N_4O_2$, but differing very materially in physical and certain chemical properties. The new base, to which has been assigned the name theophylline, was discovered during the investigation of large quantities of tea-extract, which, after treatment with sulphuric acid to remove foreign matters, was saturated with ammonia-gas and precipitated with ammoniacal silver solution. The silver precipitate was then digested with warm nitric acid, and, on cooling, the silver salt which separated out was filtered off and the filtrate rendered slightly alkaline with ammonia. On allowing this alkaline liquid to stand until the next day, a brownish deposit was noticed, which, on examination, proved to be the silver compound of a new base. The solution was therefore further concentrated, and a second and much larger yield of the silver salt obtained. This was next decomposed by sulphuretted hydrogen, the free base being thus obtained in solution. The liquid, after removal of the silver sulphide by filtration, deposited on standing a small quantity of xanthine, $C_5H_4N_4O_2$, a derivative of uric acid, whose presence in tea has previously been shown. The mother-liquors were afterwards treated with mercuric nitrate solution, which precipitated the theophylline in the form of a mercury compound, from which the base itself could readily be obtained by treatment with sulphuretted hydrogen as before. Analyses of the theophylline obtained after purification indicate the formula $C_7H_8N_4O_2$, which is that of theobromine. But the two substances are certainly not identical: their crystals are quite distinct, those of theophylline containing one molecule of crystal water which is expelled at 110°, while theobromine crystallizes anhydrous. The crystals also are totally unlike those of the other known isomer of theobromine, paraxanthine, from which theophylline differs most materially in its behaviour with soda. Again, the melting-points of the three isomers are considerably removed from each other, and their different solubilities in water are conclusive proofs of their different internal structures. Theophylline forms a well-crystallized series of salts with the mineral acids, and with platinum, gold, and mercury chlorides; and, like theobromine, yields with silver nitrate a silver substitution-compound, $C_7H_7AgN_4O_2$, which, as may be concluded from the above method of isolation, is readily soluble in nitric acid. Finally, to complete the proof of its isomerism with theobromine, which is the dimethyl derivative of xanthine, the silver compound was found to react with methyl iodide to form tri-methyl xanthine, better known as caffeine or theine, the remarkable base of the coffee and tea plants.

IN a letter lately submitted to the Elliott Society, and printed in its Proceedings, Mr. G. W. Alexander, of Charleston, S.C., tells a strange tale of a humming-bird. Mr. Alexander heard in his garden what he knew must be a cry of pain; and going to a vine, from which the cry seemed to proceed, he found a humming-bird "struggling violently, but unable to extricate itself." He took it in his hands, and, to his astonishment, saw that it was in the clutches of an insect, which he identified as a mantis, popularly known in those parts as "Johnny-cock-horse." "The bird," says Mr. Alexander, "was wounded under the wing, upon one side of the breast, which had evidently been lacerated with the powerful mandibles of its captor. The wound looked ugly enough to lead me to fear that it would prove fatal; nevertheless my children and I cared for it as tenderly as we knew how, but we found it difficult to administer nourishment to a humming-bird. So at night I placed it among the leaves of the vine—for it was a warm night—and in the morning the little sufferer lay dead on the ground beneath."

A SERIES of volumes to be entitled the "Fauna of British India," containing descriptions of the animals found in British India and its dependencies, including Ceylon and Burma, is about to be issued, under authority from the Government. For the present the work will be restricted to vertebrate animals. The editorship has been intrusted by the Secretary of State for India in Council to Mr. W. T. Blanford, formerly of the Geological Survey of India, and the printing and publication to Messrs. Taylor and Francis. The descriptions of vertebrates will occupy seven volumes, of which one will be devoted to mammals, three to birds, one to reptiles and Batrachians, and two to fishes. The mammals will be described by Mr. Blanford, the reptiles and Batrachians by Mr. G. A. Boulenger, of the British Museum, and the fishes by Mr. F. Day, Deputy Surgeon-General. The arrangements for the volumes on birds are nearly complete, and there is every probability of their being undertaken by a competent Indian ornithologist very soon. A half-volume of mammals will be issued immediately. It is expected that one or two volumes will be published each year. The work will be illustrated by cuts.

MESSRS. SAMPSON LOW will publish shortly the "Life and Correspondence of Abraham Sharp," the Yorkshire mathematician and astronomer, with memorials of his family, by William Cudworth. The work will be illustrated with numerous drawings specially prepared for it. Abraham Sharp, a member of an ancient family at Horton, near Bradford, was assistant in 1689 to Flamsteed, the first Astronomer-Royal, and designed and fixed the mural arc and other astronomical instruments with which the Astronomer-Royal made his observations at Greenwich Observatory. He also computed the places of many of the fixed stars in Flamsteed's famous "Catalogue," and was the principal means of completing and publishing the second and third volumes of the "Historia Celestis," published after Flamsteed's death. For many years after Abraham Sharp left the Observatory, a correspondence was kept up between him and Flamsteed, which gives much insight into many of the scientific events of the period, and especially refers to the difficulties experienced by Flamsteed in the publication of his great work, and to the doings of his contemporaries, Sir Isaac Newton, Dr. Halley, Sir Christopher Wren, and others. This correspondence will form the basis of Mr. Cudworth's work.

THE third number of vol. vi. of the Proceedings of the Bath Natural History and Antiquarian Field Club has been issued. Among the contents are the following papers: on some Ostracoda from the fullers' earth Oolite and Bradford clay, by Prof. T. Rupert Jones, F.R.S., and C. Davies Sherborn; landslips and subsidences, by W. Pumphery; remarks on some Hemiptera-Heteroptera taken in the neighbourhood of Bath, by Lieut.-Colonel Blathwayt; recent "finds" in the Victoria gravel pit, by the Rev. H. H. Winwood; note on *Webbina irregularis* (d'Orb.) from the Oxford clay at Weymouth, by C. Davies Sherborn.

MESSRS. WILLIAM WESLEY AND SON have issued No. 90 of their "Natural History and Scientific Book Circular." It contains lists of works relating to astronomy and mathematics.

THE heat in Norway this summer is most intense, the temperature exceeding any registered this century. At Christiania the thermometer has several times registered 30° to 32° C. in the shade, and at Nyborg, in the Varanger Fjord, near the White Sea, it was 35° C. at the end of June.

ON July 15 a remarkable mirage was seen, about 11 p.m., at Hudiksvall, on the Baltic. It represented a ship going down in a terribly agitated sea, a boat being on the point of putting off from the vessel. The mirage lasted five minutes.

A CURIOUS ornithological phenomenon is witnessed at Oddernæs, in the south of Norway, this season, the ring throstle (*Turdus torquatus*) nesting there. Generally, the bird only breeds in the extreme north. Prof. Esmark is of opinion that the present unusual occurrence is due to the severity of the spring.

DURING the spring of the present year some 200 eider-fowl were caught in fishermen's nets on the south coast of Sweden.

THE remains of several prehistoric canoes have been found at the bottom of some lakes drained off in uplands in Central Sweden. They were made by the hollowing out of trunks of trees by fire. One had evidently been sunk on purpose, being full of large stones.

AN unusually large skull of the *Rhinoceros tichorrhinus* was lately discovered in a well-preserved condition at Rixdorf, near Berlin. It has been sent to the Natural History Museum of Berlin.

THE additions to the Zoological Society's Gardens during the past week include a Green Monkey (*Cercopithecus callitrichus* ♀) from West Africa, presented by Mrs. Holden; a Rhesus Monkey (*Macacus rhesus* ♂) from India, presented by Mr. Herbert C. Oates; two Californian Quails (*Callipepla californica* ♂ ♂) from California, presented by Mrs. Fanny Lloyd; a Lesser Kestrel (*Tinnunculus cenchris*) European, presented by Mr. Harold Hanauer, F.Z.S.; two Æsculapian Snakes (*Coluber æsculapii*) from Germany, presented by Mr. P. L. Sclater, F.R.S.; seven Slender-fingered Frogs (*Leptodactylus pentodactylus*) from Dominica, W.I., presented by Dr. H. A. A. Nicholls; two American Black Bears (*Ursus americanus* ♂ ♀) from North America, a Grey Parrot (*Psittacus erithacus*, white var.) from West Africa, an Æsculapian Snake (*Coluber æsculapii*) from Germany, a Tabuan Parrakeet (*Pyrrhulopsis tabuensis*) from the Fiji Islands, deposited.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1888 *JULY* 29—*AUGUST* 4.

