THURSDAY, JULY 10, 1890.

LIFE OF SEDGWICK.[1]

II.

The Life and Letters of the Reverend Adam Sedgwick, LL.D., D.C.L., F.R.S., Fellow of Trinity College, Cambridge, Prebendary of Norwich, Woodwardian Professor of Geology, 1818-73. By John Willis Clark, M.A., F.S.A., and Thomas McKenny Hughes, M.A., F.R.S. Two Volumes. (Cambridge: University Press, 1890.)

THE main results of Sedgwick's geological work, as stated in these volumes, are briefly as follows. Passing over several contributions, often of permanent value, to the geology of the crystalline rocks of Cornwall and of the Carboniferous system, especially in the north of England, we come first to his monograph on the Magnesian Limestone and lower portion of the New Red Sandstone series. Of this Prof. Hughes justly says: "It is at once broad and minute: broad in its generalizations—for it places in order a complex group of rocks, which, until it was written, were in complete confusion; and minute in working out, through the whole of the district selected, from Nottingham to the southern extremity of Northumberland, the boundaries of the different formations and their relations to each other." We are not, however, prepared to follow Prof. Hughes, if we understand him rightly, in his objection to the name Permian as designating the lower part of this series, for the break between that formation and the so-called Trias is probably more important than at first sight appears, and New Red Sandstone is a name obviously provisional.

Sedgwick undertook a task of unusual difficulty in investigating the rock masses which enter into the "Cumbrian mountains," and ascertaining their relations with the strata in adjacent regions, but it was so successfully accomplished that subsequent observers have made few if any important changes, though of course they have amplified many details, in his results.

His work also among the Palæozoic rocks in Devonshire and Cornwall, in which, after a time, he was joined by Murchison, was a long and arduous task, at first productive of much controversy. In this, others, as it is said, "helped with facts or with useful criticism," but it seems a fair statement of the result to say that "the now received classification of the Devon rocks remains as Sedgwick and Murchison left it: Culm measures (Carboniferous) above and Devonian below; the base of the Devonian being there unknown."

Sedgwick's work in Wales commenced in the year 1831. It was a task from which the boldest geologist might well have recoiled. The country was comparatively difficult of access, the maps were not good, little help was to be obtained from palæontology; the "greywacke" rocks were a vast *terra incognita*. But the "stiffer" the problem, the greater its attraction for Sedgwick. In that and the following years he unravelled the complicated structure of North Wales, and placed in order the great rock masses, from the base which he established in the neighbourhood of the Menai Straits, under the great group named after the town of Harlech, to the top of that which he called the Bala group, clearly distinguishing the latter from the Denbigh Grits and other rocks, which are now universally recognized as Silurian. Of this part of Sedgwick's work, Prof. Hughes gives a lucid history, of which the following is a brief outline.

Sedgwick spent the summer of 1831 in North Wales, and established the succession of the rocks from his base line upwards, across Snowdon and the Merionethshire axis. Short accounts of his results were laid before the Cambridge Philosophical Society and the British Association in June 1832. Next month he sent from Wales sections which illustrate the stratigraphical succession from the Menai Straits to the Berwyns. Thus, to quote Prof. Hughes's words:—

"Sedgwick, by 1832, had explained the geological structure of North Wales; had sketched out the leading subdivisions of the Cambrian rocks, and had established the correct sequence of the Arenig and Bala series, and placed them in true relation with what were afterwards known as the Silurian (Upper Silurian of Murchison) in Central Wales and the borders."

Later in the autumn of this year we find that he "had ascertained the exact position of the Wenlock limestone south of Llandovery," and drawn a rough section, "correct as far as it goes," from the Lower Bala beds, in the valley of the Towy, to the Old Red Sandstone. Further communications, as the result of this prolonged labour in the field, were laid before the British Association and the Cambridge Philosophical Society in 1834. From time to time during the next twelve years important details were worked out; perhaps the most marked advance being made in the difficult region of Central Wales, between the Towy and the sea, where Sedgwick succeeded in establishing the general succession of the strata, obscure and almost unfossiliferous as they are. In 1851 he practically proved that the name Caradoc which had been used by Murchison in "The Silurian System" (published in 1839, from work begun in 1831) must cover two distinct groups, one containing Bala fossils, the other clearly underlying the Wenlock group, with fossils similar to those in the latter, but without those characteristic of the former. This is actually demonstrated in a paper published in 1852.

Soon afterwards began, at any rate openly, the difference regarding the limits of the Cambrian and Silurian systems which unhappily estranged him from his friend and from the Geological Society. The immediate cause appears to have been the publication, by the Geological Survey, of a map of North Wales, on which the colours used to distinguish Silurian rocks were extended over a large part of those hitherto described by Sedgwick as Cambrian. Why this was done, it is now difficult to understand. Between the base of the Cambrian and that of the Old Red only one well-marked physical break exists—that at the base of the May Hill Sandstone (Upper Llandovery). Below this is only a palæontological break, which at that date had not been clearly recognized. Accordingly,

[1] Continued from p. 219.

as time went on, the lower limit of the Silurian system descended, like a stone sinking in the mire, till at last "Lower Silurian" actually included the Menevian rocks, as may be seen to this day at the Museum in Jermyn Street. This being so, one would have thought that, even if Murchison had preceded Sedgwick in the publication of the results of his work—which was not the case—the two vital errors in his reading of the beds between the base of the Wenlock and that of the Arenig ought to have deprived him of any claim on account of prior nomenclature. Sedgwick had placed the beds of his Cambrian system in right order from base to top—that is, to beneath the so-called Upper Llandovery. These facts appear to be fully proved, and thus Sedgwick had good cause to feel aggrieved. Into the more personal aspect of the controversy it is needless to enter. One cannot greatly wonder that when once a rift opened in the lute it quickly became a rent, for the two men were so unlike, both in their excellencies and their defects. Nor can it be denied that Murchison had his grievances. Sedgwick was vexatious as a coadjutor in the preparation of papers, for he was unpunctual and unready; he was also slow in duly publishing the results of his own labours, contenting himself too much with informal communications to the British Association and the Cambridge Philosophical Society, instead of laying carefully written memoirs before the Geological Society. But it must be remembered that his time was much occupied. His fellowship, his professorship, his prebend—all entailed duties which were often heavy; and Sedgwick was too honourable a man not to give "a full pennyworth" to those who bought from him. He had to work to live, for he had no private means. It cannot, however, be denied that he interpreted too literally the precept, "Whatsoever thy hand findeth to do, do it with all thy might." Social engagements, political contests, University disputes, too often turned his attention from the main work of his life, and gave some ground for Lyell's severe remark:—"He has not the application necessary to make his splendid abilities tell in a work. Besides, everyone leads him astray; . . . to become great in science, a man must be nearly as devoted as a lawyer, and must have more than mere talent." Still it must be remembered that Sedgwick's health, notwithstanding the great age to which he attained, was far from good, and his constitutional ills were those which make continued sedentary work extremely trying. He was also unlucky in the way of accidents: a dislocated wrist, a broken arm, bad falls, an eye permanently injured, make up a large catalogue of damages for a Cambridge Professor.

Still, although I take Prof. Hughes's view as to the rights of the case, I cannot, under existing circumstances, agree with his condemnation of the proposal to give a new name—Ordovician—to the beds between the base of the May Hill Sandstone and that of the Arenig. "One shell is given to Sedgwick, another to Murchison, but who gets the oyster?" A smart remark, doubtless, but like many such rather misleading. There is no question of shell or oyster in the matter. Each part is equally edible—or indigestible. Granted that Sedgwick has the better title, possession, in questions where the right is not wholly on one side, counts for something with practical men. Cambrian also, as defined by Sedgwick, is rather disproportionately large, and the palæontological break beneath the Arenig is more marked than that which severs the Cambrian from the Silurian. I venture to think that, apart from personal questions, a tripartite division would be pronounced most in accordance with the principles of geological classification, and should not be surprised, if this be repudiated by Sedgwick's defenders, at the ultimate disappearance of Cambrian in the omnivorous maw of Silurian.

Sedgwick's permanent estrangement from the Geological Society I venture to think a mistake. Doubtless he had good cause for indignation at his treatment by its Council, and the well-meant, but arbitrary, action of one of its officers. But a Council is only a temporary aggregate of individuals, and the offence after a time should have been condoned. Its members did not really understand the question at issue; they were evidently actuated, not by any desire to be unjust, but by a nervous anxiety to keep the peace, and forgot, as men so often do, that when a sore is hidden under a plaster, it commonly festers. So the event proved in this case: molluscous amiability met with its usual reward. If the combatants had "fought it out," fairly and honourably, there would have been more chance of an ultimate reconciliation.

These interesting volumes enable us better than ever to estimate Sedgwick's place among the geologists of his generation. His especial strength lay in stratigraphy. In his power of unravelling a complicated district by attention mainly to physical evidence he has never been equalled. He was a patient and unwearied collector of facts, with a wholesome dread of viewing them "through the distorting medium of an hypothesis." Yet it must be admitted that his judgment was often warped by prejudice, using the word in its technical sense. His great power is best displayed when he attacks a problem which is completely novel; for, reformer though he was in politics, his mind, in scientific matters, had a distinctly "conservative" bias, and was too much influenced by ideas which had no better authority than tradition. Of this defect the book records several instances. It will suffice to mention his opposition to Lyell's "Principles of Geology" and to Darwin's "Origin of Species." It is of course possible to overstate the doctrine of uniformity and misuse the hypothesis of evolution; but the progress of knowledge has not justified Sedgwick's attacks on the main arguments of these works, and it must be admitted that he was inferior to their authors in power of inductive generalization. Perhaps no better example could be found of Sedgwick's strength and weakness than his well-known paper "On the Structure of Large Mineral Masses," where a magnificent co-ordination of facts has a somewhat disappointing conclusion.

But even if we grant defects in the geologist as in the man, it is impossible to deny his real greatness. Those who loved Sedgwick as a friend are fast becoming few; but the number of those who reverence his memory as that of a master in science is likely to increase rather than to diminish as his work is weighed in the balance and tested by time. To myself, though I did not know him in his prime, he always appeared to be not only truly noble in spirit, but also illuminated with that divine fire which distinguishes the man of genius from the man of talent.

T. G. BONNEY.

MEASLES AND STRAW-FUNGI.

The Prevention of Measles. By C. Candler. (Melbourne, Victoria. London: Kegan Paul, Trench, and Co., 1889.)

NOTWITHSTANDING the amount of labour which Mr. Candler has expended upon this work, and the ingenuity of some of his hypotheses, we cannot but think that his method might almost be taken as an example of how an inquiry of this kind ought not to be conducted. The author starts with an account of the observations of Dr. Salisbury, an American physician, published in 1862, by which he claimed to have established that a disease called "camp measles," prevalent among American soldiers, was produced by infection with certain fungi derived from musty straw. Salisbury cautiously abstained from positively asserting that the disease was identical with common measles, but said he could see no difference between them; and that an attack of the former protected from the latter. If the diseases were identical, his explanation applied to common measles.

This hypothesis of Dr. Salisbury's was very carefully examined by Dr. J. J. Woodward, Dr. Pepper, and others, who came, by experiment and reasoning, to the conclusion that Dr. Salisbury had not proved his point; and the theory that straw-fungi are the cause of measles has been generally discredited.

Mr. Candler thinks that the refutation of Dr. Salisbury's theory was not complete; and, falling into the not uncommon fallacy that "not absolutely disproved" is equivalent to "proved," he treats it as if it were certainly established, and proceeds to build further hypotheses upon it.

This we consider to be an inversion of the right method of procedure in science. Supposing that Salisbury's results suggested matter for further inquiry, the proper way to begin would be by testing their soundness. If Mr. Candler had himself repeated, or got some scientific friend to repeat, Salisbury's experiments with mouldy straw derived from a place where measles was rife, he might have obtained results, either positive or negative, of great value; and would certainly have made a more important contribution to the subject than is contained in the present volume.

Mr. Candler further extends the straw-fungus theory by supposing that the fungi become changed into bacteria in the body; and, indeed, uses Salisbury's untested and unrepeated experiments as a proof of one of the most fundamental questions (if it be a question) of biology—namely, the alleged genetic relation of fungi and bacteria.

The author's argument is so characteristic of his book that we venture to state it formally thus. Salisbury, by injecting fungus-dust from mouldy straw into himself and others, produced a disease resembling measles. But all such diseases are produced by "pathophytes," *i.e.* bacteria. Therefore Salisbury "*caused pathophytes to develop from fungi*" (the italics are the author's) "and demonstrated that cardinal point in dispute in regard to the bacteria."

An easy solution indeed! if, at least, it were proved that the dust of mouldy straw contained no bacteria (though such are pretty certain to be present), and if it were proved also that fungi by themselves cannot produce specific diseases (though some such diseases are well known in the lower animals, and are not quite unknown in man).

But even granting these points, surely the experiment might be repeated at least once before it is made a corner-stone of cryptogamic botany!

The dangerous fungus of measles Mr. Candler believes to lurk in damp and mouldy straw palliasses; and rejecting altogether the idea of contagion, he believes that measles is entirely due to the use of straw bedding imperfectly aired. Towards the end of the book the author begins to tread on firmer ground than at the beginning, for he bases his conclusions on some induction from facts.

In the great epidemic of measles in Victoria in the years 1874-75, he affirms that he could not discover any instance of measles in a dwelling from which damp straw (in the form of bedding) had been excluded, but in every house where measles occurred, the presence of damp straw in the bed-rooms was easily made out. Some curious instances of exemption, especially in the case of public institutions, such as asylums and the like, are quoted, and we seem to be on the verge of a systematic collation of evidence. But the result is disappointing, as the enumeration of instances is altogether inadequate to establish a general law. It is strange that Mr. Candler makes so much of the exemption of lunatic asylums from measles, to account for which he has recourse to elaborate explanations of the use of straw bedding. Surely the exemption of persons shut up in asylums, prisons, &c., from contagious epidemic diseases, is a very familiar fact, and easily explained. Such persons receive few visitors, and what is to the point here, lunatics especially are seldom or never visited by children, who are the chief carriers of the measles-contagium. Nor can we say that the author is more successful in explaining on his theory the great epidemics of measles in Fiji and in Japan.

Mr. Candler's book is written with much earnestness, not without candour, and contains many curious facts, though it fails to prove its main contention. There is nothing impossible in the supposition that damp straw favours the growth of "microbes"; and it might conceivably be proved by sufficient evidence that this is a favouring or even a necessary condition for the growth of the specific virus of measles. The objection is that the evidence is quite inadequate. Moreover, were such a law established, it would by no means prove that the cause of measles was a fungus, since it might just as well be a bacterium or other living thing.

In the meantime it cannot do harm and may do much good to draw attention to the insanitary consequences which may follow the use of straw bedding. A straw palliasse unchanged and undisturbed for years is not a desirable article of furniture, and housekeepers will do well to turn such things out of their bed-rooms. Fortunately, in this country they are being rapidly superseded by steel mattresses; and on inquiry at the large furnishing houses we find that few palliasses are now sold. We shall see whether measles becomes thereby extinct.

J. F. P.

SPIDERS' WEBS.

American Spiders and their Spinning Work: a Natural History of the Orb-weaving Spiders of the United States, with Special Regard to their Industry and Habits. By Harvey C. McCook, D.D. Vol. I., pp. 1–372, and 353 Woodcut Figures. (Philadelphia: Allen Lane and Scott, 1889.)

ALTHOUGH much has been written in a more or less fragmentary way by various authors, on the spinning organs and geometric snares of spiders, as well as on the method of entrapping their prey, the present volume is the first in which all that has been before touched upon is brought together in any systematic manner. Two other volumes are intended to follow, but the one under notice completes the subject of geometric web-spinning. In Vol. II. it is purposed to deal with the habits and industry of spiders, associated with mating, maternal instincts, the life of the young, distribution of species, and other general habits; while in the third (and concluding) volume the whole of the geometric spiders—"orb-weavers"—of the United States will be treated of systematically, and illustrated by numerous coloured plates. It might have been thought that Vol. III. would have more naturally preceded the other two; but perhaps it is scarcely fair to criticize too closely the form in which an author chooses to present his subject. Dr. McCook's evident aim is to popularize the subject of spiders' web-spinning, and all that relates to it. This is shown not only by the way in which the subject is presented, but by the bestowal of English trivial names at every turn; though it may well be doubted how far science is really advanced by thus cumbering its nomenclature. Among the most interesting portions of the present volume are those in which some snares are described, combining the geometric or *Epeirid* type with that of the *Theridiidæ*, and of which no examples have yet been found in Great Britain. Space, however, forbids our going into details of these, nor, in fact, of any part of the work. The whole volume is a mass of details, evidently the result of careful and long-continued observations; and made patent not only to the mind by lucid description, but to the eye by the very graphic illustrations thickly scattered over its pages. On one point, of very great interest in the making of geometric snares—the formation of the portion studded with viscid globules—Dr. McCook approaches very nearly to a solution of the method by which these globules are placed on the lines, but the method[1] itself appears to have as yet escaped observation.

Dr. McCook tells us that his first intention was "to write a natural history of all American spiders," but no one who has gone even a little into the spider fauna of that large region will wonder that, when this intention came really to be grappled with, the plan changed; and probably those interested in the study of spiders have gained by the exchange. The work done in this volume is divided into seven parts. Part I. treats of the general classification and structure of spiders and their spinning organs; Part II. of the general characteristics, construction, and armature of webs; Part III. is on characteristic forms and variations of snares; Part IV. on certain geometric webs devoid of viscid globules, and on "spring snares"—those singular arrangements in which the spider holds the snare taut by a single line with the slack gathered up in its claws, and, on an insect striking the web, suddenly lets the slack go with a spring, to the more certain entanglement of the prey. In Part V. we have a detail of many curious facts bearing upon the skill and intelligence of spiders, and also as to the mechanical strength of their webs and their physical powers; but some of the most curious of these details, in regard to the "engineering skill" of spiders are, no doubt rightly, set aside by the author, so far, at least, as their bearing on such skill is concerned. Part VI., under the head of "Provision for Nurture and Defence," treats of the methods of using their snares in procuring food, and on the effects and uses of the poison secreted in the falces of spiders; and the volume concludes with Part VII., in which the "nesting habits" of geometric spiders are gone into, as also the origin, use, and development of nest-making in various tribes of spiders; and the "genesis of snares," under which last head the author gives us his views as to the steps by which a simple line may have become the complicated snares now formed by these spiders.

The volume thus completed is well got up, and, abounding in interest from beginning to end, may well stir up in everyone to whom spiders are not (and it is to be regretted they sometimes are) objects of abhorrence, a wish for the speedy appearance of the remainder of the work, Vols. II. and III., the proposed contents of which have been noticed above. O. P. C.

[1] Cf. a paper on this subject by —Apstein, "Bau und Function der Spinnendrusen der Araneida," *Archiv für Naturgeschichte*, 1889, p. 29.

NATIONAL HEALTH.

National Health. By B. W. Richardson, M.D., F.R.S. Abridged from the "Health of Nations," of Sir Edwin Chadwick, K.C.B. (London: Longmans, Green, and Co., 1890.)

THE aim of this work is sufficiently explained in the preface, in which the editor states that his object has been to condense, without comment, into a single handy and cheap volume, the most practical and most popular parts of Sir Edwin Chadwick's "Health of Nations."

The volume opens with a biographical sketch of the author of the larger work, giving an interesting and detailed account of his important life-work in public health and sanitation; the remainder of the work being divided up into four sections, dealing respectively with health in the dwelling-house, in the school, the health of the community, and health in the future.

The first section, relating mainly to the dwellings of the working classes, is devoted to an inquiry into the serious consequences to health of unsanitary surroundings, such as overcrowding, want of ventilation, deficient water-supply, and imperfect drainage, especially when, as is often the case in houses of the poorer classes, the walls are pervious and absorbent through faulty construction and the use of bad materials. The author points out that as good house-drainage and complete sanitary work has proceeded in old houses, low health has immediately improved; a similar improvement becoming visible at the same time in the moral as well as the physical con-

dition of the people. A number of pages are taken up with a description of an ideal water-supply and methods of drainage, great stress being laid on the necessity for laying down drains and sewers of the smallest possible size consistent with the immediate removal of the maximum flow at any one time. The wisdom of such a plan is now admitted on all hands, the powerful flow preventing all deposit, and by maintaining a down draught from the houses, avoiding the ingress of sewer-gas.

In the section on "Health in the School," we find an account of the "Half-time System" initiated by Sir E. Chadwick with the object of ensuring to children employed in manufactories a certain time for school-work and recreation, in addition to that devoted to physical labour. The time which should be occupied by lessons at various ages, and the effect of good lighting, warming, ventilation, and personal cleanliness in augmenting the receptivity of pupils, are ably discussed, and the value of military drill as a part of the education is rightly insisted on. The methods for the prevention of the occurrence and spread of epidemics are so briefly touched upon, that we cannot but think that the importance of the subject might have demanded somewhat fuller treatment.

The most important portion of the following section deals with the results of occupation and surroundings on the length of life in various classes of society, the effects of intemperance and of bad feeding being specially considered; the author, however, being careful to point out the sources of fallacy to which all such statistics are liable. The last portion of the book is mainly devoted to an attack on the Malthusian theory.

The work is not, and does not in any way pretend to be, a student's text-book, so that the candidate for a diploma in public health will hardly find it of much value, except, perhaps, from an historical point of view. Still, there is much in its pages which may be studied with advantage by those interested in matters pertaining to general hygiene, especially as it presents in moderate compass a most readable account of the labours of a distinguished pioneer in the field of sanitary science.

OUR BOOK SHELF.

Induction and Deduction, and other Essays. By Constance C. W. Naden. Edited by R. Lewins, M.D. (London: Bickers and Son, 1890.)

THIS little work acquires a melancholy interest from the fact that the talented young authoress has not lived to see its publication. The title essay, on "Induction and Deduction," gained in 1887 the Heslop Memorial Medal, provided out of the proceeds of a bequest to the Mason Science College of Birmingham by the late Dr. Heslop, and awarded annually by the Council of the College. It is clear, concise, well-arranged, and carefully thought out; and leads one to believe that, had the hand of Death been withheld, Miss Naden would have made valuable contributions to philosophic thought. For Miss Naden the fundamental principle in philosophy is the famous Protagorean formula of relativity, that "Man is the measure of all things, of things that are that they are, of things that are not that they are not." She insists on the close inter-connection of induction and deduction in all reasoning, the two processes not being antagonistic but complementary. Both involve cognition and recognition; but whereas induction is a process of cognition involving recognitions, deduction is a process of recognition involving cognitions. The historical development is traced from the Greek cosmologists, through Plato, Aristotle, Bacon, Descartes and Locke, Mill, Jevons, and J. H. Green; and there are many signs that Miss Naden had not merely grasped but assimilated the teachings of those whose influence on the theory of reasoning she traced.

That Miss Naden was not wanting in humour is seen from the "Legend of the Inductive Method" in her introduction. This is so good as to be worth quoting.

"In the beginning was a set of philosophers, who, instead of looking about them, simply investigated their own thoughts, and tumbled into many ditches, not so much through star-gazing, as through mind-gazing. Out of their inner consciousness they extracted a great many principles which were inapplicable to Nature, and were therefore of none effect; and on account of this wilful perversion they failed to invent the steam-engine or to discover the circulation of the blood. This state of things went on for a long time; and in the Middle Ages matters grew worse rather than better; for now there appeared a set of men called schoolmen, who submitted everything to the authority of the Church and of Aristotle, and wasted their time in frivolous debates about phantoms named quiddities and hocceities and haeceities. Their method also was deductive, and was false. But in the glorious sixteenth century, and in our own glorious island, there arose a Lord Chancellor who wrote a book which changed the face of the intellectual world. This great man found out that the proper office of the mind is to make discoveries, and that the proper way to make discoveries is to interrogate Nature. He laid down rules for the correct framing of our interrogations. He is the father of all such as make far places near by steam-engines and electric telegraphs, or numb our pain by anæsthetics, or light the world by gas or electricity. His method is called inductive, and is true."

The other essays are on ethical and sociological questions, and on "Hylo-Idealism: the Creed of the Coming Day." They are somewhat unequal in value. The work is prefaced by a short memoir. C. LL. M.

The Lepidopterous Fauna of Lancashire and Cheshire. By John W. Ellis, M.B. (Vic.), F.E.S. (Leeds: Printed by McCorquodale and Co., 1890.)

THIS volume, the contents of which are reprinted from the *Naturalist*, will be of great service to all students of the subject to which it relates. Dr. Ellis does not offer his list as conclusive; but he has "endeavoured to present, as completely as possible, the facts known with reference to the occurence in Lancashire and Cheshire of the British species of Lepidoptera." The list is preceded by a short statement as to the geological and meteorological conditions which, by affecting the flora of the district, affect indirectly its lepidopterous fauna.

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.*]

Intelligence of Chimpanzees.

ONE is glad to see that your review of Mr. Stanley's book calls attention to the following statement, which is made on the authority of Emin Pasha, and rendered in his own words:—

"The forest of Msongwa is infested with a large tribe of chimpanzees. In summer-time, at night, they frequently visit the plantations of Mswa Station to steal the fruit. But what is remarkable about this is the fact that they use torches to light the way! Had I not witnessed this extraordinary spectacle personally, I should never have credited that any of the Simians understood the art of making fire."

On this passage your reviewer remarks:—"We cannot doubt

the accuracy of Mr. Stanley's report, nor the trustworthiness of Emin's observation; but we should like to have more details." But as Emin himself allows that he would never have credited the fact alleged had he not witnessed it personally, we may, perhaps, without discourtesy, refuse to accept so bald a statement of "this extraordinary spectacle." Of what were the torches constructed? How do these "Simians" practise "the art of making fire"? Having once acquired the art, do they use it only for the purpose of making "torches to light the way"?

Speaking for myself, and not without some knowledge of the intelligence of a chimpanzee, I confess that, until at least these "details" are supplied, I *do* "doubt the trustworthiness of Emin's observation," and I shall be satisfied to suppose that, owing to a shortsightedness of which we have heard so much, the Pasha has mistaken a band of native children for his "large tribe of chimpanzees."

GEORGE J. ROMANES.

July 6.

Dr. Kœnig's Theory of Beats.

I MADE an experiment, some years ago, which would seem to support and illustrate Dr. Kœnig's theory of beats, as set forth by Prof. Silvanus Thompson in his lecture before the Physical Society, and reported in your issue of June 19. Taking two tuning-forks, each of which gave the middle C (256 vibrations), I weighted one of them so as to make it give one beat a second when sounded with the other. Then, sounding this fork, so weighted, with another giving the fifth above, G (384 vibrations), I heard distinctly three beats a second. I could only account for these beats by assuming that the weighted fork C produced a feeble twelfth, and that the fork G produced a feeble octave. These two overtones would, if present, give three beats a second, $255 \times 3 = 765$, and $384 \times 2 = 768$. But I could not show by any independent evidence that these overtones are really present when the tuning-forks are sounded; and, in fact, the general opinion is against such an assumption.

If, however, Dr. Kœnig's theory be accepted, the beats are easily accounted for. According to his view, as stated by Prof. Thompson, these forks when sounded together would yield two sets of beats, called, respectively, *superior* and *inferior;* and each set of beats would blend into a musical tone. Thus we should get—

Inferior beat ... ... $384 - 255 = 129$
Superior beat ... ... $510 - 384 = 126$

These primary beats, or beat-tones as they may be called, of 129 and 126 vibrations would act as independent tones, and produce secondary beats of three in the second.

I hope Prof. Thompson's paper will be published in full, that we may all have an opportunity of considering the details of Dr. Kœnig's reasoning; but, in the meantime, I thought the experiment I have described would be interesting to your readers, as it is very easily made. Perhaps I should add that the experiment succeeds equally whether the forks are mounted on resonance-boxes or not; and therefore the effect cannot be ascribed to the boxes.

GERALD MOLLOY.

Catholic University, Dublin, June 22.

The "Night-shining Clouds."

I HAVE not yet seen, in any English publication, mention of the important results of the more recent researches of Herr O. Jesse and his coadjutors on these clouds. By taking simultaneous photographs from two or more widely separated places, the height of the clouds has been determined with great exactness. On July 2, 1889, this was found to be somewhat over 80 kilometres. The operations have evidently been conducted with great care, and the results may therefore be fully trusted. The question is therefore set at rest as to whether the clouds are self-luminous, for it is evident that at such a height their brightness is fully accounted for by the sun shining upon them. In 1886, Herr Jesse had, upon this supposition, ascertained their brightness to be from 49 to 54 kilometres, and that the lower the sun descended the smaller was the illumination needed to show them as the atmosphere darkened, so that the calculated height increased with the sun's depression below the horizon. Some people were incredulous about the great height at that time attributed; but the photographs give them a yet greater elevation, which places them quite out of the category of any ordinary clouds. Those who have not seen the photographs may query as to the possibility of identifying the same points in the two photographs compared, and may think that even synchronous photographs might show very different details by being taken from two distant stations; but, on the contrary, in those examples I have seen, the two photographs are so exactly alike that it is very difficult to discover any difference whatever between them, though taken at Nauen and Steglitz, 35 kilometres apart, which consideration of itself shows the enormous height of the clouds. In some of the photographs the stars α and β Aurigæ are distinctly visible.