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on July 29

Sun rises, 4h. 22m.; souths, 12h. 6m. 11·1s.; sets, 19h. 51m.: right asc. on meridian, 8h. 36·5m.; decl. 18° 36′ N. Sidereal Time at Sunset, 16h. 23m.

Moon (at Last Quarter July 30, 20h.) rises, 22h. 31m.*; souths, 4h. 46m.; sets, 11h. 13m.: right asc. on meridian, 1h. 14·8m.; decl. 2° 21′ N.

Planet.	Rises. h. m.	Souths. h. m.	Sets. h. m.	Right asc. and declination on meridian. h. m.	° ′
Mercury..	2 48	10 44	18 40	7 13·7	20 26 N.
Venus	4 44	12 28	20 12	8 57·9	18 31 N.
Mars	12 43	17 34	22 25	14 5·1	13 55 S.
Jupiter	14 42	19 6	23 30	15 37·8	18 39 S.
Saturn	4 36	12 19	20 2	8 49·1	18 29 N.
Uranus	10 42	16 21	22 0	12 51·7	4 52 S.
Neptune..	23 44*	7 31	15 18	4 0·8	18 57 N.

* Indicates that the rising is that of the preceding evening.

Comet Sawerthal.

	h.	Right Ascension. h. m.	Declination. ° ′
July. 29	0	1 6·4	53 4 N.
Aug. 2	0	1 4·6	53 37

July. 29 ... 21 h. ... Mercury at greatest elongation from the Sun 19° west.

Aug. 2 ... 1 h. ... Saturn in conjunction with the Sun.

Occultations of Stars by the Moon (visible at Greenwich).

July.	Star.	Mag.	Disap.	Reap.	Corresponding angles from vertex to right for inverted image.
			h. m.	h. m.	° °
31	*f* Tauri	4	23 44	0 22†	25 297
Aug.					
2	B.A.C. 1351	6½	2 20	3 6	112 205
2	63 Tauri	6	2 44	near approach	158 —
4	χ^3 Orionis	6	1 52	2 4	346 319
4	χ^4 Orionis	5	1 58	2 36	109 195

† Occurs on the following morning.

Variable Stars.

Star.	R.A. h. m.	Decl. ° ′		h. m.	
U Cephei	0 52·4	81 16 N.	July 30,	20 30	*m*
			Aug. 4,	20 9	*m*
Algol	3 0·9	40 31 N.	July 31,	2 24	*m*
			Aug. 2,	23 13	*m*
U Monocerotis	7 25·5	9 33 S.	,, 1,		*M*
U Canis Minoris	7 35·3	8 39 N.	July 31,		*m*
U Virginis	12 45·4	6 10 N.	Aug. 1,		*M*
R Hydræ	13 23·6	22 42 S.	,, 1,		*m*
δ Libræ	14 55·0	8 4 S.	,, 2,	23 52	*m*
U Coronæ	15 13·6	32 3 N.	,, 2,	4 0	*m*
U Ophiuchi	17 10·9	1 20 N.	July 29,	3 36	*m*
			and at intervals of	20 8	
W Sagittarii	17 57·9	29 35 S.	Aug. 1,	1 0	*m*
Z Sagittarii	18 14·8	18 55 S.	,, 4,	1 0	*M*
U Sagittarii	18 25·3	19 12 S.	July 30,	0 0	*M*
S Vulpeculæ	19 43·8	27 1 N.	Aug. 4,		*m*
η Aquilæ	19 46·8	0 43 N.	,, 2,	3 0	*M*
R Sagittæ	20 9·0	16 23 N.	,, 2,		*m*
X Cygni	20 39·0	35 11 N.	,, 4,	1 0	*m*
T Vulpeculæ	20 46·7	27 50 N.	,, 2,	2 0	*M*
			,, 3,	3 0	*m*
δ Cephei	22 25·0	57 51 N.	July 30,	2 0	*M*

M signifies maximum ; *m* minimum.

Meteor-Showers.

	R.A. °	Decl. °	
Near δ Andromedæ	7	31 N.	Swift ; streaks.
The *Perseids*	33	55 N.	Swift ; streaks.
Near β Persei	48	42 N.	Very swift ; streaks.
	350	52 N.	Very swift.

GEOGRAPHICAL NOTES.

THE *Mittheilungen* of the Vienna Geographical Society for June has a paper by Dr. Hans Meyer on the German East African possessions which is likely to attract some attention at the present juncture. No attempt is made to give either the area or the population of this ill-defined region, which, however, is stated to comprise the central section of the East African coastlands, terraces, and plateaux for a distance north and south of about 550 geographical miles, and 150 east and west between the Swaheli coast and the water-parting towards the Congo basin. It is conterminous towards the north with the new British East African protectorate, from which it is separated by a conventional line passing from Lake Victoria Nyanza in an oblique direction along the north foot of Mount Kilima-Njaro to the coast at about 5° S. lat. below Mombasa. Southwards the frontier is marked by the Rovuma River, and another conventional line running thence west to Lake Nyassa, while on the east side it is made to reach the Indian Ocean, thus apparently absorbing the ten mile zone of coastlands reserved to the Sultan of Zanzibar by the Anglo-German Convention of October 29, 1886. It is described as orographically and hydrographically the most diversified region in the whole of Africa, including within its limits the highest summit (Kilima-Njaro) as well as the head-waters of streams flowing north to the Nile, west to the Congo, and south to the Zambesi basin. Hence it presents a great variety of climate and vegetation, but nevertheless, except in a few favoured spots, it is not to be compared in productiveness with the rich tropical lands of the Eastern Archipelago. Its prospects as a future field of German colonial enterprise are spoken of in depressing terms. Both servile and free labour in the interior are stated to be alike impracticable, and for the present at least it will be impossible to develop any great commercial activity except on the fertile and more thickly-peopled, but also mostly fever-stricken coastlands. Hence a foundation for the future development of the colony is stated to have been laid by the recently-accomplished transfer of the administration of the seaboard from the Sultan of Zanzibar to the German East African Company's agents. But it is added that even here, without State aid, it will be difficult successfully to compete with their English rivals, who have been longer in possession of the field, and who have at their disposal more capital and resources of all kinds.

ELECTRICAL NOTES.

KUNDT (*Phil. Mag.*, July 1888) has determined experimentally that there exists a proportionality between the velocity of light, electric conductivity, and conduction of heat in metals. The velocity of red light is proportionately as follows—

Silver	100	Iron	14·9
Gold	71	Nickel	12·4
Copper (impure)	60	Bismuth (crystallized)	10·3
Platinum	15·3		

The order is the same for heat and electricity. These figures were obtained in each instance by determining the index of refraction of each metal, which is the ratio of the velocity of light *in vacuo* to its velocity in the metal. The actual indices obtained were, for red light—

Silver	0·27	Iron	1·81
Gold	0·38	Nickel	2·17
Copper	0·45	Bismuth	2·61
Platinum	1·76		

Thus the velocity of light in silver is ten times that in bismuth. How is the velocity of light affected by temperature? and how is it changed by a magnetic field? Kundt proposes to examine these points.

PROF. ELIHU THOMSON (U.S.A.) states that he has observed as many as six lightning-flashes very quickly following each other along the same path. He kept his head rapidly wagging during a thunderstorm, and his eyes fixed in one direction. Most people have experienced a peculiar throbbing during a flash of lightning; and a succession of rapid currents, sometimes forming letters, are observed on telegraphs. A lightning discharge may therefore have the same oscillatory character as the discharge of a Leyden jar. But no trace of such an effect is visible in the photographs of lightning-flashes unless it be the mysterious dark flashes that have been recorded.

CHAPERON AND MERCADIER (*Comptes rendus*, cvii., June 4, 1888) have shown that the periodic incidence of rays of light upon a cell of silver sulphide, H_2SO_4, and bright silver produces sounds in a telephone by the corresponding variations of E.M.F. They call the effect electro-chemical radiophony. The cell copper-oxide, sodium chloride, copper also forms an electro-chemical radiophone.

E. G. ACHESON (*Electrical World*, N.Y., July 7, 1888) has made some very useful measurements on the sparking distance in air of alternate currents used in electric light working. He finds that it varies with the capacity of the circuit and with the *cube of the E.M.F.* It is expressed by

$$d = \frac{E^3K}{a},$$

d being the sparking distance in inches, E and K being in B.A. units, and a a constant = 135. Two thousand volts, with 0·0032 microfarad in circuit, sparked about 0·2 inch, and 1000 volts about 0·02 inch. These results are very different from those obtained by Warren De la Rue with his great battery, who found that with direct currents 1200 volts sparked across 0·012 inch and 2400 volts across 0·021 inch, but the capacity present is not given.