The letter by "M. E." (p. 198) evidently describes an apparition of these clouds on the night of the 17th ult., when, as I am informed, they were also seen from Sunderland; but I have not myself seen them either this year or last, though they have been seen both years in Germany—more especially after midnight. They generally are seen in June and July, the earliest recorded date being May 26, and the latest August 11.

Sunderland, July 8. T. W. BACKHOUSE.

IN a letter which you published some time ago on "night-shining clouds," there was a request for notes of their occurrence. It may, therefore, interest some of your readers to know that they were well seen here on the evening of the 4th inst. They appeared rather suddenly shortly before 10 p.m., covering the sky from N. to N.E., and from the horizon for about 15° up. They were not in regular strata, but scattered in all directions, like cirrus after a storm. About midnight they were still visible, but more to the left, some being west of north. The first time I saw these clouds was on June 18, 1886, soon after midnight, when they were about N.W., and 20° from the horizon, and since then they have often been seen; but never, so far as I know, with the storm-tossed appearance they presented last week.

CECIL SHAW.

Belfast, July 7.

A VERY fine display of luminous night-clouds was visible here during the night of the 4th inst., the luminosity extending to an altitude of 30° above the northern horizon, ending above in definite cirrous streamers, or cloud wisps. It will be seen by the Ben Nevis June Summary that these clouds were noted on the 29th ult. In NATURE of the 3rd inst. (p. 222), the writer's communication on this subject was misprinted Kensington instead of Kingstown (Co. Dublin). The present dates from Scotland.

Aberdeen, July 7. D. J. ROWAN.

An Electrical Effect.

IT may be of value to remind teachers of an effect not generally known, which is produced by varying the ordinary mode of performing the experiment of putting pieces of zinc and silver in the mouth and touching them, to obtain the acid taste which accompanies the completion of the electric circuit.

If the piece of zinc be placed under the tongue, and a florin vertically between the upper lip and the top row of teeth, and the two metals be brought in contact, a faint flash is seen in both eyes when the eyes are open.

If the eyes are shut the sensation of light is not felt, so that the effect is probably due to a muscular twitching.

It is necessary to use a large silver coin, and not a shilling, and to push it well home behind the upper lip.

The experiment so made seems to be a handy and simple illustration of the meaning of subjective phenomena.

Clifton College, July 7. EDWARD B. COOK.

THE PHOTOGRAPHIC IMAGE.[1]

THE history of a discovery which has been developed to such a remarkable degree of perfection as photography has naturally been a fruitful source of discussion among those who interest themselves in tracing the progress of science. It is only my presence in this lecture theatre, in which the first public discourse on photography was given by Thomas Wedgwood at the beginning of the century, that justifies my treading once again a path which has already been so thoroughly well beaten. If any further justification for trespassing upon the ground of the historian is needed, it will be found in the circumstance that in the autumn of last year there was held a celebration

[1] Friday Evening Lecture delivered at the Royal Institution by Prof. Raphael Meldola, F.R.S., on May 16, 1890.

of what was generally regarded as the jubilee of the discovery. This celebration was considered by many to have reference to the public disclosure of the Daguerreotype process, made through the mouth of Arago to the French Academy of Sciences on August 10, 1839. There is no doubt that the introduction of this process marked a distinct epoch in the history of the art, and gave a great impetus to its subsequent development. But, while giving full recognition to the value of the discovery of Daguerre, we must not allow the work of his predecessors and contemporaries in the same field to sink into oblivion. After the lapse of half a century we are in a better position to consider fairly the influence of the work of different investigators upon modern photographic processes.

I have not the least desire on the present occasion to raise the ghosts of dead controversies. In fact, the history of the discovery of photography is one of those subjects which can be dealt with in various ways, according to the meaning assigned to the term. There is ample scope for the display of what Mr. Herbert Spencer calls the "bias of patriotism." If the word "photography" be interpreted literally as writing or inscribing by light without any reference to the subsequent permanence of the inscription, then the person who first intentionally caused a design to be imprinted by light upon a photo-sensitive compound must be regarded as the first photographer. According to Dr. Eder, of Vienna, we must place this experiment to the credit of Johann Heinrich Schulze, the son of a German tailor, who was born in the Duchy of Madgeburg, in Prussia, in 1687, and who died in 1744, after a life of extraordinary activity as a linguist, theologian, physician, and philosopher. In the year 1727, when experimenting on the subject of phosphorescence, Schulze observed that by pouring nitric acid, in which some silver had previously been dissolved, on to chalk, the undissolved earthy residue had acquired the property of darkening on exposure to light. This effect was shown to be due to light, and not to heat. By pasting words cut out in paper on the side of the bottle containing his precipitate, Schulze obtained copies of the letters on the silvered chalk. The German philosopher certainly produced what might be called a temporary photogram. Whatever value is attached to this observation in the development of modern photography, it must be conceded that a considerable advance was made by spreading the sensitive compound over a surface instead of using it in mass. It is hardly necessary to remind you here that such an advance was made by Wedgwood and Davy in 1802.[1] The impressions produced by these last experimenters were, unfortunately, of no more permanence than those obtained by Schulze three-quarters of a century before them.

It will perhaps be safer for the historian of this art to restrict the term photograph to such impressions as are possessed of permanence: I do not, of course, mean absolute permanence, but ordinary durability in the common-sense acceptation of the term. From this point of view the first real photographs, *i.e.* permanent impressions of the camera picture, were obtained on bitumen films by Joseph Nicéphore Niepce, of Châlons-sur-Sâone, who, after about twenty years' work at the subject, had perfected his discovery by 1826. Then came the days of silver salts again, when Daguerre, who commenced work in 1824, entered into a partnership with Niepce in 1829, which was brought to a termination by the death of the latter in 1833. The partnership was renewed between Daguerre and Niepce de St. Victor, nephew of the elder Niepce. The method of fixing the camera picture on a film of silver iodide on a silvered copper plate—the process justly associated with the name of Daguerre—was ripe for disclosure by 1838, and was actually made known in 1839.

The impartial historian of photography who examines critically into the evidence will find that quite indepently of the French pioneers, experiments on the use of silver salts had been going on in this country, and photographs, in the true sense, had been produced almost simultaneously with the announcement of the Daguerreotype process by two Englishmen whose names are as household words in the ranks of science. I refer to William Henry Fox Talbot and Sir John Herschel. Fox Talbot commenced experimenting with silver salts on paper in 1834, and the following year he succeeded in imprinting the camera picture on paper coated with the chloride. In January 1839 some of his "photogenic drawings"—the first "silver prints" ever obtained—were exhibited in this Institution by Michael Faraday. In the same month he communicated his first paper on a photographic process to the Royal Society, and in the following month he read a second paper before the same Society, giving the method of preparing the sensitive paper and of fixing the prints. The outcome of this work was the "Calotype" or Talbotype process, which was sufficiently perfected for portraiture by 1840, and which was fully described in a paper communicated to the Royal Society in 1841. The following year Fox Talbot received the Rumford Medal for his "discoveries and improvements in photography."[1]

Herschel's process consisted in coating a glass plate with silver chloride by subsidence. The details of the method, from Herschel's own notes, have been published by his son, Prof. Alexander Herschel.[2] By this means the old 40-foot reflecting telescope at Slough was photographed in 1839. By the kindness of Prof. Herschel, and with the sanction of the Science and Art Department, Herschel's original photographs have been sent here for your inspection. The process of coating a plate by allowing a precipitate to settle on it in a uniform film is, however, impracticable, and was not further developed by its illustrious discoverer. We must credit him, however, as being the first to use glass as a substratum. Herschel further discovered the important fact that while the chloride was very insensitive alone, its sensitiveness was greatly increased by washing it with a solution of silver nitrate. It is to Herschel, also, that we are indebted for the use of sodium thiosulphate as a fixing agent, as well as for many other discoveries in connection with photography, which are common matters of history.

Admitting the impracticability of the method of subsidence for producing a sensitive film, it is interesting to trace the subsequent development of the processes inaugurated about the year 1839. The first of photographic methods—the bitumen process of Niepce—survives at the present time, and is the basis of some of the most important of modern photo-mechanical printing processes. [Specimens illustrating photo-etching from Messrs. Waterlow and Sons exhibited.] The Daguerreotype process is now obsolete. As it left the hands of its inventor it was unsuited for portraiture, on account of the long exposure required. It is evident, moreover, that a picture on an opaque metallic plate is incapable of reproduction by printing through, so that in this respect the Talbotype possessed distinct advantages. This is one of the most important points in Fox Talbot's contributions to photography. He was the first to produce a transparent paper negative from which any number of positives could be obtained by printing through. The silver print of modern times is the lineal descendant of the Talbotype print. After forty years' use of glass as a substratum, we are going back to Fox Talbot's plan, and using thin flexible

[1] "An Account of a Method of Copying Paintings upon Glass, and of making Profiles by the Agency of Light upon Nitrate of Silver. Invented by T. Wedgwood, Esq. With Observations by H. Davy." Journ. R.I., 1802, p. 170.

[1] For these and other details relating to Fox Talbot's work, necessarily excluded for want of time, I am indebted to his son, Mr. C. H. Talbot, of Lacock Abbey.

[2] *Photog. Journ. and Trans. Photog. Soc.*, June 15, 1872.

films—not exactly of paper, but of an allied substance, celluloid. [Specimens of Talbotypes, lent by Mr. Crookes, exhibited, with celluloid negatives by the Eastman Company.]

If I interpret this fragment of history correctly, the founders of modern photography are the three men whose labours have been briefly sketched. The jubilee of last autumn marked a culminating point in the work of Niepce and Daguerre, and of Fox Talbot. The names of these three pioneers must go down to posterity as co-equal in the annals of scientific discovery. [Portraits by Mr. H. M. Elder shown.] The lecture theatre of the Royal Institution offers such tempting opportunities to the chronicler of the history of this wonderful art that I must close this treatment of the subject by reminding myself that in selecting the present topic I had in view a statement of the case of modern photography from its scientific side only. There is hardly any invention associated with the present century which has rendered more splendid services in every department of science. The physicist and chemist, the astronomer and geographer, the physiologist, pathologist, and anthropologist will all bear witness to the value of photography. The very first scientific application of Wedgwood's process was made here by the illustrious Thomas Young, when he impressed Newton's rings on paper moistened with silver nitrate, as described in his Bakerian Lecture to the Royal Society on November 24, 1803. Prof. Dewar has just placed in my hands the identical slide with the Newton rings still visible, which he believes Young to have used in this classic experiment. [Shown.]

Our modern photographic processes depend upon chemical changes wrought by light on films of certain sensitive compounds. Bitumen under this influence becomes insoluble in hydrocarbon oils, as in the heliographic process of the elder Niepce. Gelatine mixed with potassium dichromate becomes insoluble in water on exposure to light, a property utilized in the photo-etching process introduced in 1852 by Fox Talbot, some of whose original etchings have been placed at my disposal by Mr. Crookes. [Shown.] Chromatized gelatine now plays a most important part in the autotype and many photo-mechanical processes. The salts of iron in the ferric condition undergo reduction to the ferrous state under the influence of light in contact with oxidizable organic compounds. The use of these iron salts is another of Sir John Herschel's contributions to photography (1842), the modern "blue print" and the beautiful platinotype being dependent on the photo-reducibility of these compounds. [Cyanotype print developed with ferricyanide.]

Of all the substances known to chemistry at the present time, the salts of silver are by far the most important in photography on account of the extraordinary degree of sensitiveness to which they can be raised. The photographic image with which it is my privilege to deal on this occasion is that invisible impression produced by the action of light on a film of a silver haloid. Many methods of producing such films have been in practical use since the foundation of the art in 1839. All these depend on the double decomposition between a soluble chloride, bromide, or iodide, and silver nitrate, resulting in the formation of the silver haloid in a vehicle of some kind, such as albumen (Niepce de St. Victor, 1848) or collodion on glass, as made practicable by Scott Archer in 1851. For twenty years this collodion process was in universal use; its history and details of manipulation, its development into a dry plate process by Colonel Russell in 1861, and into an emulsion process by Bolton and Sayce in 1864, are facts familiar to everyone.

The photographic film of the present time is a gelatino-haloid (generally bromide) emulsion. If a solution of silver nitrate is added to a solution of potassium bromide and the mixture well shaken, the silver bromide coagulates and rapidly subsides to the bottom of the liquid as a dense curdy precipitate. [Shown.] If instead of water we use a viscid medium, such as gelatine solution, the bromide does not settle down, but forms an emulsion, which becomes quite homogeneous on agitation. [Shown.] This operation, omitting all details of ripening, washing, &c., as well known to practical photographers, is the basis of all the recent photographic methods of obtaining negatives in the camera. The use of this invaluable vehicle, gelatine, was practically introduced by R. L. Maddox in 1871, previous experiments in the same direction having been made by Gaudin (1853-61). Such a gelatino-bromide emulsion can be spread uniformly over any substratum—glass, paper, gelatine, or celluloid—and when dry gives a highly sensitive film.

The fundamental problem which fifty years' experience with silver haloid films has left in the hands of chemists is that of the nature of the chemical change which occurs when a ray of light falls on such a silver salt. Long before the days of photography—far back in the sixteenth century—Fabricius, the alchemist, noticed that native horn silver became coloured when brought from the mine and exposed. The fact presented itself to Robert Boyle in the seventeenth century, and to Beccarius, of Turin, in the eighteenth century. The change of colour undergone by the chloride was first shown to be associated with chemical decomposition in 1777 by Scheele, who proved that chlorine was given off when this salt darkened under water. I can show you this in a form which admits of its being seen by all. [Potassium iodide and starch paper were placed in a glass cell with silver chloride, and the arrangement exposed to the electric light till the paper had become blue.] The gas which is given off under these circumstances is either the free halogen or an oxide or acid of the halogen, according to the quantity of moisture present and the intensity of the light. I have found that the bromide affects the iodide and starch paper in the same way, but silver iodide does not give off any gas which colours the test paper. All the silver haloids become coloured on exposure to light, the change being most marked in the chloride, less in the bromide, and least of all in the iodide. The latter must be associated with some halogen absorbent to render the change visible. [Strips of paper coated with the pure haloids, the lower halves brushed over with silver nitrate solution, were exposed.] The different degrees of coloration in the three cases must not be considered as a measure of the relative sensitiveness: it simply means that the products of photo-chemical change in the three haloids are inherently possessed of different depths of colour.

From the fact that halogen in some form is given off, it follows that we are concerned with photo-chemical decomposition, and not with a physical change only. All the evidence is in favour of this view. Halogen absorbents, such as silver nitrate on the lower halves of the papers in the last experiment, organic matter, such as the gelatine in an emulsion, and reducing agents generally, all accelerate the change of colour. Oxidizing and halogenizing agents, such as mecuric chloride, potassium dichromate, &c., all retard the colour change. [Silver chloride paper, painted with stripes of solutions of sodium sulphite, mercuric chloride, and potassium dichromate, was exposed.] It is impossible to account for the action of these chemical agents except on the view of chemical decomposition. The ray of light falling upon a silver haloid must be regarded as doing chemical work; the vibratory energy is partly spent in doing the work of chemical separation, and the light passes through a film of such haloid partly robbed of its power of doing similar work upon a second film. It is difficult to demonstrate this satisfactorily in the lecture-room on account of the opacity of the silver haloids, but the work of Sir John Herschel, J. W. Draper, and others has put it beyond doubt that there is a relationship of this kind between

absorption and decomposition. It is well known also that the more refrangible rays are the most active in promoting the decomposition in the case of the silver haloids. This was first proved for the chloride by Scheele, and is now known to be true for the other haloids. It would be presumption on my part in the presence of Captain Abney to enlarge upon the effects of the different spectral colours on these haloids, as this is a subject upon which he can speak with the authority of an investigator. It only remains to add that the old idea of a special "actinic" force at the more refrangible end of the spectrum has long been abandoned. It is only because the silver haloids absorb these particular rays that the blue end of the spectrum is most active in promoting their decomposition. Many other instances of photo-chemical decomposition are known in which the less refrangible rays are the most active, and it is possible to modify the silver haloids themselves so as to make them sensitive for the red end of the spectrum.

The chemical nature of the coloured products of photo-chemical decomposition is still enshrouded in mystery. Beyond the fact that they contain less halogen than the normal salt, we are not much in advance of the knowledge bequeathed to us by Scheele in the last century. The problem has been attacked by chemists again and again, but its solution presents extraordinary difficulties. These products are never formed—even under the most favourable conditions of division and with prolonged periods of exposure—in quantities beyond what the chemist would call "a mere trace." Their existence appears to be determined by the great excess of unaltered haloid with which they are combined. Were I to give free rein to the imagination, I might set up the hypothesis that the element silver is really a compound body invariably containing a minute percentage of some other element, which resembles the compound which we now call silver in all its chemical reactions, but alone is sensitive to light. I offer this suggestion for the consideration of the speculative chemist.[1] For the coloured product as a whole, *i.e.* the product of photo-decomposition with its combined unchanged haloid, Carey Lea has proposed the convenient term "photosalt." It will avoid circumlocution if we adopt this name. The photosalts have been thought at various times to contain metallic silver, allotropic silver, a sub-haloid, such as argentous chloride, &c., or an oxyhaloid. The free metal theory is disposed of by the fact that silver chloride darkens under nitric acid of sufficient strength to dissolve the metal freely. The acid certainly retards the formation of the photosalt, but does not prevent it altogether. When once formed the photo-chloride is but slowly attacked by boiling dilute nitric acid, and from the dry photosalt mercury extracts no silver. The assumption of the existence of an allotropic form of silver insoluble in nitric acid cannot be seriously maintained. The sub-haloid theory of the product may be true, but it has not yet been established with that precision which the chemist has a right to demand. We must have analyses giving not only the percentage of halogen, but also the percentage of silver, in order that it may be ascertained whether the photosalt contains anything besides metal and halogen. The same may be said of the oxyhaloid theory: it may be true, but it has not been demonstrated.

The oxyhaloid theory was first suggested by Robert Hunt[2] for the chloride; it was taken up by Sahler, and has recently been revived by Dr. W. R. Hodgkinson. It has been thought that this theory is disposed of by the fact that the chloride darkens under liquids, such as hydrocarbons, which are free from oxygen. I have been repeating some of these experiments with various liquids, using every possible precaution to exclude oxygen and moisture; dry silver chloride heated to incipient fusion has been sealed up in tubes in dry benzene, petroleum, and carbon tetrachloride and exposed since March. [Tubes shown.] In all cases the chloride has darkened. The salt darkens, morever, in a Crookesian vacuum.[1] By these experiments the oxychloride theory may be scotched, but it is not yet killed; the question now presents itself, whether the composition of the photosalt may not vary according to the medium in which it is generated. Analogy sanctions the supposition that when the haloid darkens under water or other oxygen-containing liquid, or even in contact with moist or dry air, that an oxychloride may be formed, and enter into the composition of the photosalt. The analogy is supplied by the corresponding salt of copper, viz. cuprous chloride, which darkens rapidly on exposure. [Design printed on flat cell filled with cuprous chloride by exposure to electric light.] Wöhler conjectured that the darkened product was an oxychloride, and this view receives a certain amount of indirect support from these tubes [shown], in which dry cuprous chloride has been sealed up in benzene and carbon tetrachloride since March; and although exposed in a southern window during the whole of that time, the salt is as white as when first prepared. Some cuprous chloride sealed up in water, and exposed for the same time, is now almost black. [Shown.]

When silver is precipitated by reduction in a finely divided state in the presence of the haloid, and the product treated with acids, the excess of silver is removed and coloured products are left which are somewhat analogous to the photosalts proper. These coloured haloids are also termed by Carey Lea photosalts because they present many analogies with the coloured products of photo-chemical change. Whether they are identical in composition it is not yet possible to decide, as we have no complete analyses. The first observations in this direction were published more than thirty years ago in a report by a British Association Committee,[2] in which the red and chocolate-coloured chlorides are distinctly described. Carey Lea has since contributed largely to our knowledge of these coloured haloids, and has at least made it appear highly probable that they are related to the products formed by the action of light. [Red photo-chloride and purple photobromide and iodide shown.]

The photographic image is impressed on a modern film in an inappreciable fraction of a second, whereas the photosalt requires an appreciable time for its production. The image is invisible simply because of the extremely minute quantity of haloid decomposed. In the present state of knowledge it cannot be asserted that the material composing this image is identical in composition with the photosalt, for we know the composition of neither the one nor the other. But they are analogous in so far as they

[1] I have gone so far as to test this idea experimentally in a preliminary way, the result being, as might have been anticipated, negative. Silver chloride, well darkened by long exposure, was extracted with a hot saturated solution of potassium chloride, and the dissolved portion, after precipitation by water, compared with the ordinary chloride by exposure to light. Not the slightest difference was observable either in the rate of coloration or in the colours of the products. Perhaps it may be thought worth while to repeat the experiment, using a method analogous to the "method of fractionation" of Crookes.

[2] "Researches on Light," 2nd ed., 1854, p. 80.

[1] Some dry silver chloride which Mr. Crookes has been good enough to seal up for me in a high vacuum darkens on exposure quite as rapidly as the dry salt in air. It soon regains its original colour when kept in the dark. It behaves, in fact, just as the chloride is known to behave when sealed up in chlorine, although its colour is of course much more intense after exposure than is the case with the chloride in chlorine.

[2] These results were arrived at in three ways. In one case hydrogen was passed through silver citrate suspended in hot water, and the product extracted with citric acid. "The result of treating the residue with chlorhydric acid, and then dissolving the silver by dilute nitric acid, was a rose-tinted chloride of silver." In another experiment the dry citrate was heated in a stream of hydrogen at 212° F., and the product, which was partly soluble in water, gave a brown residue, which furnished "a very pale red body on being transformed by chlorhydric and nitric acids." In another experiment silver arsenite was formed, this being treated with caustic soda, and the black precipitate then treated successively with chlorhydric and nitric acids: "Silver is dissolved, and there is left a substance . . . . [of] a rich chocolate or maroon, &c." This on analysis was found to contain 24 per cent. of chlorine, the normal chloride requiring 24·74 and the sub-chloride 14·08 per cent. The Committee which conducted these experiments consisted of Messrs. Maskelyne, Hadow Hardwick, and Llewelyn. B.A. Rep., 1859, p. 103.

are both the result of photo-chemical decomposition, and there is great probability that they are closely related, if not identical, chemically. It may turn out that there are various kinds of invisible images, according to the vehicle or halogen absorbent—in other words, according to the sensitizer with which the silver haloid is associated. The invisible image is revealed by the action of the developer, into the function of which I do not propose to enter. It will suffice to say that the final result of the developing solution is to magnify the deposit of photosalt by accumulating metallic silver thereon by accretion or reduction. Owing to the circumstance that the image is impressed with such remarkable rapidity, and that it is invisible when formed, it has been maintained, and is still held by many, that the first action of light on the film is molecular or physical, and not chemical. The arguments in favour of the chemical theory appear to me to be tolerably conclusive, and I will venture to submit a few of them.

The action of reagents upon the photographic film is quite similar to the action of the same reagents upon the silver haloids when exposed to the point of visible coloration. Reducing agents and halogen absorbents increase the sensitiveness of the film: oxidizing and halogenizing agents destroy its sensitiveness. It is difficult to see on the physical theory why it should not be possible to impress an image on a film, say of pure silver bromide, as readily as on a film of the same haloid embedded in gelatine. Everyone knows that this cannot be done. I have myself been surprised at the extreme insensitiveness of films of pure bromide prepared by exposing films of silver deposited on glass to the action of bromine vapour. On the chemical theory we know that gelatine is a splendid sensitizer—*i.e.* bromine absorbent. There is another proof which has been in our hands for nearly thirty years, but I do not think it has been viewed in this light before. It has been shown by Carey Lea, Eder, and especially by Abney—who has investigated the matter most thoroughly—that a shearing stress applied mechanically to a sensitive film leaves an impression which can be developed in just the same way as though it had been produced by the action of light. [Pressure marks on Eastman bromide paper developed by ferrous oxalate.] Now that result cannot be produced on a surface of the pure haloid: some halogen absorbent, such as gelatine, must be associated with the haloid. We are concerned here with a chemical change of that class so ably investigated by Prof. Spring, of Liége, who has shown that by mere mechanical pressure it is possible to bring about chemical reaction between mixtures of finely divided solids.[1] Then again, mild reducing agents, too feeble to reduce the silver haloids directly to the metallic state, such as alkaline hypophosphites, glucose or lactose and alkali, &c., form invisible images which can be developed in precisely the same way as the photographic image. All this looks like chemical change, and not physical modification pure and simple.

I have in this discourse stoically resisted the tempting opportunities for pictorial display which the subject affords. My aim has been to summarize the position in which we find ourselves with respect to the invisible image after fifty years' practice of the art. This image is, I venture to think, the property of the chemist, and by him must the scientific foundation of photography be laid. We may not be able to give the formula of the photosalt, but if the solution of the problem has hitherto eluded our grasp it is because of the intrinsic difficulties of the investigation. The photographic image brings us face to face—not with an ordinary, but with an extraordinary class of chemical changes due entirely to the peculiar character of the silver salts. The material composing the image is not of that definite nature with which modern chemical methods are in the habit of dealing. The stability of the photosalt is determined by some kind of combination between the sub-haloid or oxyhaloid, or whatever it may be, and the excess of unaltered haloid which enters into its composition. The formation of the coloured product presents certain analogies with the formation of a saturated solution; the product of photo-chemical decomposition is formed under the influence of light up to a certain percentage of the whole photosalt, beyond which it cannot be increased—in other words, the silver haloid is saturated by a very minute percentage of its own product of photo-decomposition. The photosalt belongs to a domain of chemistry—a no-man's land—peopled by so-called "molecular compounds," into which the pure chemist ventures but timidly. But these compounds are more and more urging their claims for consideration, and sooner or later they will have to be reckoned with, even if they lack that definiteness which the modern chemist regards as the essential criterion of chemical individuality. The investigation may lead to the recognition of a new order of chemical attraction, or of the old chemical attraction in a different degree. The chemist who discourses here upon this subject at the end of the half-century of photography into which we have now entered will no doubt know more about this aspect of chemical affinity; and if I may invoke the spirit of prophecy in concluding, I should say that a study of the photographic film with its invisible image will have contributed materially to its advancement.

[1] The connection between the two phenomena was suggested during a course of lectures delivered by me two years ago ("Chemistry of Photography," p. 191). I have since learnt that the same conclusion had been arrived at independently by Mr. C. H. Bottanley, of the Yorkshire College, Leeds.

THE VELOCITIES OF PROJECTILES.[1]

THE experimenters, whose work is recorded in the papers noted below, have succeeded admirably in their attempts to photograph projectiles while moving with their ordinary velocities. At the same time, they have obtained indications of the forms of the waves excited in the air by projectiles when moving with velocities higher than the normal velocity of sound in the air.

The first experiments were conducted by Mach and Wentzel with velocities of the projectiles about 240 m.s. (787 f.s.), which were below the normal velocity of sound, when they obtained only negative results. After this, Mach and Salcher carried on experiments of the same nature with three small arms, which respectively gave muzzle velocities of 438 m.s. (1437 f.s.), 338 m.s. (1100 f.s.), and 522 m.s. (1713 f.s.). The arrangements were such that, when the projectile was in the focus of the camera lens, it caused the discharge of a spark from a Leyden jar at a point in the axis of the lens which was more distant from the lens than the projectile. As the illumination was necessarily of very short duration, the instantaneous photographs were taken on a small scale. These photographs showed a well-defined wave of condensation of the air in front of the projectile when the velocity of the shot exceeded that of sound, or about 340 m.s. (1116 f.s.). All the experiments of value were

[1] Aus den *Sitzungsberichten d. kais. Akademie d. Wissenschaften in Wien*:—
(1) "Photographische Fixirung der durch Projectile in der Luft eingeleiteten Vorgänge," von E. Mach und P. Salcher. 1887.
(2) "Ueber die Fortpflanzungsgeschwindigkeit des durch scharfe Schüsse erregten Schalles," von E. Mach. 1888.
(3) "Ueber die in Pola und Meppen angestellten ballistischphotographischen Versuche," von E. Mach und P. Salcher. 1889.
(4) "Ueber die Schallgeschwindigkeit beim scharfen Schuss nach von dem Krupp'schen Etablissement angestellten Versuchen," von E. Mach. 1889.
(5) "Optische Untersuchung der Luftstrahlen," von E. Mach und P. Salcher. 1889.
(6) "Weitere ballistisch-photographische Versuche," von E. Mach und L. Mach. 1889.
(7) "Ueber longitudinale fortschreitende Wellen im Glase," von E. Mach und L. Mach. 1889.
(8) "Ueber die Interferenz der Schallwellen von grosser Excursion," von E. Mach und L. Mach. 1889.

made by the two small arms, which gave muzzle velocities of 1437 f.s. and 1713 f.s. When proper arrangements were made, the photographs of the projectiles fired by these two guns were always very fine and sharp. With a sufficient velocity of the shot, the limit of the condensed air-wave in front of the projectile appeared to be of a hyperboloidal form, whose vertex was in advance of the projectile, and axis in the line of flight. Similar traces in the photograph, indicating conical waves whose axes were also in the line of flight, took their rise from the base of the shot. Other but weaker traces of waves of air took their rise from points on the surface of the shot. All these straight lines in the photograph were inclined to the line of flight at a rather less angle than the traces of the head wave. When the velocity of the projectile was increased, the angles which the traces of the waves made with the line of flight were diminished.