ANOTHER of Mr. H. Tomlinson's remarkable papers appears in the *Phil. Mag.* for July. The chief remarkability of these papers consists in their diffuseness. It is almost impossible to extract the new facts out of them. His terms are peculiar. What is "the specific heat of electricity" which changes sign at varying temperatures? The conclusion of this long paper appears to be that the temperature at which permanent magnetism begins to suddenly disappear is not the temperature at which permanent torsion begins to suddenly disappear. We find the mechanical qualities, viz. hardness, elasticity, linear expansion, internal friction, tensile strength, molecular structure, torsion, &c., of iron, steel, and nickel inextricably mixed up with magnetic susceptibility and retentiveness, electric resistance and thermo-electric conditions, specific and latent heat, and varying temperatures.

THE PROGRESS OF THE HENRY DRAPER MEMORIAL.[1]

THE additional facilities provided by Mrs. Draper have permitted a considerable extension of this research during the past year. The 11-inch refractor belonging to Dr. Draper, and the 8-inch photographic telescope provided by the Bache Fund, have been kept at work throughout every clear night. The 28-inch and 15-inch reflectors constructed by Dr. Draper have been moved to Cambridge, and the first of these instruments is placed in a building surmounted by a dome constructed for the purpose. Experiments are now in progress with it, and it will probably soon be employed regularly. Four assistants take part in making the photographs, one of whom comes to the Observatory every clear night about midnight, and keeps the 8-inch and 11-inch telescopes in use until interrupted by the morning twilight. Five ladies have been employed in the measurements and reductions.

The various investigations now in progress are described in detail below. The first three of these, including the photographic work of the 8-inch and 11-inch telescopes, will be finished in about a year. It is accordingly proposed in the autumn of 1889 to send an expedition to the southern hemisphere, probably to Peru, and there complete the work to the South Pole. As only about one quarter part of the sky is too far south to be conveniently observed at Cambridge, it is expected that the photographs needed to cover this portion of the sky could be obtained in two years. Each investigation could thus be extended to all parts of the sky upon the same system.

An important advance has been made by the recent improvements in the manufacture of dry plates. The M. A. Seed Company of St. Louis have endeavoured to comply with our request for more sensitive plates, and have gradually increased their sensitiveness, so that they now furnish us with plates measuring 27 on their scale, while a year ago the most sensitive plates were only numbered 21. As a result, stars nearly a magnitude fainter can be photographed, and the number of objects which can be examined is nearly doubled. A careful study will shortly be made, by the help of the instruments described below, of the most sensitive plates obtainable. It is hoped that makers of very sensitive plates will send specimens to Cambridge for trial. The demand for increased sensitiveness is so great not only here, but at all other observatories where stellar photography is carried on, that a real improvement would be widely appreciated.

Various improvements have been made in the methods of detecting defects in the photographic processes. Each plate, when it is taken from its box, is exposed to a standard light for exactly one second. The portion of the flame of an oil lamp shining through a small circular aperture constitutes the standard light. The exposure is made for a second by means of a pendulum, which allows the light to shine on the plate for this interval through a small square aperture. When the plate is developed, a dark square appears near its edge, whose intensity measures the sensitiveness of the plate, and also serves to detect any defect in its development. Passing clouds, or a variation in the clearness of the sky, are detected by an instrument called the Pole-Star recorder. It consists of a telescope with a focal length of about 3 feet, placed parallel to the earth's axis. An image of the Pole-Star is formed by it, and allowed to fall upon a sensitive plate, describing an arc of a circle, which is interrupted whenever clouds pass. The plate is changed every day, and the instrument is closed automatically by an alarm-clock every morning before the twilight begins. Much trouble is experienced from the deposition of moisture on the objectives of the photographic telescopes, on account of their exposure to a large portion of the sky. The failure of some of the earlier plates may be due to this cause. Moisture is now carefully looked for, and, if detected, removed by gently heating the objectives. Another test of the quality of the plates consists in occasionally exposing a plate in the 8-inch telescope to the circumpolar sky, first with and then without the prism. The trails of the stars near the Pole and the spectra of the brighter stars are thus photographed. A comparison of the intensity of these images tests the condition of the air, the instrument, and the plates.

[1] Extracted from the "Second Annual Report of the Photographic Study of Stellar Spectra conducted at the Harvard College Observatory," Edward C. Pickering, Director. With 2 Plates. (Cambridge: John Wilson and Son, University Press, 1888.)

The various investigations will now be described in order, as in the last Report.

1. *Catalogue of Spectra of Bright Stars.*—The spectra of all the brighter stars have been photographed with the 8-inch telescope, giving an exposure of at least five minutes to each. Each plate contains from two to four regions 10° square. The plates representing the region north of −25° were divided into three series, which may be distinguished as polar, zenith, and equatorial. Each region is contained on two plates, and the work has been repeated in two successive years, so that at least four photographs should be obtained of all the brighter stars. If a plate proved poor, it was repeated, so that the very bright stars will appear in several plates. The photographic portion of this work was finished last November. If no plates had been repeated, 36 polar, 72 zenith, and 72 equatorial plates would have been required each year, or 360 in all. The actual numbers of plates taken and measured were 46, 120, and 93, total 259, the first year; and 61, 209, and 104, total 374, the second year; or 633 in all. In the later work the number of zenith plates was doubled, to avoid the confusion arising when several exposures were made on a single plate. The numbers of spectra measured on these plates were 2381, 3314, and 2618, total 8313, the first year; and 7199, 8217, and 4074, total 19,490, the second year. Two plates covering the immediate vicinity of the North Pole contain 150 spectra. The whole number of spectra is therefore 27,953. The measurement and identification of this large number of spectra has occupied the greater portion of the time of the corps of computers. Each plate to be measured was placed on a stand, and the light of the sky was reflected through it by means of a mirror. The approximate co-ordinates of each spectrum in turn were then read off, and a careful description of the spectrum was given. Besides the usual division into types, each additional line visible was recorded both as regards its position and intensity. The photographic intensity of the brightest portion of each spectrum was also measured by means of a photographic plate, dark at one end and light at the other, like a wedge of shade glass. When the spectra show sudden changes in brightness, additional measurements are made. This portion of the work is complete only for the polar plates and about 62 of the other plates, including 12,574 spectra. The identification of the spectra is effected either by computation from its co-ordinates, or by laying the plate upon the maps of the "Durchmusterung," the scale being the same for both. All the plates have, however, been checked by the latter method. The names of the stars are then taken from the "Harvard Photometry," "Uranometria Argentina," or "Durchmusterung," according to their brightness and declination. Their places are next brought forward to 1900, the epoch of the final catalogue. As the intensity of the photograph of a given spectrum will vary greatly with the sensitiveness of the plate, the clearness of the air, and the rate of the driving-clock, all must be reduced to the same system. The scale of the "Harvard Photometry" is adopted for this purpose. The most prevalent spectra are those of the first type, in which the K line is too faint to be visible. After applying a correction for the declination of the stars, the brightness of all such spectra on each plate is compared with the photometric magnitudes. A correction is thus derived for each plate, which is applied to all the spectra upon it. The effect of colour, so far as it varies with the type of spectrum, is thus eliminated. It is possible that, owing to variations in temperature, or other causes, some stars may be redder or bluer than others having the same type of spectrum.

2. *Catalogue of Spectra of Faint Stars.*—Until the photographs required for the research mentioned above were completed, the time of the 8-inch telescope was mainly devoted to them. Since then it has been used principally in photographing the fainter stars. An exposure of one hour is given to each portion of the sky, a region 10° square being included upon each plate. Stars as far south as −25° can be advantageously photographed at Cambridge, and the plan proposed covers this region. The plates overlap, so that the region north of −20° will appear on at least two plates. The southern stars are only photographed when the sky is unusually clear. Each plate is examined, and, if unsatisfactory, the work is repeated. If all were good, 650 plates would be required. Thus far, 606 plates have been taken, covering 339 of the desired regions. As the time of the computers has been mainly devoted to the first investigation mentioned above, the greater portion of these plates have not been measured or reduced. The total number measured is 105 plates, containing 6931 spectra, of which 94 plates and 6293 spectra

have been reduced. The form of reduction and publication will be similar to the catalogue of bright stars, except that it will be convenient to retain the "Durchmusterung" numbers and places, arranging the stars in the order of the zones in that catalogue. It is hoped that the photographs for this investigation will be nearly all taken by the autumn of 1888, and the remainder during the following year. To provide for a possible increase in sensitiveness of the plates, precedence is given to those completely covering the sky once, the alternate plates, covering the sky the second time, being taken later. The actual improvement in the plates shows itself by an increase in the number of spectra in this second series of plates. In some cases over three hundred stellar spectra appear on a single plate.