When the highest velocities were obtained, the channel vacated by the projectile was immediately filled with peculiar little clouds, which appeared almost as regular and symmetrical as beads strung on a line stretched in the direction of the line of flight. And there was no indication of a vacuum in the rear of the shot, even when the velocity was so high as 900 m.s. (2953 f.s.). As the air was transparent, the form of the waves of air in the photographs must have been caused by the varying density of the air, which refracted the rays of light.

Long ago Robins noticed a change in the law of resistance of the air to projectiles at about the velocity of sound. Although Hutton disputed this change in the law of resistance and others ignored it, recent experiments have completely confirmed Robins's discovery. It now appears that the disturbances caused by the projectile in the air travel faster than the shot for low velocities, so that the compression of the air in front of the projectile is not sufficient to cause traces of waves in the photographs.

The two guns which gave satisfactory results with muzzle velocities of 1437 f.s. and 1713 f.s., showed widely different curvatures at the vertex of the wave of condensation in advance of the projectile. It was therefore very desirable that the velocity of the shot should have been exactly determined at the moment each photograph was taken. This condition has unfortunately not been sufficiently attended to, for although an improvised ballistic pendulum was used in some cases, it was soon discarded.

Afterwards the experimenters made use of guns of larger calibre. Salcher carried out experiments at Pola with a gun of 9 cm. (3·5 inches) calibre, which gave a muzzle velocity of 448 m.s. (1470 f.s.). Other experiments were made at Meppen, by Mach, assisted by his son, with a gun of 4 cm. (1·6 inch) calibre, which gave a muzzle velocity of 670 m.s. (2198 f.s.). The head wave appeared as a stronger and broader hyperbolic curve in the photograph, which was rather more in advance of the head of the shot than in the case where small arms were used. But when the velocities of the shot were nearly the same in the two cases, the traces of the waves in the photographs made nearly the same angle with the line of flight. This perhaps might have been expected, as it has been found experimentally that the resistance of the air to projectiles varies as the square of their diameter.

Further experiments were afterwards carried out in the laboratory. In this case projectiles composed of various metals were used, as brass, aluminium, and lead, which were of various forms. Attempts were made to determine the velocities of the projectiles in two different ways, neither of which can be regarded as quite satisfactory. In one case it was assumed that the work done on the projectile by a given charge of powder would be constant. But this assumption would not be true for considerable variations in the weight of the projectile. In the other case, the velocity was calculated by using the inclination, a, of the trace of the rear wave in the photograph to the line of flight, on the supposition that the velocity of sound = velocity of the projectile $\times \sin a$.

Much labour and ingenuity have been expended in bringing these experiments to their present satisfactory state. The ground has been well prepared for sets of systematic experiments made with useful forms of projectiles fired with various muzzle velocities. The results given by spherical projectiles might prove useful to the theorist. Other experiments might be carried out with ogival, hemispherical, and flat-headed elongated projectiles. In all cases the readings of the barometer and thermometer should be recorded, and the velocity of the projectile should be measured. The ballistic pendulum would probably give the best results if the block was shielded from the action of the wave of condensed air which accompanies the projectile.

Further, E. Mach has attempted to compare the velocity of the report of a gun with that of the projectile. In one series of his experiments, when the terminal velocity of the projectile was higher than the normal velocity of sound, the time of flight of the projectile, and the time in which the report of the gun travelled over the same distance, agreed very closely. But in another series, where the terminal velocity of the projectile was below that of sound, it was found that the time of flight of the projectile was greater than that of the report of the gun over the same distance. It was therefore considered that the report of the gun travels at the same velocity as the projectile so long as the velocity of the projectile is greater than that of sound. But when the velocity of the projectile is reduced by the resistance of the air below the velocity of sound, then the report of the gun travels in advance of the projectile, moving with the normal velocity of sound. As experiments are frequently made with velocities of the projectile more than double that of sound, there seems to be no difficulty in the way of deciding whether the report of a gun travels at the same velocity as the projectile for high velocities. If so, as appears probable, there arises the question as to the velocity with which the report of the gun travels in various directions from the muzzle of the gun. If a stretched membrane could be made to interrupt a galvanic current for a moment on the passage of a sound-wave, it would not be difficult to determine the law of propagation of the report of a gun in all horizontal directions. For the projectile might be made to cut equidistant screens, and if lines of properly prepared membranes, at the same distance apart as the screens, were run in various directions, each line being provided with its own galvanic current and marker, the progress of the projectile and of the report of the gun in the chosen directions might be registered on the surface of a cylinder rotating with a known velocity. B.

NOTES.

ON Friday last, Mr. Isaac Roberts, F.R.S., of Maghull, Liverpool, was presented with an address on the occasion of his removal from Liverpool to his new observatory near Tunbridge Wells. The presentation took place in the Council Chamber at the Town Hall before a large and representative assembly. The Mayor (Mr. Thomas Hughes), who presided, referred in eulogistic terms to the services rendered to astronomy by Mr. Roberts in his chosen field of celestial photography. Principal Rendall proposed the adoption of the address, in which reference was made to Mr. Roberts's long and honourable business career in Liverpool, and to the important discoveries made by him in stellar photography. The address was signed by the Mayor, Principal Rendall and the Professorial staff of University College, many members of the City Council and of learned and scientific Societies in Liverpool, and other prominent citizens. Mr. John Hartnup, of the Bidston Observatory, seconded the motion, and

it was supported by Mr. A. G. White, the President of the Master Builders' Association. The Mayor then made the presentation. Mr. Roberts, in responding, drew attention to the fact that the city contained no monument or record of the labours of the two great Liverpool astronomers, Lassell and Jeremiah Horrocks, and expressed his willingness to join in any movement having that object in view. He also explained that his reasons for leaving Liverpool were because of the unsuitable nature of the atmosphere for taking observations.

IT is expected that the Electrical Standards Committee will arrange for a discussion, at the Leeds meeting of the British Association, on the best values to adopt for the units of electrical measurement.

MR. W. C. MACDONALD, a merchant of Montreal, has just made a munificent contribution to McGill College. He has given 150,000 dollars to the Law Faculty for the endowment of the Dean's and another chair, and also 50,000 dollars for the endowment of a Chair of Experimental Physics, and has offered to erect buildings for the Faculty of Applied Science, to include class-rooms and laboratories. Altogether, the value of Mr. Macdonald's gift is about 400,000 dollars.

AT a meeting of the Council of the South Wales University College on the 2nd inst., Mr. Archibald C. Elliott was elected to the Engineering Professorship just founded at Cardiff.

THE death took place, on the 29th ult., of Mr. Alexander Parkes, of West Dulwich, and formerly of Birmingham, at the age of seventy-six years. Mr. Parkes was well known as the inventor of the substance parkesine or celluloid, and also of many important manufacturing and metallurgical processes.

THE death, on the 2nd inst., is announced of Mr. John Page, chief engineer of the canals of the Canadian Dominion, and the projector and constructor of the enlarged St. Lawrence Canal system.

THE German Emin Pasha Relief Committee has received a telegram announcing the arrival of Dr. Peters with his Expedition in Usugara.

AT the invitation of Sir William MacGregor, Mr. C. Hedley, of the scientific staff of the Queensland Museum, has gone to New Guinea for the purpose of making a thorough scientific investigation of the invertebrate fauna of the east coast of that country.

MR. JAMES BENNETT has (according to the *Colonies and India*) been commissioned by Lord Knutsford to proceed to Lagos, to make full inquiry into and report upon the mineral and vegetable resources of the colony with a view to their further development. Mr. Bennett is the inventor of a special process for extracting, by means of chemicals, pure rubber from the milk of the wild fig-tree, of which several species are to be found in Lagos and the neighbourhood, and it seems likely that considerable advantage will accrue to the colony from his visit. Mr. Bennett will devote particular attention to such products as rubber, gums, fibres, and minerals, in which it is thought that the present trade of the colony may be largely increased, or which are considered likely to become subjects of local manufacture.

MR. BROWN, the South Australian Government Geologist, has left Adelaide for the north, having been specially commissioned to carry out the geological survey of the Macdonnell Ranges, and to report on the Hale River gold-field. He will be joined on the journey by two members of the Board already selected, and some valuable work will, it is thought, be accomplished by the party before they return.

ACCORDING to the Report of the Oxford University Extension scheme which has been issued, and which comes up to the commencement of July, "Since June 1889, 148 courses have been delivered in 109 centres by 25 lecturers. Examinations were held at the conclusion of 119 courses, and the examiners have awarded certificates of merit or distinction to 927 candidates. The courses were attended by 17,854 students, and the average period of study covered by each course was 10 weeks." In 1885–86 the number of courses delivered was 27 only, and the number of lecture centres 22. Amongst the chief signs of progress recorded are (1) a great extension of University teaching in small towns; (2) a marked increase in the number of working men attending the lectures; (3) the arrangement of a number of successful and well-attended courses during the early summer months; (4) the establishment of 36 Students' Associations at various centres; and (5) the federation in two new districts of the various lecture centres. The Students' Associations are very valuable, inasmuch as "they encourage the students to undertake regular reading throughout the year in preparation for, or in continuation of, the courses of lectures." The federation movement is also extremely helpful. It enables the difficulty sometimes experienced in procuring lecturers to be more easily surmounted, and it fosters and stimulates local interest in the study undertaken. The Committee regrets that a greater proportion of students do not present themselves for examination, but those who do go through the ordeal appear, on the whole, to come out very creditably. Scholarships are given to the writers of the best essays on a number of subjects connected with those studied during the course; and "amongst the successful essayists," we are told, "were two carpenters, two clerks, a fustian weaver, an artisan employed in a Government dockyard, and three elementary teachers." In an examination recently held, those who were awarded certificates included "a national schoolmistress, a young lawyer, a plumber, and a railway signalman." Again, we are informed that "a course of lectures on zoology recently given by an Oxford lecturer in Devonshire was attended by a student whose essays convinced the lecturer of her singular powers of accurate and original observation. She was encouraged by the lecturer to undertake a course of systematic study, and at his suggestion became a candidate in the examination for scholarships at Somerville Hall, where she was elected to the second scholarship."

AT the third summer meeting of University Extension and other students, which is to be held at Oxford in August, Mr. E. B. Poulton, F.R.S., will lecture on the influence of courtship on colour, and Mr. Francis Gotch on the physiology of the nervous system; Prof. Patrick Geddes will deal with problems of evolution, organic and social; Prof. Green, F.R.S., will give a course on geology; and Mr. C. Carus-Wilson lectures on geological phenomena. The teaching of geography, by Mr. H. J. Mackinder; protective adaptations in plants, by Mr. J. B. Farmer; and some aspects of light, by Mr. V. Perronet Sells, are also subjects announced in the programme.

DURING the cruise of the *Garland* on the west coast of Scotland in June, for the purpose of examining oyster and mussel grounds, Mr. Anderson Smith records the following captures of more especial interest to naturalists. The large *Pennatula quadrangularis* was found to be commonly distributed in great abundance in several lochs. The rare *Isocardia cor* was taken in the trawl in Loch Sunart, alive. *Balanoglossus* was obtained from deep water off Dunvegan, Skye, and may be considered the first specimen recorded from Scotland. The rare fish *Cepola rubescens*, L., or Red Band-fish, was taken off Jura, and is an addition to the fauna of the outer waters, although one or more specimens have been recorded from the Clyde area. Among *Crustacea* many interesting species were found, and the individual supply was such as to lead to the presence at some time or other of a more plentiful fish supply than was met with during the cruise.

A TELEGRAM from Quilimane announces the departure of an Expedition to Zumbo, under the command of Captain Soares d'Andrea, overseer of the River Zambesi. Satisfactory news is said to have been received of Senhor Joaquin Almeida's Expedition to Gungunghama, which landed at Chaichai, 30 miles above the mouth of the River Limpopo, on its way to Gazaland. Good news has also been received from Captain Cerales, in Bilene.

THE latest information of the Russian Expedition to Tibet, under the command of Colonel Pevtsoff, is contained in the following letter from the mining engineer Bogdanovitch, published by the Russian newspaper the *Messenger of the Volga*:—"Having happily passed through the winter at Nia, the Expedition set out on April 24 to traverse the defile of Idjelik-Khanoum, and thus reach Tibet. Colonel Pevtsoff had sent half his camels, carrying 23 bales with his collections, to the banks of the Cherchen River, where they could recover their strength with the abundant pasture. These animals are intended to facilitate our return to Russia. Our baggage will be carried into Tibet on oxen hired for the purpose. We ourselves are riding thither on horseback, carrying with us the light portion of our effects. We left Nia with 30 horses. During the winter M. Roborovsky made an excursion to Cherchen, and I made one to the mountains of Karangon-Fag, south of Khoten. During my tour I met Grombchevsky, who came with me to Khoten in February, and thence returned for a short time to Nia. The health of all the members of the Expedition is perfect, and during the winter we have received all our letters and papers from St. Petersburg, thanks to the good offices of M. Petrovsky, our Consul at Kashgar. We shall send our collections to Russia through his agency." M. Grombchevsky has informed the military Governor of the Syr-Darya district that the time of his journey has been extended until January 15, 1891. His Expedition has already traversed 5000 versts. M. Grombchevsky will pass the summer in exploring Tibet between Polon-Lhasa and Rudok.

THE July number of the *Kew Bulletin* contains further information on the cultivation and preparation of the colouring substance known as annatto. The present instalment deals with the West African seed, which does not appear to possess the qualities of that from Jamaica. A new method of preserving grain from weevils is suggested, while there is a long correspondence on Colombian india-rubber. The letters contain an account of a tree which yields rubber, and which is known in commerce as "Colombia Virgen." It has the peculiarity of growing at high elevations, and therefore in a comparatively cool climate. Another section deals with the fibre industry of the Bahamas, and particulars are given of the establishment of the botanical station at Lagos, the first of its kind on the West Coast of Africa. A letter from the Curator, Mr. McNair, gives interesting information respecting some of the plants under experimental cultivation there.