3. *Detailed Study of the Spectra of the Brighter Stars.*—These spectra are obtained by placing four prisms, having an angle of about 15°, and each nearly a foot square, over the object-glass of the 11-inch telescope, as described in the last Report. The increased sensitiveness of the plates has greatly increased the number of stars bright enough to produce a satisfactory image in this way. The white stars of the first type give good images when no brighter than the fourth magnitude. These spectra are about 4 inches in length. An improvement has been made in the method of enlargement with a cylindrical lens described in the last Report. When such a lens was used with an enlarging lens having a small aperture, the width of the spectrum was greatly reduced; with a large aperture, the best definition could not be attained. A slit perpendicular to the axis of the cylindrical lens is accordingly placed over it. This reduces the aperture in one direction so that the definition of the lines is good, without affecting the width of the spectrum. Slow plates are also used in the enlargements to increase the contrast. Much more brilliant spectra are thus obtained.

4. *Faint Stellar Spectra.*—As stated above, the 28-inch reflector constructed by Dr. Draper is now ready for use. The difficulties commonly encountered in the use of a large reflector have been met, and it is hoped successfully overcome. A spectroscope has been devised for this instrument which will give a dispersion about equal to that employed in the first and second of the researches described above. As the area of the aperture of this telescope is about eleven times that of the 8-inch telescope, it is hoped that much fainter stars can be photographed with it. A study will be made of the spectra of the variable stars of long period, of the banded stars, and of other objects having peculiar spectra.

But little progress has been made with the other investigations proposed, including the reduction to wave-lengths, and the study of the approach and recession of the stars. It seemed best to concentrate our work on the researches described above, undertaking the other investigations as soon as time permitted.

The investigations described above are illustrated by a plate. A special study was made of the spectrum of the variable star β Persei. A variation in this spectrum would have an important bearing on the theory that the diminution in light is due to an interposed dark satellite. Spectra of this star at minimum were first obtained with one prism. With the increased sensitiveness of the plates more prisms were tried, until finally good spectra were obtained with all four prisms even when the star was at its minimum. At first it was thought that a variation was detected in the spectrum, but this change was not confirmed under more favourable circumstances. The spectrum of this star on February 6, 1888, when at its full brightness, is contrasted in the plate with the spectrum on February 9, 1888, when the star was at its minimum. A careful inspection of the original negatives failed to show any differences in the spectra. Twenty lines are visible at minimum, all of which are seen at maximum. The spectrum of α Orionis is also given. Before the recent increase in the sensitiveness of the photographic plates, satisfactory photographs could not be obtained of the spectrum of this star, on account of its red colour.

INFLUENCE MACHINES.[1]

I HAVE the honour this evening of addressing a few remarks to you upon the subject of influence machines; and the manner in which I propose to treat the subject is to state as shortly as possible, first, the historical portion, and afterwards to point out the prominent characteristics of the later and the more commonly known machines.

In 1762, Wilcke described a simple apparatus which produced electrical charges by influence, or induction, and following this the great Italian man of science, Alexander Volta, in 1775 gave the electrophorus the form which it retains to the present day. This apparatus may be viewed as containing the germ of the principle of all influence machines yet constructed.

Another step in the development was the invention of the doubler by Bennet in 1786. He constructed metal plates which were thickly varnished, and were supported by insulating handles, and which were manipulated so as to increase a small initial charge. It may be better for me to here explain the process of building up an increased charge by electrical influence, for the same principle holds in all of the many forms of influence machines.

This Volta electrophorus, and these three blackboards, will serve for the purpose. I first excite the electrophorus in the usual manner, and you see that it then influences a charge in its top plate; the charge in the resinous compound is known as negative, while the charge induced in its top plate is known as positive. I now show you by this electroscope, that these charges are unlike in character. Both charges are, however, small, and Bennet used the following system to increase them.

Let these three boards represent Bennet's three plates. To plate No. 1 he imparted a positive charge, and with it he induced a negative charge in plate No. 2. Then with plate No. 2 he induced a positive charge in plate No. 3. He then placed the plates Nos. 1 and 3 together, by which combination he had two positive charges within practically the same space, and with these two charges he induced a double charge in plate No. 2. This process was continued until the desired degree of increase was obtained. I will not go through the process of actually building up a charge by such means, for it would take more time than I can spare.

In 1787, Carvallo discovered the very important fact that metal plates when insulated always acquire slight charges of electricity; following up those two important discoveries of Bennet and Carvallo, Nicholson in 1788 constructed an apparatus, having two disks of metal insulated and fixed in the same plane. Then, by means of a spindle and handle, a third disk, also insulated, was made to revolve near to the two fixed disks, metallic touches being fixed in suitable positions. With this apparatus he found that small residual charges might readily be increased. It is in this simple apparatus that we have the parent of influence machines, and as it is now a hundred years since Nicholson described this machine in the Phil. Trans., I think it well worth showing a large-sized Nicholson machine at work to-night.

In 1823, Ronalds described a machine in which the moving disk was attached to and worked by the pendulum of a clock. It was a modification of Nicholson's doubler, and he used it to supply electricity for telegraph working. For some years after these machines were invented no important advance appears to have been made, and I think this may be attributed to the great discoveries in galvanic electricity which were made about the commencement of this century by Galvani and Volta, followed in 1831 to 1857 by the magnificent discoveries of Faraday in electro-magnetism, electro-chemistry, and electro-optics, and no real improvement was made in influence machines till 1860, in which year Varley patented a new form of machine.

In 1865 the subject was taken up with vigour in Germany by Toepler, Holtz, and other eminent men. In 1866, Bertsch invented a machine, but not of the multiplying type; and in 1867, Sir William Thomson invented a form of machine, which, for the purpose of maintaining a constant potential in a Leyden jar, is exceedingly useful.

The Carré machine was invented in 1868, and in 1880 the Voss machine was introduced, since which time the latter has found a place in many laboratories. It closely resembles the Varley machine in appearance, and the Toepler machine in construction.

In condensing this part of my subject, I have had to omit many prominent names and much interesting subject-matter, but I must state that, in placing what I have before you, many of my scientific friends have been ready to help and to contribute; and, as an instance of this, I may mention that Prof. Silvanus P. Thompson at once placed all his literature and even his private notes of reference at my service.

I will now endeavour to point out the more prominent features

[1] Lecture delivered at the Royal Institution, by Mr. J. Wimshurst, on April 27, 1888.

of the influence machines which I have present, and, in doing so, I must ask a moment's leave from the subject of my lecture to show you a small machine made by that eminent worker, Faraday, which, apart from its value as his handiwork, so closely brings us face to face with the imperfect apparatus with which he and others of his day made their valuable researches.

The next machine which I take is a Holtz. It has one plate revolving, the second plate being fixed. The fixed plate, as you see, is so much cut away that it is very liable to breakage. Paper inductors are fixed upon the back of it, while opposite the inductors, and in front of the revolving plate, are combs. To work the machine (1) a specially dry atmosphere is required; (2) an initial charge is necessary; (3) when at work the amount of electricity passing through the terminals is great; (4) the direction of the current is apt to reverse; (5) when the terminals are opened beyond the sparking distance the excitement rapidly dies away; (6) it does not part with free electricity from either of the terminals singly.

It has no metal on the revolving plates, nor any metal contacts; the electricity is collected by combs which take the place of brushes, and it is the break in the connection of this circuit which supplies a current for external use. On this point I cannot do better than quote an extract from p. 339 of Sir William Thomson's "Papers on Electro-statics and Magnetism," which runs:—"Holtz's now celebrated electric machine, which is closely analogous in principle to Varley's of 1860, is, I believe, a descendant of Nicholson's. Its great power depends upon the abolition by Holtz of metallic carriers and metallic make-and-break contacts. It differs from Varley's and mine by leaving the inductors to themselves, and using the current in the connecting arc."

In respect to the second form of Holtz machine I have very little information, for since it was brought to my notice nearly six years ago I have not been able to find either one of the machines or any person who had seen one. It has two disks revolving in opposite directions; it has no metal sectors and no metal contacts. The "connecting arc circuit" is used for the terminal circuit. Altogether I can very well understand and fully appreciate the statement made by Prof. Holtz in *Uppenborn's Journal* of May 1881, wherein he writes that "for the purpose of demonstration I would rather be without such machines."

The first type of Holtz machine has now in many instances been made up in multiple form, within suitably constructed glass cases, but when so made up great difficulty has been found in keeping each of the many plates to a like excitement. When differently excited, the one set of plates furnished positive electricity to the comb, while the next set of plates gave negative electricity: as a consequence no electricity passed the terminals.

To overcome this objection, to dispense with the dangerously cut plates, and also to better neutralize the revolving plate throughout its whole diameter, I made a large machine having twelve disks 2 feet 7 inches in diameter, and in it I inserted plain rectangular slips of glass between the disks, which might readily be removed; these slips carried the paper inductors. To keep all the paper inductors on one side of the machine to a like excitement, I connected them together by a metal wire. The machine so made worked splendidly, and your late President, Mr. Spottiswoode, sent on two occasions to take note of my successful modifications. The machine is now ten years old, but still works splendidly. I will show you a smaller-sized one at work.

The next machine on which I make observations, is the Carré. It consists essentially of a disk of glass which is free to revolve without touch or friction. At one end of a dicmeter it moves near to the excited plate of a frictional machine, while at the opposite end of the dicmeter is a strip of insulating material, opposite which, and also opposite the excited amalgam plate, are combs for conducting the induced charges, and to which the terminals are metallically connected; the machine works well in ordinary atmosphere, and certainly is in many ways to be preferred to the simple frictional machine. In my experiments with it I found that the quantity of electricity might be more than doubled by adding a segment of glass between the amalgam cushions and the revolving plate. The current in this type of machine is constant.

The Voss machine has one fixed plate and one revolving plate. Upon the fixed plate are two inductors, while on the revolving plate are six circular carriers. Two brushes receive the first portions of the induced charges from the carriers, which portions are conveyed to the inductors. The combs collect the remaining portion of the induced charge for use as an outer circuit, while the metal rod with its two brushes neutralizes the plate surface in a line of its diagonal diameter. When at work it supplies a considerable amount of electricity. It is self-exciting in ordinary dry atmosphere. It freely parts with its electricity from either terminal, but when so used the current frequently changes its direction, hence there is no certainty that a full charge has been obtained, nor whether the charge is of positive or negative electricity.

I next come to the type of machine with which I am more closely associated, and I may preface my remarks by adding that the invention sprang solely from my experience gained by constantly using and experimenting with the many electrical machines which I possessed. It was from these I formed a working hypothesis which led me to make the small machine now before you. The machine is unaltered. It excited itself when new with the first revolution. It so fully satisfied me with its performance that I had four others made, the first of which I presented to this Institution. Its construction is of the simplest character. The two disks of glass revolve near to each other, and in opposite directions. Each disk carries metallic sectors; each disk has its two brushes supported by metal rods, the rods to the two plates forming an angle of 90° with each other. The external circuit is independent of the brushes, and is formed by the combs and terminals.

The machine is self-exciting under all conditions of atmosphere, owing probably to each plate being influenced by, and influencing in turn its neighbour, hence there is the minimum surface for leakage. When excited, the direction of the current never changes; this circumstance is due probably to the circuit of the metallic sectors and the make-and-break contacts always being closed, while the combs and the external circuit are supplemental, and for external use only. The quantity of electricity is very large and the potential high. When suitably arranged, the length of spark produced is equal to nearly the radius of the disk. I have made them from 2 inches to 7 feet in diameter, with equally satisfactory results.

I have also experimented with the cylindrical form of the machine; the first of these I made in 1882, and it is before you. The cylinder gives inferior results to the simple disks, and is more complicated to adjust. You notice I neither use nor recommend vulcanite, and it is perhaps well to caution my hearers against the use of that material for the purpose, for it warps with age, and when left in the daylight it changes and becomes useless.

I have now only to speak of these larger machines. They are in all respects made up with the same plates, sectors, and brushes as were used by me in the first experimental machines, but for convenience sake they are fitted in numbers within a glass case.

This machine has eight plates of 2 feet 4 inches diameter; it has been in the possession of the Institution for about three years.

This large machine, which has been made for this lecture, has twelve disks, each 2 feet 6 inches in diameter. The length of spark from it is $13\frac{1}{2}$ inches.

During the construction of the machine every care was taken to avoid electrical excitement in any of its parts, and after its completion several friends were present to witness the fitting of the brushes and the first start. When all was ready the terminals were connected to an electroscope, and the handle was moved, so slowly that it occupied thirty seconds in moving one half revolution, and at that point violent excitement appeared.

The machine has now been standing with its handle secured for about eight hours; no excitement is apparent, but still it may not be absolutely inert; of this each one present may judge, but I will connect it with this electroscope, and then move the handle slowly, so that you may see when the excitement commences and judge of its absolutely trustworthy behaviour as an instrument for public demonstration. I may say that I have never under any condition found this type of machine to fail in its performance.

I now propose to show you the beautiful appearances of the discharge, and then in order that you may judge of the relative capabilities of each of these three machines, we will work them all at the same time.

The large frictional machine which is in use for this comparison is so well known to you that a better standard could not be desired.

In conclusion I may be permitted to say that it is fortunate I had not read the opinion of Sir William Thomson and Prof.

Holtz, as quoted in the earlier part of my lecture, previous to my own practical experiments. For had I read such opinions from such authorities I should probably have accepted them without putting them to practical test. As the matter stands I have done those things which they said I ought not to have done, and I have left undone those which they said I ought to have done, and by so doing I think you must freely admit that I have produced an electric generating machine of great power, and have placed in the hands of the physicist, for the purposes of public demonstration, or original research, an instrument more trustworthy than anything hitherto produced.

NOTE ON THE TARPON OR SILVER KING (MEGALOPS THRISSOIDES).

THE genus Megalops belongs to the family Clupeidæ, and, amongst other features, is characterized, according to Dr. Günther,[1] by an oblong compressed body, the presence of a narrow osseous lamella attached to the mandibular symphysis and lying between the halves of the mandible. Further, the latter is prominent, the intermaxillary short, the maxillary forming the lateral part of the mouth. There are bands of villiform teeth on the jaws, vomer, palatines, pterygoid, tongue, and base of skull.

The interest in the species above-mentioned has been considerably increased of late by the fact that the huge fish (between 5 and 6 feet in length, and weighing from 90 to 150 pounds) can be caught by rod and line, and I am much indebted to Lady Playfair for giving me all the information she had obtained on the subject through her father and Mr. W. G. Russell of Boston, United States.

The tarpon (*Megalops thrissoides*) frequents the Atlantic shores of North America, and is especially found "on the western or Gulf coast of Southern Florida, haunting the shallow bays and creeks inside the bars and keys which stretch along that coast; and the fishes are supposed to enter by the passes from the outer Gulf.[2]

"In shape the tarpon somewhat resembles the salmon, but, as becomes one of the herring tribe, it is deeper and less rounded, and the head is larger, the scales (cycloid) are thick and large, more than an inch in diameter" (a fine scale sent by Lady Playfair measures 2¼ inches both in antero-posterior and transverse diameter), "and the exposed portion is of a bright silvery hue, indeed it looks as if it had been dipped in silver and burnished: hence the name 'silver king.' I have seen specimens weighing from 50 to 137 pounds, and have heard of none above 150 pounds.

"The tarpon has always been upon the Gulf coast, but was formerly captured, as the sword-fish is, by the harpoon. In 1885, however, a Mr. Wood undertook successfully to secure the fish by rod and reel. . . . About 150 have been caught in this manner during the seasons 1885 and 1886, the time being in March and April, perhaps a little earlier in a warm season: after April it is too hot for fishing.

"The fish is caught on the edge of the channels in 15 to 25 feet of water with a bait of (half a) mullet. The rod should be very stiff, not more than 9 feet in length, such as is used for large sea-bass, and the line strong, but fine enough to carry 200 to 250 yards on the reel, which must therefore be large and heavy. A snood or gauging of about 3 feet of cod-line, copper-wire, or chain, should be fixed to the hook[3] as the dental apparatus of the fish efficiently combines a file and shears, with which even a double cod-line may be frayed or worn off, or severed without a sensible strain.