AN appendix to the *Bulletin* contains a list of new garden plants, including not only those brought into cultivation for the first time during 1889, but the most noteworthy of those which had been re-introduced after being lost from cultivation. Other plants included in the lists have been in gardens for several years, but either were not described or their names had not been authenticated until recently. All hybrids, whether introduced or of garden origin, described for the first time in 1889, are included. The list contains a reference to the place where the plant is first described or figured, or where additional information is given; besides the natural order and country, a brief notice of the habit and most striking points of each plant is given.

THE Lucayan Indians, who inhabited the islands now called the Bahamas, were the first Indians seen by Columbus. In less than twenty years this interesting people, numbering, according to the estimate of the conquerors, 40,000 persons, was wholly exterminated. The hammock was found among the Lucayans, and both the word and the thing were adopted by the Spaniards, through whom they were passed on to other nations. Various skulls have been recovered from caves in the Bahamas, and have been made the subject of a valuable paper by Mr. W. K. Brooks. This paper was read some time ago before the National Academy of Sciences, America, and has now been reprinted as a separate memoir, with carefully executed illustrations. Columbus testifies that the Lucayans were "of good size, with large eyes and broader foreheads than he had ever seen in any other race of men"; and Mr. Brooks says this agrees perfectly with the results he has reached, the most conspicuous characteristics of the skulls he has examined being the great breadth noted by Columbus, and the massiveness and solidity of the head. "We may, therefore, unhesitatingly decide," says Mr. Brooks, "that they are the remains of the people who inhabited the islands at the time of their discovery, and that these people were a well-marked type of that North American Indian race which was at that time distributed over the Bahama Islands, Hayti, and the greater part of Cuba. As these islands are only a few miles from the peninsula of Florida, this race must at some time have inhabited at least the south-eastern extremity of the continent, and it is therefore extremely interesting to note that the North American crania which exhibit the closest resemblance to those from the Bahama Islands have been obtained from Florida."

THE *Times* gives some details of the new expedition to the North Pole, for which the Norwegian National Assembly voted 200,000 kroner on the 30th ult., and which will be under the charge of M. Nansen. Hitherto, with one possible exception, all attempts to reach the North Pole have been made in defiance of the obstacles of Nature. It has been an open campaign between the endurance of man and the icy barrier of the Arctis Seas, in which Nature has always been triumphant. On this occasion a systematic and well-organized attempt will be made to ascertain if Nature herself has not supplied a means of solving the difficulty, and if there is not, after all, a possibility of reaching the North Pole by utilizing certain natural facilities in these frozen seas of which all earlier explorers were ignorant. The circumstances on which these new hopes are founded may be thus summarized. The *Jeannette* Expedition of 1879-81 and the loss of that vessel seemed to sound the knell of all expeditions to reach the Pole by Behring Straits; but in the end the results of that effort are shown to have been more satisfactory and auspicious than any of the officers of the *Jeannette* could have hoped for when, with extreme difficulty, they succeeded in reaching Siberia across the ice from their wrecked vessel. In June 1884, exactly three years after the *Jeannette* sank, there were found near Julianshaab, in Greenland, several articles which had belonged to the *Jeannette* and been abandoned at the time of its wreck by the crew, and which had been carried to the coast of Greenland, from the opposite side of the Polar Sea, on a piece of ice. This fact at once aroused curiosity as to how it accomplished the journey across the Arctic Ocean, and as to what unknown current had borne the message from Behring Straits to Greenland. However these objects reached Julianshaab, they could not have come in an eastern direction, through Smith's Sound, for the only current which reaches Julianshaab is that from the eastern coast of Greenland *viâ* Cape Farewell and the north. Nor is there much probability that they were borne in a western direction from the place where the *Jeannette* sank, for all the currents round Nova Zembla, Franz-Josef Land, and Spitzbergen are known, and it seems impossible for

the ice bearing the relics of the unfortunate *Jeannette* to have traversed the intervening distance in the space of three years, even if it were possible at all. There remains only the alternative that there is a comparatively short and direct route across the Arctic Ocean by way of the North Pole, and that Nature herself has supplied a means of communication, however uncertain, across it. Increased significance to the discovery of the *Jeannette* relics in 1884 was given by the identification in 1886 of bows found on the coast of Greenland with those by the Eskimo in the vicinity of Behring Straits, at Port Clarence, Norton Sound, and the mouth of the Yukon River. M. Nansen's Expedition will endeavour to realize these hopes of a direct route across the apex of the Arctic Ocean. A specially constructed boat of 170 tons will be built, and provisions and fuel taken for five years, although it is hoped that two will suffice. The Expedition will consist of 10 or 12 men, and M. Nansen proposes to leave Norway in February 1892.

THE *Meteorologische Zeitschrift* for June contains summaries, by Dr. T. Hann, of the results of the meteorological observations at the following international Polar stations :—(1) Sodankylä, in Lapland, where observations were made for two years ending August 1884. (2) Möller Bay, in Novaia Zemlia—September 1882 to August 1883. (3) Sagastyr, at the mouth of the Lena —September 1882 to June 1884. The observer at this station remarks that they were all more susceptible of cold in summer than in winter; in autumn this susceptibility ceased. In winter they could expose themselves experimentally for a few minutes to a temperature of about – 58° F., with scarcely any clothing, without any unpleasant feeling. The explanation is probably to be found in the complete stillness of the air at the time.

THE Harvard College has published, as vol. xxii. of its Annals, the very complete and valuable series of meteorological observations made at the summit of Pike's Peak, Colorado, between January 1874 and June 1888. This station is the highest in the world, being 14,134 feet above the sea-level. The observations, which have been prepared for publication under the superintendence of the Chief Signal Officer, contain the actual readings taken several times daily, and for a portion of the time even hourly readings, in addition to monthly means for various hours. General Greely draws attention to several nteresting facts resulting from a cursory examination of the data. The maxima of both pressure and temperature occur in July, and the minima in January; the annual march of both elements is the same, and the two curves are almost coincident. The mean temperature for the above period was 19°·3; the maximum observed was 64°, and the minimum – 39°. The maximum daily range occurs in July and September (about 14°·3), and the minimum in December (11°·6) which is only about half of the range on the low plateau country to the eastward. The precipitation exhibits peculiarities in its distribution throughout the year; 35 per cent. of the whole amount falls in the summer, and 33 per cent. in spring, the maximum occurring in July and the minimum in February. The mean wind velocity decreases gradually from 26·6 miles per hour in January to 12·5 in July, and 12·3 in August, and it decreases from 2h.–4h. a.m. to 11h. a.m. and noon. The mean hourly velocity during any day rarely exceeds 50 miles; the highest velocity was 112 miles per hour on May 11, 1881, which General Greely states has been frequently exceeded at exposed points on the Atlantic and Pacific coasts. The prevalent direction is from south-west to north-west. Pike's Peak is frequently visited by electrical storms, but they only occur when the air is moist; many interesting details of these are given in the extracts from the observers' journals, at the end of the volume.

THE Chief Signal Officer of the U.S. Army has published a valuable "Supplement to the Monthly Weather Review" for the year 1889, which contains a general discussion of the weather of that year over the United States and Canada, by Captain Dunwoody, illustrated by seven charts prepared from data from about 1000 stations. The annual mean temperature was highest in the southern parts of California, Arizona, and Florida, where it rose above 75°, and it was lowest in Manitoba, where it fell below 35°. The highest maximum temperature was 117° at Yuma, Arizona, on July 3. The highest temperature ever recorded by the Signal Service observers was 119°, at Fort McDowell, Ariz., in 1887. The lowest temperature reported by a regular station of the Signal Service was – 43°, at St. Vincent, Minn., on February 23. The lowest minimum ever reported by a regular station of the Signal Service was – 63°, at Poplar River, Mont., in 1885. With regard to atmospheric pressure, Captain Dunwoody remarks that the effect of marked departures from the usual distribution of monthly mean pressure was noticeable on the paths of the storms. In August and December, for instance, when the pressure over the Southern States was more than 0·1 inch above the normal, no cyclone traversed the country east of the Mississippi and south of the Ohio Rivers. With regard to rainfall, at several of the stations in the Middle Atlantic States, the annual amount was the heaviest ever reported, and the greatest deficiencies occurred in Louisiana and Washington. Fogs occurred in the vicinity of the Banks of Newfoundland most frequently from April to October; in August, fog occurred on 22 days, and in January and December on only 5 and 4 days respectively. The charts show, in addition to the mean values for 1889, the departures of that year from the normal values.

THE occurrence of St. Elmo's fire at sea has been lately studied by Captain Haltermann, of Hamburg, who made examination of a number of ships' log-books for 1884 and 1885, reporting 156 cases, in 800 months of observation (*Met. Zeits.*). He finds a greater number of cases in north than in south latitudes. And of 63 cases observed in the North Atlantic (the stormiest sea in winter) 49 occurred in the months November to April, and only 14 in the other half of the year. Of the total (156) only 27 were unaccompanied by thunder and lightning, and only 6 by precipitates of some kind. Snow and hail showers, with strong wind, seemed specially favourable. Of 133 cases accompanied by rain, there were only 15 without also thunder and lightning; while of 32 with hail, 18 were without thunder and lightning; and of 14 with snow, 12 without thunder and lightning. As to wind, there were instances with all degrees of intensity. The wind was in most cases (beyond 35° lat.) from equatorial direction, and this, with the commonly observed decrease of pressure, indicates that the cases mostly occurred in the front part of depressions. In 46 cases the barometer rose, and in 8 it was unaffected. In most cases the thermometer fell. Between the equator and 10° N. lat. 12 cases were observed, and not one in the corresponding region to the south, where the trade wind generally prevails. In the region of the constantly blowing trade wind St. Elmo's fire is never met with. The western half of seas extending polewards from 30° lat. seems to afford the best conditions. On the whole, the occurrence of St. Elmo's fire may probably be ascribed to the same causes as give rise to thunder and lightning.

MR. J. LLOYD BOZWARD, of Worcester, writes to us that "during a rainstorm on Tuesday (July 1), black rain fell in a district lying between the parishes of Crewle and Broughton Hackett in this county. In road-ruts where rain-water had collected, a considerable film of black sediment remained the day after the storm. The day had been remarkable for a dense canopy of shifting masses of dark-coloured clouds of the nimbus formation. Great rainstorms had been prevalent in this and the adjoining counties. The temperature had been low, and the weather rather like that of November than of July."

MR. L. W. WIGLESWORTH, writing from Brunswick, says:—"I am indebted to a friend for the following observation. A squirrel, in leaping from a height of 33 feet to the ground, caused itself, by means of curving its tail strongly to one side just before alighting, to swerve in its course and so avoid some hard substance upon which it would otherwise have fallen. It landed safely upon a more suitable spot. If no one has done so already, I should like to call attention to the use of the squirrel's tail as a steering and balancing organ during the animal's passages through the air. For other uses see NATURE, vol. xx. p. 603."

THE fresh instalment of the Panama Canal Report deals with the various plans and specifications submitted to the Committee, which are divided into four categories: (1) a canal completely isolated, and making no use of the existing rivers and streams; (2) a canal making use of the existing waterways; (3) a canal with a ship railway over part of the course; (4) a canal with a tunnel through the high land of Culebra. The Report points out the various defects or omissions in the different schemes.

MESSRS. GEORGE BELL AND SONS will publish in a few days an octavo volume entitled "The Diseases of Crops and their Remedies," by Dr. A. B. Griffiths. The work is illustrated with 51 figures, and the chemical treatment of plant diseases is fully discussed.

MR. G. CLARIDGE DRUCE, 118 High Street, Oxford, is compiling a Flora of Berkshire, which will give all available information upon the plants of that county and their distribution through it and the adjoining counties. In order to make the work as complete as possible, the compiler would greatly value any notes on plant occurrences which may be sent to him.

THE schoolmaster, it would seem, is not abroad in Spain, at least as far as geography is concerned. A leading journal of Barcelona announces that England has ceded to Germany Heligoland which is situated on the African coast. This fact suggests to it a number of ingenious political considerations. At the end of the article it is mentioned that Heligoland does not belong to anybody, and is situated between the African territories of Nyanza, Victoria, and the Congo.

SOME very remarkable observations on the production of the ripe figs of *Ficus Roxburghii*, Wall., have recently been published by Dr. D. D. Cunningham, F.R.S., of the Indian Medical Service. The species is diœcious, the male receptacles or figs containing perfect male flowers with pollen, together with imperfect or atrophied female or "gall-flowers," which never produce seed; the female figs contain perfect female flowers only. Both kinds of fig are visited by the "fig-insect," usually a species of *Eupristis*, for the purpose of laying its eggs in the ovary. This is effected in the "gall-flowers" of the male figs; but in the female figs the efforts of the insect to deposit its eggs within the ovary are frustrated by the great thickness of the wall of the ovary. It is very rare to find more than a very few grains of pollen in the female figs; and, according to Dr. Cunningham, the embryo-sac in the female flowers retains, up to the period of the visits of the insect, the character of a uninucleate cell without oosphere, synergidæ, or antipodal vesicles. The full development of the embryo in the female flowers is brought about simply by hypertrophy of the tissues, the result of the stimulation caused by the unsuccessful attempts of the insect to pierce the wall of the ovary. If these observations are confirmed, we have here one of the most remarkable instances of parthenogenesis yet recorded in the vegetable kingdom.