"The tarpon takes the bait lying on the bottom, and moves off, swallowing it, until he is struck, and the moment he feels the hook he is out of the water, perhaps 3 or 6 feet in the air, shaking his head fiercely—as does the black bass—to disengage the hook, and then begins such a fight as, I believe, no other game fish ever shows. It frequently leaps with a clean breach twenty times before the game is over, and so close that it occasionally sends a douche over the boatmen; while in one instance a large one made a run of 100 yards, the whole of which was a succession of frantic leaps and plunges, leaving a wake like that of a steamer. The same fish towed my boat, with three men in it, about two miles, and, after more than an hour's hard fight, ended by three huge leaps out of the water amongst some mangrove-trees, the oysters on the roots of which cut my line, so that we parted company after a close and protracted intimacy."

There is little doubt, from the foregoing remarks, that the splendid sport of tarpon-fishing must make it most fascinating. In April 1887, indeed, a single rod caught nine fish in eleven days, two of them weighing respectively 151 and 149 pounds, and in length 6 feet 4 inches, and 6 feet 5 inches. These were taken at Punta Rassa on the western coast of Florida, the total weight of the catch being 1042 pounds, or an average of about 116 pounds for each. The tarpon, like others of its tribe, has the advantage also of being good food.

W. C. McINTOSH.

[1] "Introduction to Fishes," pp. 661–62.

[2] Extracted from a description (from personal observation) by Mr. W. G. Russell, of Boston.

[3] Described elsewhere as "an O'Shaughnessy knobbed 10-0 hook."

SCIENTIFIC SERIALS.

Bulletins de la Société D'Anthropologie de Paris, tome dixième, 4e fascicule, 1887.—This closing number for the last year enumerates the various presentations made to the Society since the previous publication of the Bulletins. Among the recent communications attention is due to M. Boban's report of the interesting collection of North American flint instruments presented to the Society by the Smithsonian Institution. They appear to be almost identical with those existing in Europe, and belonging to the Stone Age.—M. Verneau, on presenting various stone instruments from the Canary Isles, drew attention to their rude forms, due, he believes, to the relatively brittle character of the basalt and obsidian from which they were cut. The few specimens of polished stone belong only to Gomère and Canary Proper, and are, therefore, conjectured to have been introduced by some of the numerous North African invaders who landed on those islands.—M. André Sanson's paper on experimental craniology in reference specially to domestic animals, which he considers under two cephalic types only, viz. the dolicocephalic and the brachycephalic, is directed against the systems of craniometry and anthropometry at present in vogue. M. Fauvelle took a leading part in the discussion to which the paper gave rise, and gave his views in regard to the value of the cephalic index, which he considered to have been greatly overestimated by Broca and his followers. These remarks, and the refutation of Broca by M. Topinard, form, with M. Sanson's paper, a complete exposition of the various views maintained in different provinces of anthropological science in France.—Report on the various papers presented by competitors for the Godard Prize in 1887, by M. Moudière. — On aphasia and its history since the original observations of Broca, by M. M. Duval.—On the distinctive characteristics of the human brain considered from a morphological point of view, by M. le Dr. S. Pozzi.—On a case of supernumerary digits on the cubital margin of each hand, by Dr. Béranger.—On the morphological variability of the muscles under the influence of functional variations, by Mme. Clémence Royer.—On the abnormal elongation of the cuboides, accompanied by the pressure of a round pronator in a horse, by M. E. Cuyer.—On the tumulus of Kerlescan at Carnac, by M. Gaillard. The remains of this interesting monument, with its double dolmens similar to the covered allées, known as "Hunebeds" in Holland, were first described in 1860, since which time they have suffered so much from neglect and wanton injury that M. Gaillard is making a strong appeal to the Government for their protection.—Note on the tumuli of a covered gallery, examined in 1887, near Montigny l'Engrain (Aisne), by M. Vauville, and report of the crania found there, and referred to the Furfooz men of the dolmen age, by Dr. Verneau. The preponderating character of these crania was their length and straightness. Several bore marks of cicatrised wounds.—On a Quaternary equidean, similar to the *kertag* of Kirghis, described by M. Poliakoff under the the name of *Equus Przewalskii*. The description of the kertag with its short and straight mane, its relatively large head and inferior height, corresponds remarkably well with the numerous representations of the Quaternary equidean found in different parts of Western Europe among the varied debris that mark the site of primæval settlements. In the Magdelian carvings found in the cavern at Arudy among mammoth bones, special prominence is given to the thin, rat-like character of the tail of the animal, a feature that is very marked in the kertag, which appears to be the nearest living representative of the horse of the Quaternary age.

Bulletin de l'Académie Royale de Belgique, May.—On the new elements of the orbit of Eucharis, by L. de Ball. Continuing his researches on the elements of this planet (181), the author here establishes two new normal positions by means of the observations made in 1886 and 1887. He also revises the positions of the comparison stars, and resumes the calculation of the perturbations caused by Jupiter, Saturn, and Mars, utilizing for the last named the results of Asaph Hall's observations on the satellites.—Contribution to the study of pulsation in the lower animal organisms, by Dr. De Bruyne. The results are given of the author's studies on the pulsating function of an encysted Protozoon obtained in abundance by culture, but of not yet determined family. From his minute observations on the formation, development, and action of the vesicle endowed with rhythmical motion, he concludes that this organ has no communication with the periphery, and has nothing to do with the digestive function, as is commonly supposed, but is a true organ of respiration and circulation, a heart and lung combined.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, May 31.—"The Conditions of the Evolution of Gases from Homogeneous Liquids." By V. H. Veley, M.A., University College, Oxford.

In Part I. an account is given of the effect of finely divided particles on the rate of evolution of gases resulting from chemical changes; in Part II. the phenomenon of initial acceleration, as also the effect of variation of pressure on the evolution of gases, is discussed; in Part III. the case of the decomposition of formic acid into carbonic oxide and water is investigated under constant conditions, other than those of the mass of reacting substances and of temperature.

Part I.—It is found that the addition of finely divided chemically inert particles increases the rate of evolution of gases from liquids in which they are being formed. The effect of these particles on the following chemical changes is investigated: (i.) the decomposition of formic acid yielding carbonic oxide; (ii.) the decomposition of ammonium nitrite in aqueous solution yielding nitrogen; (iii.) the reduction of nitric acid into nitric oxide by means of ferrous sulphate; (iv.) the decomposition of ammonium nitrate in a state of fusion producing nitrous oxide; and (v.) the decomposition of potassium chlorate in a state of fusion producing oxygen. The finely divided substances used are pumice, silica, graphite, precipitated barium sulphate and glass-dust.

Part II.—It is observed that, conditions of temperature remaining the same, the rate of evolution of a gas from a liquid is at first slow, then gradually increases until it reaches a maximum, and for some time constant, rate. From this point the rate decreases proportionally to the diminution of mass. This is observed in the cases of decomposition of formic acid, potassium ferrocyanide, and of oxalic acid by concentrated sulphuric acid, and in that of ammonium nitrate. It has previously been observed in the case of the decomposition of ammonium nitrite in aqueous solution. The same phenomenon repeats itself when the temperature is temporarily lowered and then raised to its former point, and also to a more marked degree when, temperature remaining the same, the superincumbent pressure is suddenly increased.

The reduction of pressure from one to a fraction of an atmosphere produces no *permanent* effect on the rate of evolution of a gas from a liquid; a decrease of pressure, however, produces *temporarily* an increase in the rate, and an increase of pressure conversely produces *temporarily* a decrease in the rate.

Part III.—The case of the decomposition of formic acid into carbonic oxide and water by diluted sulphuric acid is studied with the aid of an apparatus by means of which the temperature is kept constant within one-twentieth of a degree. It is shown that the rate of evolution of carbonic oxide is expressible by the following equation—

$$\log(\tau + t) + \log r = \log c,$$

in which τ is the time from the commencement of the observations; t is the interval of time from the moment of commencement, and that at which, conditions remaining the same, the interval of time required for unit change would have been *nil*; r is the mass at the end of each observation, and c is a constant. The results calculated by this hypothesis agree with those observed, whether the interval of time required for unit change is 30 or 960 minutes. The curve expressing the rate of chemical change in terms of mass is thus hyperbolic and illustrative of the law—

$$\frac{dr}{d\tau} = -\frac{r^2}{c},$$

which expresses the rate at which equivalent masses act upon one another; $1/c$ in each experiment is the amount of each unit mass which reacts with the other per unit of time, when a unit mass of each substance is present. Since, then, equivalent masses take part in the change, it is reasonable to suppose that at first an anhydride of formic acid is produced, which is subsequently decomposed into carbonic oxide and water.

The change may thus be compared to the production of ethyl formate from formic acid and alcohol, with which it shows several points of analogy.

June 14.—"The Electric Organ of the Skate. Structure and Development of the Electric Organ of *Raia radiata*." By J. C. Ewart, M.D., Regius Professor of Natural History, University of Edinburgh. Communicated by Prof. J. Burdon Sanderson, F.R.S.

The first part of this paper is chiefly devoted to a comparison of the electric organs of *Raia radiata*, *Raia batis*, and *Raia circularis*. It is shown that the organ in the species *radiata* differs in many respects from the organ in the two other species, and that an exhaustive study of its structure and development is likely to throw considerable light on the nature of electric organs generally, and also on the structure of the motor plates of muscles. While *Raia batis* may reach a length of over 180 cm., *Raia radiata* seldom measures more than 45 cm. from tip to tip, and is thus only about half the size of a large *Raia circularis*. In *Raia radiata* the electric organ is absolutely and relatively extremely small. In *Raia batis* the electric organ may be 60 cm. in length and 7 cm. in circumference at the centre, and extend from the skin to the vertebral column, but in an adult *Raia radiata* the organ is seldom over 13 cm. in length and 8 mm. in circumference, and the posterior two-thirds is confined to a narrow cleft between the skin and the great lateral muscles of the tail. Further, the organ of *Raia radiata* consists of minute shallow cups, which only remotely resemble the large well-formed electric cups of *Raia circularis*. In the latter species the various layers of the electric cup are readily comparable to the more important layers of the electric disk of *Raia batis*, but in *Raia radiata* the electric cup is little more than a muscular fibre, with one end expanded and slightly excavated to support a greatly enlarged motor plate, in which terminate numerous nerve-fibres. The striated layer of *Raia batis* and *circularis*, which consists of characteristic lamellæ, having an extremely complex arrangement, is entirely absent from *Raia radiata*, the electric layer is indistinct, and instead of a thick richly nucleated cortex, the cup is merely invested by a slightly thickened sarcolemma. Further, the tissue forming the shallow, thick-walled cup, both in its appearance and consistency, closely resembles an ordinary muscular fibre, while the long stem usually remains distinctly striated to its termination.

In the second part of the paper an account is given of the development of the electric cups of *Raia radiata*. It is shown that the rate of development compared with *Raia circularis*, but more especially with *Raia batis*, is extremely slow. The young *radiata* is nearly double the size of the *batis* embryo before the muscular fibres reach the "club" stage, and the long nearly uniform clubs, instead of at once developing into rudimentary cups as is the case in *batis*, assume the form of large Indian clubs. When the young skate reaches a length of about 35 cm., the long secondary clubs begin to expand anteriorly, and this expansion continues until a fairly well-moulded cup mounted on a long delicate stem is produced. But the process of conversion is scarcely completed when the skate has reached a length of 40 cm., *i.e.* when it has nearly reached its full size, for in the species *radiata* a length of 50 cm. is seldom if ever attained.

The cup-stage having been eventually reached, the stem, which for a time may still increase in length, is often compressed by two or more cups being closely applied together, and part of the rim of the cup may be slightly everted or projected forwards, but even in the largest specimens of *Raia radiata* examined there was never any indication of retrogressive changes.

The small size of the electric organ, together with the shallowness of the minute cups of which it consists, seems at first to indicate that in *Raia radiata* we have an electric organ in the act of disappearing. But when the organ of the species *radiata* is carefully compared with the organ of the species *batis* and *circularis*, the evidence seems to point in an opposite direction, and the view that the cups of *Raia radiata* are in process of being elaborated into more complex structures, such as already exist in *Raia circularis*, is apparently confirmed by the developmental record. Were the electrical organ of *Raia radiata* a mere vestige of a larger structure which formerly existed, we should expect to find the motor (electric) plate incomplete, or only occupying a portion of the electric cup; and the nerves proceeding to it, either few in number or undergoing degenerative changes. But instead of this we have a relatively large bunch of extremely well-developed nerves proceeding to the motor plate, which is not only complete, but extends some distance over the rim of the cup. Further, there is no indication of the walls of the cup having ever consisted of extremely complex lamellæ, such as we have in *Raia circularis*. They consist of a nearly solid mass of muscular tissue, scarcely to be distinguished rom the unaltered adjacent muscular fibres. The electric cup of *Raia radiata* may, in fact, when its structure alone is considered, be said to be a muscular fibre which has been enlarged at one end to support a greatly overgrown motor plate. But the development of the electric cups is even more suggestive than their structure. Had the muscular fibres in *Raia radiata* assumed the form of clubs before the young skate escaped from the egg capsule; had the clubs been rapidly transformed into electric cups; and had the cups soon after reaching completion begun to disappear, the evidence in favour of degeneration would have been complete. But, as has been indicated, the conversion of the muscular fibres into an electric organ is late in beginning, and the clubs having appeared, pass slowly through a long series of intermediate stages before they eventually assume the cup form. Further, as has already been mentioned, in the largest specimens of *Raia radiata* examined no evidence was found of retrogressive changes, either in the cup proper, or the numerous nerves passing to its electric plate. Hence it may be inferred that the electric organ of *Raia radiata*, notwithstanding its apparent uselessness and its extremely small size, is in a state of progressive development.

EDINBURGH.

Royal Society, June 18.—In the report of this meeting the title of a paper on the development and life-histories of the food and other fishes, communicated by Prof. W. C. McIntosh and Mr. E. E. Prince, was inadvertently omitted.

July 2.—Prof. Chrystal, Vice-President, in the chair.—Dr. Ramsay Traquair read a paper on fossil fishes from the Pampherston oil-shale, and exhibited specimens.—Dr. W. Peddie read a paper on the effects of electromotive force and current-density on the total opposition (due to resistance of the conductors, reverse electromotive force, &c.) to the passage of an electric current through a liquid.—Mr. George Brook described a lucifer-like crustacean larva from the West Coast, and also communicated, in conjunction with Mr. W. E. Hoyle, a paper on the metamorphosis of the British *Euphausiidæ*.—Prof. Haycraft and Dr. E. W. Carlier read a paper on morphological changes which take place in blood during coagulation.—Prof. Tait submitted a paper on Laplace's theory of the internal pressure in liquids.

July 9.—A special meeting was held, Sir Douglas Maclagan, Vice-President, in the chair.—Dr. Berry Hart read a paper on the mechanism of the separation of the placenta and membranes during labour.—Dr. Woodhead communicated a paper, by Dr. J. W. Martin, on the pathology of cystic ovary; and also a paper, by Mr. T. A. Helme, on histological observations on the muscle, fibre, and connective tissue of the uterus during pregnancy and the puerperium.—Dr. T. G. Nasmyth read a paper on the air in coal-mines.

PARIS.