A NEW crystalline carbohydrate, of the composition $C_{18}H_{32}O_{16}$, named by its discoverers *stachyose*, has been extracted by Drs. von Planta and Schulze from the bulbs of *Stachys tuberifera* (*Berichte*, 1890, No. 10, p. 1692). It crystallizes from 90 per cent. alcohol in well-defined hard brilliant crystals belonging to the triclinic system, and containing three molecules of water of crystallization, $C_{18}H_{32}O_{16} + 3H_2O$. When these crystals are powdered, and heated to 103°–104°, they lose their water, leaving a colourless powder consisting of the free carbohydrate $C_{18}H_{32}O_{16}$. The crystals and their aqueous solution possess a faint sweet sugar-like taste, and the solution in water, which is of neutral reaction, rotates the plane of polarization strongly to the right. The solution does not reduce Fehling's solution until after warming with a mineral acid, when reduction rapidly ensues. On heating with nitric acid, the carbohydrate furnishes 37·3 per cent. of mucic acid. When heated with resorcinol and concentrated hydrochloric acid, a deep red coloration is produced. One of the principal products of the inversion of stachyose is galactose, as shown by the following experiment. About 30 grams of stachyose were boiled with a litre of 2½ per cent. sulphuric acid for an hour in a flask furnished with a reflux condenser. After cooling, the sulphuric acid was precipitated by barium hydrate, the barium sulphate filtered off, and the filtrate evaporated to a syrup. On extracting the syrup with 95 per cent. alcohol, and allowing the extract to evaporate over oil of vitriol, crystals slowly separated, possessing, after recrystallization, the right-handed rotation of galactose ($\alpha_D = 80°{\cdot}5$). From these properties stachyose is considered to belong to the group of carbohydrates termed by Prof. Tollens crystallizable polysaccharides. In this group are included raffinose or mellitose, gentianose, and lactosine Stachyose resembles the latter substance very closely, especially as regards the formation of galactose on inversion; but it is distinguished from lactosine by its much lower dextro-rotatory power. As regards the preparation of stachyose from the *Stachys tuberifera*, the bulbs were first crushed and the juice extracted as completely as possible by water. The extract was then successively treated with lead acetate and nitrate of mercury, the lead and mercury removed by a current of sulphuretted hydrogen gas, the filtered liquid neutralized with ammonia and evaporated to a thin syrup upon a water-bath. This syrup was then poured into alcohol, when a thick precipitate was formed, which gradually collected as a dark-coloured syrup in the lower portion of the flask. After removal of the alcohol the syrup was dissolved in water, treated with phospho-tungstic acid, and filtered, excess of phospho-tungstic acid being subsequently removed by baryta-water. A stream of carbon dioxide was then led through the liquid, which was again filtered, evaporated, and poured into absolute alcohol, when a perfectly white precipitate was obtained, consisting of almost pure stachyose. The crystals are best obtained by pouring a concentrated aqueous solution of the precipitated carbohydrate into such a quantity of absolute alcohol that a 91 per cent. solution of alcohol is obtained. Crystals of stachyose immediately commence to separate.

FOR the first time since the establishment of the Gardens of the Zoological Society there is now to be seen there one of the ancient breed of the English wild cattle, Earl Ferrers having presented to the Society a fine young bull, which he captured in Chartley Park, Staffordshire. From Garner's "Natural History of Staffordshire" it appears that the wild ox formerly roamed over Needwood Forest. In the thirteenth century William de Farrarus caused the park of Chartley to be separated from the forest, and the turf of this extensive enclosure still remains almost in its primitive state. Here a herd of wild cattle has been preserved down to the present day, and they retain their wild characteristics, like those at Chillingham.

THE additions to the Zoological Society's Gardens during the past week include a Water-buck (*Cobus ellipsiprymnus* ♂), a Serval (*Felis serval*), six Vulturine Guinea Fowls (*Numida*

vulturina), three Mitred Guinea Fowls (*Numida mitrata*) from East Africa, presented by Mr. George S. Mackenzie; a Tawny Owl (*Syrnium aluco*), British, presented by Mr. G. Gurney; a Long-eared Owl (*Asio otus*), British, presented by Miss Muriel Hele; a Feathery-footed Owl (*Athene plumipes*), a Black and White Jackdaw (*Corvus daiirica*) from Newchang, South Mantchuria, presented by M. J. De La Touche; two Indian White-Eyes (*Zosterops palpebrosus*) from India, a Yellow-winged Sugar-Bird (*Cæreba cyanea* ♂) from Brazil, a Dufresne's Waxbill (*Estrelda dufresnii*) from South Africa, six Vulturine Guinea Fowls (*Numida vulturina*) from East Africa, deposited; a Plumbeous Fish-Eagle (*Polioaëtus plumbeus*) from North-west India, two Golden-headed Parrakeets (*Cyanorhamphus auriceps*) from New Zealand, a Green-winged Dove (*Chalcophaps indica* ♀) from India, purchased; two Emus (*Dromæus novæ-hollandiæ*), received in exchange; a Yak (*Poëphagus grunniens* ♂), a Viscacha (*Lagostomus trichodactylus*), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

OBJECTS FOR THE SPECTROSCOPE.

Sidereal Time at Greenwich at 10 p.m. on July 10 = 17h. 15m. 5s.

Name.	Mag.	Colour.	R.A. 1890.	Decl. 1890.
			h. m. s.	° ′
(1) G.C. 4355	—	—	17 55 41	−23 2
(2) α Herculis	3·1-3·9	Orange.	17 0 38	+14 31
(3) β Draconis	3	Yellow.	17 28 0	+52 23
(4) ζ Draconis	3	Bluish-white.	17 8 30	+65 51
(5) 205 Schj.	8	Very red.	17 38 29	−18 37
(6) R Scuti	Var.	Red.	18 41 36	− 5 50

Remarks.

(1) Unfortunately this interesting object only attains a low altitude in this country, but it is quite possible that there may be some nights on which spectroscopic observations may be made. It is the object known as the "Trifid Nebula," which is thus described in the General Catalogue:—"A very remarkable object; very bright; very large; trifid; double-star involved." For a further description observers may refer to Herschel's "Outlines." The spectrum was recorded as "continuous" by Captain Herschel in 1868, but in the same year it was observed by Prof. Winlock at Harvard College, and found to contain bright lines. This observer records: "Spectrum of the multiple star continuous, with many bright lines and some bands; one end of spectrum at λ 4280± . . . one bright line seen by C. S. Peirce at λ 4980±." I am not aware that any further observations of the spectrum have been made, but these observations should certainly be repeated with as large an aperture as possible. There can be little doubt that the line near λ 4980 is really the chief nebula line at λ 500. The appearance of bands is especially interesting, as indicating that only a relatively low temperature can be in question.

(2) The spectrum of α Herculis is probably well known to everyone who possesses a telescope and spectroscope. It is a very beautiful one of Group II., all the bands being very wide and dark, giving an appearance of alternating bright and dark bands. From the observations of Prof. Lockyer, Mr. Maunder, and myself, there can now be little doubt that we have here to deal with a mixed spectrum of bright carbon flutings and dark metallic ones. One bright band in the green is coincident with the chief carbon band, and has, moreover, the same appearance. The measures of the dark bands in the green and yellow by Vogel and Dunér show close coincidences with the flutings of manganese (λ 558 and 586) and lead (λ 546), and I have confirmed these by direct comparisons. The principal object in inserting the star in this column is to remind observers that this is a good opportunity for them to demonstrate for themselves that in stars of this type we are dealing with cometary conditions, as indicated by the carbon radiation.

(3 and 4) These stars have spectra of the solar type and of Group IV. respectively (Gothard).

(5) Dunér describes the spectrum of this star as one of Group VI., in three zones, of which the green is the brightest. He states that the spectrum is rather feebly developed, but it is not clear whether this is due to the faintness of the star, or that the bands are narrow as compared with other stars of the group. If the latter, the star may be one of the long-required connecting links between stars of this group and stars of the solar type.

(6) The spectrum of this variable does not appear to have been recorded, although its magnitude at maximum is about 5. The minimum is irregular, 6·0–8·5, and the period, according to Schmidt, is about 168 days. There will be a maximum about July 14. A. FOWLER.

SECULAR INEQUALITIES IN THE MOON'S MOTION.—In the *Astronomical Journal* for June 20, Prof. J. N. Stockwell contributes the abstract of a discussion of the problem of the secular variation of the motion of the moon's perigee and node. The value found for the secular variation of the mean longitude of the moon's node does not differ very materially from that found by Laplace and subsequent investigators. But it is otherwise with the secular equation of the motion of the moon's perigee; and if the value Prof. Stockwell has obtained for the secular motion of the moon's perigee is nearly correct, the value found by Laplace and his immediate successors cannot be regarded even as a first approximation to the value of that motion.

If the mean longitude of the moon's perigee be denoted by ω, and the number of centuries from a given epoch by i, the variation $\Delta\omega$ of the mean longitude of the perigee at any number of centuries from the epoch are quoted by Airy as follows:—

	$\Delta\omega$
	″
Laplace	$-30''{\cdot}55i^2$
Börg and Burckhardt	$-29''{\cdot}98i^2$
Damoiseau	$-39''{\cdot}70i^2$
Plana	$-40''{\cdot}23i^2$
Hansen	$-39''{\cdot}18i^2$
Hansen	$-36''{\cdot}31i^2$.

Notwithstanding this agreement of the results of other investigators, Prof. Stockwell has found, by direct calculation, that $\Delta\omega$ is very nearly expressed by the formula

$$\Delta\omega = +15''{\cdot}61i^2;$$

and since the motion of the perigee is direct, it follows that this motion is *accelerated* instead of being *retarded* from age to age, as has been hitherto supposed. The application of the result to the discussion of some ancient eclipses is reserved for a future communication.

ANNULAR ECLIPSE OF JUNE 17.—The current number of the *Comptes rendus* contains a letter from M. A. de la Baume Pluvinel to M. Janssen, respecting his observations at Canea Photographs of the annular and partial phases were obtained, and will be of service in determining the diameters of the sun and moon. M. Pluvinel also finds that there is no difference between photographs of the spectrum of the edge of the sun during the annular phase and the ordinary solar spectrum. It is interesting to note that during the eclipse the temperature fell from 33°·4 to 27°·4 C.

THE ETHNOLOGY OF THE GAMBIA REGION.

THE Governor of the Gambia, in his last Report, devotes a long section to an account of the African tribes connected with that settlement, of which the following is a brief summary:—

Mandingoes.—The head-quarters of this extensive and powerful race lie in the mountainous district near the sources of the Niger and the Gambia, extending as far as Kong. From this region they overran the surrounding country westward to Bambouk, and still pushed on, until the banks of the Gambia, as far as the sea, more or less, fell under their sway. At the present moment the principal countries on the north bank of the river are occupied mostly by Mandingoes, and the dominant tribes in Combo, on the south bank, are also of the same race, though the heathen Jolas in the bordering Fogni country are able to hold their own against them. They practically control the trade of the lower river. Three-fourths of the ground-nuts hitherto cultivated have been grown by them; the export of bees'-wax seems to be also dependent upon the Mandingoes, who bring it down from the interior of the Jola country. They also bring cattle and hides into the market, and cultivate cotton largely, which their women spin and weave into the country cloths which play

so conspicuous a part in the trade of the river. The Mandingo language is rich and musical, and susceptible of more variety of expression than the Jolof tongue, which, next after the Mandingo, is, perhaps, the most prevalent language. The latter adopt the decuple system of numeration, whereas the former only possess a quinquennial period. The Mandingoes, as a rule, are Mohammedans, though many are "Soninkees"; and in all their faith is permeated more or less with Fetishism. The term Soninkee is applied by Mohammedans to all people, irrespective of race, who drink spirits. Physically, they are in general a spare, athletic race, of medium height, often with aquiline features, but in contour always distinct from the typical Negro. In colour, they are not so dark as the Jolofs, but their hair is woolly. The laws in Mandingo towns are administered by "Alcalis," or Sumas, both terms having the same signification. The only difference is that the former is a kind of Prime Minister in a Mohammedan town, while the latter holds a similar office in a Soninkee town. Murder and adultery are punished by death. The sentence in the former case is carried out by killing in the same manner as the murder was committed, and in the latter the adulterer is usually killed with cutlasses. The adulteress suffers only whipping, and is cast out by her husband. Theft is punished by whipping, an instrument something similar to the "cat" being used for the purpose. Slander and disrespect to parents or the aged are punished by fine, which goes to the Alcali and headman of the town. Immorality as distinguished from adultery is almost unknown; but if practised and discovered would meet with the death penalty as in adultery. The Mandingoes still keep up a connection with their original country, and recognize a supreme authority in the ancient Mandingo kingdom, though the recognition is more sentimental than real, the distance being too great for any effective authority to be exercised.

Sereres.—This race occupies the neighbourhood of Joal, Seine, and Baol, to the north of the Gambia, and outside British jurisdiction. They are a distinct people, with a language having no affinity either to the Mandingo or Jolof. They are an independent and comparatively industrious race, cultivating largely both corn and rice; they also rear numerous cattle. They seldom buy cotton goods, and have no craving for luxuries of any description. Their wardrobe never consists of more than two *pagns* or country cloths. During the dry season many Serere youths come to Bathurst to work as labourers for about three months, their ambition being satisfied when they have earned sufficient to buy a trade musket, a knife, a wooden box, and a few minor articles, such as iron bars, iron pots, raw cotton, &c. Others at times come in with small canoes, and cut firewood for the Bathurst market, and also do a little fishing. In religion the Sereres are infidels, and, except in a few instances, have hitherto resisted all attempts to convert them to Islamism. They recognize a Supreme Being, but he is only invoked in case of hostile invasion, a fashion which has doubtless been borrowed from the Mohammedans. The king of Seine, who is the ruler of the Serere nation, keeps one Marabout attached to his person for the express purpose, but his services are never put into requisition on any other occasion. Physically they are a fine, well-grown race, with not unpleasant features, their complexion as a rule being of a deep black. As with the Mandingoes, murder and adultery are punished with death; shooting or decapitation, according to the decree of the king, being the means adopted. Immorality is treated in a more lenient fashion, and resolves itself into a question of money. It is stated by persons who know the customs of both tribes well that the Mandingoes and Sereres frequently condone the offence of adultery if the male culprit is rich enough to satisfy the outraged honour of the husband, and moreover from the necessity of extreme caution that the wives resort to various cunning devices in order to deceive their husbands. The virtue of these communities is therefore more apparent than real. Each Serere man is permitted by custom to have ten wives, but indulgence in a greater number is regarded as a pardonable folly. Theft is punished in a very drastic manner. The thief has the whole of his goods confiscated and handed over to the victim of the robbery. The primitive quinquennial period in reckoning is adopted by the Sereres, as is the case with the Jolofs.

Nominkas.—This race occupies the region known as the kingdom of Nuomi or Barra. Formerly Barra was the most important of all the kingdoms of the Gambia, owing to the number and strength of the war canoes controlled by the king. The present Nominkas appear to be divided into two sections, named respectively the Nomibartokas (meaning those living at the entrance of the river) and the Nomibantokas (meaning those living more within the river). The former occupy the region between Jonwar and Jinneck, and the latter live between the towns of Essow and Jooroonko. The Nominkas are all Mandingoes, but the Nomibartokas live so near to the Sereres that they speak this language in addition to their own. The Nominkas communicate with Bathurst by means of large canoes, which some of them are very clever at making. These canoes will sometimes carry as much as three tons of ground nuts, of which they cultivate large quantities. In religion most of the Nominkas are now Mohammedans, though originally they were Soninkees. Their laws are similar to the Mandingoes, from whom they sprang.