Academy of Sciences, July 16.—M. Janssen, President, in the chair.—Experiments with a new hydraulic machine, by M. Anatole de Caligny. This apparatus is of less simple structure than the valved machine with oscillating tube already described and exhibited by the inventor. But it has the advantage, under certain conditions, of giving relatively better results.—On the planet Mars, by M. Perrotin. These remarks are made in connection with the four sketches referred to in a previous communication, which are here reproduced, and which give the appearance of the planet on May 8, 1888, June 12, 1888, May 21–22, 1886, and June 4, 1888. The two first show the new canal A and that of the north polar ice-cap, the second also giving the smaller canal B seen for the first time on June 12. The fourth shows four simple and three double canals, all clearly defined. Two of the latter stretch from near the equator along the meridians 330° and 5° of Schiaparelli's chart to the vicinity of the north polar ice-cap. The difference is very striking, especially in the region of Libya, between the first and second of this year, and the corresponding No. 3 for the year 1886.—On the explanation of an experiment by Joule according to the kinetic theory of gases, by M. Ladislas Natanson. The experiment in question occurs in vol. i. p. 183 of Joule's "Scientific Papers." From the considerations here advanced, M. Natanson concludes that, so far from being opposed to the kinetic theory of gases, this experiment might be regarded as a practical confirmation of the law determining the distribution of molecular velocities discovered by Clerk Maxwell, and generalized by Boltzmann.—M. Natanson's paper was accompanied by a note from M. G. A. Hirn, who still maintains that not one of his nine fundamental objections to the kinetic theory itself has yet been answered, and consequently that this theory is already out of date.—On the thermic conductibility of mercury above 100° C., by M. Alphonse Berget. In continuation of a previous note (*Comptes rendus*, April 16, 1888), the author here gives the results of his studies on the variation in the thermic conductibility of mercury between 100° and 300° C. For 1° he finds the variation in the coefficient of thermic conductibility to be − 0·00045.—Measurement of the velocities of etherification by means of electric conductibilities, by M. Negreano. The author has already shown that the velocity of etherification for a mixture with equal equivalents of alcohol and acetic acid may be measured by determining the electric resistance of the liquid by Lippmann's electrometric method. In the present communication he extends the same process to masses of alcoholic reagents or acetic acid differing in the number of their equivalents.—Observations respecting some recent communications from M. Sabatier on the chlorhydrate of cupric chloride, and the chlorhydrate of cobalt chloride, by M. Engel. While insisting on his admitted claim to priority, the author points out that there are two distinct chlorhydrates of the chloride of copper. He also shows that the pale blue powdery precipitate observed by M. Sabatier is not a chlorhydrate of chloride, but a hydrate of cobalt chloride.—On the elementary composition of crystallized strophanthine, by M. Arnaud. This is an extract from *Strophanthus Kombé*, much used by the Fans of West Equatorial Africa for poisoning their spear- and arrow-heads. The formula is here shown to be $C_{31}H_{48}O_{12}$, its elementary composition thus showing it to be a close homologue of the wabain ($C_{30}H_{46}O_{12}$), the active principle of the wabaio plant used for similar purposes by the Somali people.—Influence of the temperature of fermentation on the production of the higher alcohols, by M. L. Lindet. The experiments here described seem to show that the yield of the higher alcohols is little affected by varying the temperatures of fermentation.—On *Fascicularia radicans*, C. Vig., a new type of Anthozoa, by M. Viguier. This little specimen of an Alcyonium was lately obtained during some dredgings in the port of Algiers. From the description here given it appears to be most closely related to the Paralcyonia, although sufficiently distinct to form an independent group or sub-family of the Fasciculariæ.—M. A. d'Arsonval describes and illustrates a new metal self-regulating stove, which is intended to maintain invariable temperatures by the exclusive use of gas and water. It is specially adapted for physiological and microbiological researches, and is constructed essentially on the same principle as that submitted to the Academy on March 5, 1877.

BERLIN.

Physical Society June 29.—Prof. von Helmholtz, President, in the chair.—Dr. R. von Helmholtz exhibited a new form of bolometer differing from that used by Langley. In Langley's instrument the alterations of electrical resistance produced by radiation are measured by introducing the exposed bolometer into one arm of a Wheatstone bridge a similar one protected from the light being introduced into the second arm of the bridge, while the other two arms contain a corresponding resistance. In the new bolometer as constructed by Siemens and Halske all four arms of the bridge are composed of equal wires rolled up into a coil and of these coils 1 and 3 are illuminated, while 2 and 4 are kept dark, and then coils 2 and 4 are illuminated, and 1 and 3 kept dark. By this means a fourfold sensitiveness of the bolometer is theoretically obtained. All four coils lie inside a brass tube, and by turning a screw at one time coils 1 and 3, at another coils 2 and 4 are brought opposite the opening. In comparing the speaker's experiments with those of Langley it appeared that the latter's measurements were five times more delicate than those of the speaker, a result which must however be entirely attributed to the fact that Langley's galvanometer was twenty times more sensitive. The speaker then expounded the theoretical efficiency and conditions of perfect sensitiveness of the bolometer, and compared with these the capabilities of a thermopile. Dr. Fritz Kötter discussed some new instances for the application of the Helmholtz-Kirchoff theory of stationary motion of fluids. Prof. Gad gave some explanations in connection with his demonstration of the phosphorescent moss. Prof. Neesen spoke on an ether calorimeter which he has succeeded in constructing in such a form, after many experiments, that it presents many advantages, when compared with an ice-calorimeter. It consists of a tube for the reception of the object whose heat is to be measured; this tube is surrounded with a layer of lamp-wick which dips into ether at its lower end. From the side of the outer vessel a tube passes with appropriate bending to a horizontal capillary tube containing as index some ether, and by a parallel capillary tube to a second and similar calorimeter. After the index has been adjusted, its movement, as resulting from the vaporisation of ether due to the warm object, indicates how much heat has been given up to the wick saturated with ether. The sensitiveness of this calorimeter is 2000 greater than that of an ice-calorimeter. The speaker has determined with this instrument the specific heat of platinum, palladium and copper, and also the heat produced by the passage of an electric spark between a metallic point and a mass of mercury in the tube of the calorimeter. The results were very satisfactory. The special advantage of this instrument consists in the fact that extremely small masses of any substance can be examined calorimetrically. The extreme sensitiveness of the apparatus makes it also suitable for the measurement of radiant heat. The speaker has additionally examined other fluids as to their suitability for a vapour-calorimeter, especially alcohol.

Physiological Society, July 6.—Prof. Munk, President, in the chair.—Prof. Zuntz described a simplified method of measuring the gaseous interchange during respiration, intended to make it possible to introduce such measurements into the limits of clinical observations to the same extent that urinary analysis is now carried out. In this method breathing is carried on, the nose being closed, through a mouth-piece which is connected by very mobile valves with gasometers, which thus measure the volume of the inspired as well as of the expired air. Samples of the expired air can be collected at any desired intervals of time and the amount of O and CO_2 which they contain determined by Hempel's method. The burette into which the gas is drawn off by means of an aspirating apparatus connected with the gas meter, is connected by a gutta-percha pipe with a vertical tube which is partly filled with water: the latter not only permits of the measurement, at atmospheric pressure, of the volume of air drawn off, but also provides a means of forcing it out of the burette into a pipette filled with a solution of caustic potash, in which the absorption of the CO_2 speedily takes place. By lowering the tube the gas is allowed to pass into the burette again, and the reduction in its volume gives the amount of CO_2 in the expired air. After this the gas is forced into a pipette which contains lumps of phosphorus which absorb all the oxygen it contains in five or six minutes. On passing the gas again back into the burette, the further diminution in its volume gives the amount of O in the expired air. A new sample can now be taken, and thus the expired air may be tested as often as may be desired for its contents of O and CO_2. Dr. Loewy has carried out some experiments with the above apparatus on five intelligent persons in order to determine the influence of digesting activity on the respiratory interchange. The respiratory interchange of the patients was determined in the morning while fasting and in a perfectly quiescent condition; as soon as this was found to be constant they received doses of 5, 10 or 15 grains of Glaubersalt, and as soon as the action of the salt had manifested itself painfully, and increased peristaltic action had set in, the respiratory interchange was again determined up to the time of defæcation. In all cases the gaseous interchange was increased, more oxygen being used up and more carbonic acid given out, the increase being between 7 and 30 per cent. of the normal. The several persons behaved very differently in this respect and the same person showed marked differences in the increase of respiratory interchange at different times, after equal doses of the salt. As a rule the increase was proportional to the amount of discomfort experienced by the patient in the lower parts of the body. Dr. Loewy is inclined to attribute the increased oxydational interchange to the greater activity of the unstriated muscles of the alimentary canal; the increased activity of its mucous membrane, resulting from the presence of the purgative, appeared to have no influence.—Prof. Munk gave an account of his experience last year while using catgut as a ligature. After having used catgut for some time as a substitute for silk, with excellent results, suddenly bad results began to follow its use, so that each ligature was accompanied by suppuration. A series of control experiments showed that the wounds healed well when silk was used, but never did so with catgut, and inasmuch as the above change was first observed after obtaining the catgut from a new source he proceeded to obtain the article again from the original source, and at once found it worked successfully again. No matter how long the second sample of catgut was disinfected its use was always attended with suppuration. Prof. Munk has hence reverted to the use of silk ligatures, and urges great caution in the use of catgut in surgery.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Parish Patches: A. N. Simpson (Buncle, Arbroath).—The Senses and the Will: W. Preyer, translated by H. W. Brown (Whittaker).—A New Theory of Necessary Truths: Leonard Hall (Williams and Norgate).—Camping Out, or Holidays under Canvas: Gyp; second edition (Simpkin).—A Bibliography of Chemistry for the year 1887: H. C. Bolton (Washington).—Bericht über die Thätigkeit der Botanischen Section der Schlesischen Gesellschaft im Jahre 1887: Dr. F. Cohn.—On the Structure, Development, and Affinities of *Trapella*, Oliv., a New Genus of Pedalineæ: F. W. Oliver.—Bulletins of the Philosophical Society of Washington, vols. ix. x. (Washington).—Proceedings of the American Philosophical Society, vol. xxv. No. 127 (Philadelphia).—Botanische Jahrbücher für Systematik, Pflanzengeschichte, und Pflanzengeographie, Zehnter Band, 1 and 2 Heft (Leipzig).

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