Jolas.—The history of this primitive and extraordinary race is involved in much obscurity. No idea appears to exist among themselves in regard to their origin, and even tradition is silent except as to recent events in the chronicles of their country. Even under favourable circumstances, Jola intelligence is of such a low standard that it is not easy to acquire much reliable ethnological information from them. So far as it is possible to learn from the people themselves, the Jolas, or Fellups, have always occupied a region having for its eastern boundary Vintang Creek, following the course of that tributary, and extending as far south as the head waters of Cazamance, continuing along the north bank of that river to its mouth, and from thence extending to the limits of foreign Combo. The Banyans, Papels, Balantes, and Biafares, sometimes called Jolas, appear to be allied races. Durand, a former Governor of the Isle of St. Louis, in his voyage to Senegal, published in 1805, gives some interesting details of these people, and the extensive Portuguese establishments which then existed at various stations in Vintang Creek and the Cazamance. He remarks that both banks of the latter river "are inhabited by savage and cruel Fellups, who will not hold any communication with the whites, and are always at war with their neighbours." Those, however, who resided in the neighbourhood of the Gambia, appear to have shown different characteristics, for in writing of the town of Bintan (Vintang), the same author says:—"The negro inhabitants of this part are Felups, they speak a language peculiar to themselves, and are idolaters. . . . Those of Bintan, or its environs, who are occupied in commerce, are gentle, frank, and civilized; they like strangers, are always ready to render them service, and are candid and honest in their commercial dealings." Vintang Creek, once an important trading district, producing large quantities of wax, hides, and ivory, is now all but abandoned, and the people content themselves with the cultivation of sufficient rice and corn to supply the bare necessaries of life. They are decidedly an industrious race, and numbers of them come to Bathurst to obtain work as labourers, especially during the trade season. Vessels are laden almost entirely by Jola women, and the merchants would find it difficult to get on without them. Physically they are not an attractive-looking race, and both sexes wear little or no clothing. In their own country there is practically no government and no law; every man does as he chooses, and the most successful thief is considered the greatest man. There is no recognized punishment for murder or any other crime. Individual settlement is the only remedy, and the fittest is the survivor. Unlike the rule amongst most African races, there is absolutely no formality in regard to marriage, or what passes for marriage, amongst them. Natural selection is observed on both sides, and the pair, after having ascertained a reciprocity of sentiment, at once cohabit. No presents are made by the bridegroom, and the consent of parents is entirely ignored. They do not intermarry with any other race. There appear to be three distinct languages spoken by the Jolas, having no affinity to those of the contiguous tribes, and but little resemblance to each other. The vocabulary appears to be poor, as might be expected in the case of a people with so few wants. The Jolas do not count beyond ten, and distinct terms are used only up to five, as in all the tribes noticed, except the Mandingoes. Beyond ten the counting becomes pantomimic, the people using both hands and feet to represent higher numbers. Pieces of stick are also employed for the same purpose. The Jolas, whether from persecution, or for some other reason, have always been an isolated race, and have shunned contact with their neighbours. In spite of the proselytizing nature of the powerful Mandingoes, they have utterly failed to introduce Mohammedanism, and the Portuguese appear to have been equally unsuccessful in establishing the Roman Catholic religion.

Jolofs.—Although "Jolof" is a word very frequently used in Bathurst, and most of the inhabitants speak that language, yet, as a matter of fact, very few of the genuine race are to be found in it. The habitat of the Jolofs is in the adjoining French colony of Senegal. The Jolofs proper are stated to be a handsome race; they are proud, and exceedingly vain, claiming for themselves a very ancient descent. The women are inordinately fond of gay apparel and personal adornments of every description. They frequently pierce the ear along the entire edge with a series of holes, so that this feature may be, as far as possible, loaded with ornamentation. The wool is pulled out to its extreme length and plaited into thin strips, which hang from the head, giving a peculiar character to these natives. Of their moral character report speaks very unfavourably, mendacity, deceit, and licentiousness being prominent characteristics of this people. In religion they are fervent Mohammedans; they rarely intermarry with any other race, but are extremely sensitive to any mishap in this direction. The Jolof language is expressive, and has received considerable attention from philologists, more than one grammar having been published. Golberry, who gives a vocabulary of the Jolof language, pertinently comments upon the curious fact that in spite of the contiguity of the Jolofs to the Moors, who adopt the Arabic system of numeration, the former should have persistently adhered to the method of reckoning on one hand only, instead of on both. It is a curious and perplexing circumstance that the Mandingoes, who are an inland people, and probably came into contact with more enlightened races at a later period than the tribes nearer the coast, should be in advance of all the other races in this portion of West Africa in their system of counting. The question whether this method originated with the language, or has been acquired at a later period of their history, must be left for philologists to settle. The Mandingoes, however, have always been great traders, and it is possible that their instincts taught them at an early stage the advantages of a system based on ten fingers instead of five.

Salum Salums.—These are neighbours of the Sereres, and through intermarriage their language is a mixture of Jolof and Serere. In religion they are partly Marabouts and Soninkees. The former frequently take wives from the latter, but no Marabout would give his daughter to a Soninkee unless to a king or a prince, and that reluctantly.

Lowbeys.—This race may be described as the gypsies of North-West Africa. It is almost impossible to obtain any certain information in regard to their history. They wander about from place to place, but have no settled country. There can be no doubt that they are practically the same race as the Foulahs, though for some reason they have become detached from them. Those seen by the Governor were decidely better looking than the average Negro, resembling the Foulahs, though of a darker complexion. They confine themselves almost exclusively to the making of the various wooden utensils in use by natives generally, and the manufacture of canoes. They settle temporarily with any tribe but never intermarry with another race, thus preserving the type of feature which obviously separates them from their human surroundings. In religion most of them are pagans, though a few profess Islamism. They have no laws of their own, but are guided by those of the people with whom they are for the time being located. In case of war happening, they very sensibly remove at once to a district where there is peace. The Foulahs and Toocalores, to whom allusion is made below, are practically the same race. Little need be said of them, as the former are a well-known race, and many travellers have noted their unusual lightness of complexion. Dr. Goulsbury, in his report on the Upper Gambia Expedition, gives a concise history of this people. Their capital is Timbo in the Futa Jallon country. The Toocalores reside principally in the Futa Toro country in Senegal, but from having intermixed with other races they are darker in colour. They are a warlike people, and at times are troublesome to our neighbours the French. An appendix to the report contains a vocabulary of common words and expressions used in the Mandingo, Jolof, Serere, Jola, and Foulah languages, all of which are spoken within a comparatively small radius of the Gambia. "No one can fail to be struck with the marked differences in the word forms of the various languages, though Mr. Robert Cust, in his valuable work, 'The Modern Languages of Africa,' classes all except the Foulah in one group, which he styles the northern section of the Atlantic sub-group, and which extends from the River Senegal to Cape Mount. It is difficult, however, for any but a trained philologist to detect wherein the relationship lies, or how such radical distinctions could exist and be preserved in the languages of races living in close proximity to each other. The Jolas especially offer a very curious problem to the ethnologist; it is not probable that they were ever an interior race which has been pushed gradually by stronger neighbours to the sea, and it is somewhat extraordinary that they should have been able hitherto to withstand the power of the conquering Mandingo, and to maintain their individuality. It is true they have always been a savage and intractable people, but in point of numbers their weakness would seem to mark them out as an easy prey to the invaders. This, however, is far from being the case, and there is but little of the Jola country in the hands of strangers."

SEEDLING SUGAR-CANES.

THE Government of Barbadoes has issued a valuable Report bearing on seedling sugar-canes. It records the results obtained by Prof. J. B. Harrison and Mr. J. R. Bovell on the experimental fields at Dodds Reformatory in 1889. As the subject is one of great importance to the cane industry, the following extracts may be read with interest. We may note that a paper describing the fruit of the sugar-cane was lately read before the Linnean Society by Mr. D. Morris, and that seedling canes are growing at Kew.

"In our Report for 1888 we briefly alluded, for the purpose of insuring priority, to the fact that we had succeeded in obtaining seedlings of the sugar-cane.

"That the sugar-cane could not produce fertile seeds has been for many years regarded by botanical authorities as a proved and accepted fact, whilst very many of the older planters here believed that the canes could produce fertile seed.

"Attention here was first strongly directed to this point in 1859 by the Hon. J. W. Parris, who succeeded, at his estate, Highlands, in St. Thomas's parish, in rearing successfully self-sown seedlings. . . .

"Mr. Parris has recently stated to us that he finally succeeded in planting four and a half acres with canes raised from these original seedlings, and that he estimated their yield of sugar at over four hogsheads to the acre. He, however, from certain objectionable characteristics which arose in the canes, finally abandoned their cultivation, and did not again turn his attention to the subject. In order to test the truth of Mr. Parris's discovery of cane seedlings, several persons here attempted to raise them from the cane arrows. This was done successfully by Mr. Carter, of Bridge Cot, and by Mr. J. Wiltshire Clarke, neither of whom, however, appeared to have attached much importance to their results. At another time Mr. T. Clarke, of Cane Field, discovered cane seedlings growing from a fallen cane arrow, but did not succeed in raising them, and Mr. E. S. Sisnett found some cane seeds growing in Christ Church about the year 1861; these were allowed to grow amongst canes that were planted in the usual way, but as they were very small and thin when they reached maturity they were destroyed. In this last case the seeds appear to have come from the Bourbon canes. Next we find that the late Mr. W. Drumm paid much attention to this subject and wrote several letters to the *Sugar Cane* upon it. He, however, stated to us in March 1884 that, whilst he had repeatedly obtained cane seed, he had never succeeded in raising canes from it, and that he believed the various instances we have mentioned to be errors of observation.

"At Dodds the cultivation of the different varieties of canes in large numbers and side by side has placed us in a specially favourable condition for examining into this question. In January 1888, Mr. J. B. Pilgrim, one of the overseers at Dodds, reported to us that in the neighbourhood of one of the experimental fields he noticed that certain fine grasses were springing up, and we found at intervals from then to the middle of March similar seedlings. These were found not only on the surface of the field, but also growing in the bottom of a somewhat deep drain which had been recently dug. Much difficulty was experienced in preserving these seedlings, as they were exceedingly sensitive to the effects of exposure to the sun or wind. In June 1888 the seedlings which had survived were transplanted, giving us about 60 plants. Certain of them were dug up with great care, and placed in water until the soil crumbled away from their roots, and were carefully examined for any traces of cane

that might be on the roots. Nothing could be detected, and we were strengthened in an opinion that they were true seedling canes by the very great difference in their mode of growth from that of canes growing from the eyes of canes. A few months later we found that there were several distinct varieties amongst them. In December 1888 we examined them with great care, and grouped them into ten groups according to their most strongly marked characteristics, and found that in many of our groups thus formed the canes graduated from one group into another. Many of these canes exhibited some of the characteristics of certain of our varieties, together with the characteristics of other varieties, but in some cases we could not even form any opinion as to their parentage, as they differed completely from any canes we had ever seen. During the latter stages of their growth these canes were examined by many planters and sugar chemists, all of whom were particularly struck with the amount of variation they exhibited and with the fact that certain of them were entirely different from any canes they had previously seen. The canes, as grouped, were replanted in the usual manner, and are now in course of experimental cultivation. The remaining canes were reaped on March 8, 1889, and fifty plants yielded 307 pounds of cane tops and 1626 pounds of canes, which gave 61 per cent. of juice of a density of 10°·6 Beaumé, containing 1·629 pounds of sucrose and 0·090 pounds of glucose in the imperial gallon. The following are the compositions of the canes, cane-juice, and megass :—

	Canes.	Cane-juice.	Megass.
Water	68·11	81·18	48·20
Sucrose	12·62	15·13	8·70
Glucose	0·69	0·83	0·48
Ash	0·47	0·30	0·75
Albuminoids	0·33	0·17	0·59
Fibre	15·44	—	39·60
Organic matters ...	2·34	2·39	1·68
	100·00	100·00	100·00

"In order to definitely settle the question of whether the sugar-cane produced fertile seed, from the middle of December 1888 to that of February 1889 most careful search was made through the fields for growing seedlings and for arrows containing fertile seed. The search for both of these proved successful, but only on the fields in which the varieties were growing and on which, as pointed out by us in our 1888 Report, the conditions for fertilization are most favourable. The seedlings, as found, were transplanted into boxes, but, on account of the unfavourable climatic conditions, great difficulty was experienced in preserving them : on one occasion an accidental exposure to the sun for about three hours destroyed five out of seven contained in the exposed box. One seedling was found attached to a portion of cane arrow which had fallen in a damp and sheltered position. The portions of cane arrows found which apparently contained fertile seed were collected, the apparent seeds carefully separated from the spikelets of the panicles and sown at intervals, commencing on January 12. Ten days after, some of the seeds were seen to be germinating, and certain of them were removed and preserved as microscopic objects. Of the apparent seeds, less than 5 per cent. germinated, and not more than one-fourth of the germinated ones finally survived.

"As the self-sown seedlings and those raised from the seeds by ourselves reached a sufficiently advanced stage of growth (the exceedingly slow growth of the seedlings at an early time is most marked, a point which in certain previous researches may have prevented the attainment of complete proof of the fact that the sugar-cane produces fertile seed, and in which mode of growth the seedlings strikingly differ from the rapid growth of canes from the buds) were, similarly to the seedlings of 1888, transplanted into the field, and are now in course of experimental cultivation.

"As far as our experience at present shows, the conditions most favourable for the production of fertile seed by the sugar-cane are found in the cultivation of varieties side by side and in comparatively large numbers, although from observations recently made, apparently fertilized ovules are to be found from time to time upon arrows of Bourbon canes growing by themselves. To secure the germination of the seeds, it is necessary to sow them soon after the arrow ripens, under similar conditions to those necessary with the seeds of other of the Gramineæ of low germinating power.

"The fertile seeds inclosed in the glumes are long and narrow, being from 3 to 4 millimetres in length and 0·65 to 0·70 millimetres in breadth, and terminate in a beard from 6 to 8 millimetres long."

MUSICAL SCIENCE.[1]

THE object of this little pamphlet is one with which musical students are tolerably familiar. The author complains that the science of acoustics, although now well advanced, is unable to explain the actual structure of musical compositions, or to account for their effect on the mind. Many writers have made the same complaint, and have endeavoured, each according to his own fancy, to "account for" everything by some particular system of his own.

Now, it happens that some quarter of a century ago a person named Helmholtz wrote a great book with the express object of explaining this difficulty. He showed, about as conclusively as anything can be shown, that, although physical science has furnished an intelligible basis on which the musical art is founded, it goes but a very little way in explaining practical musical composition, this being guided chiefly by the æsthetic instincts and the artistic feelings of the best composers, with which physical science can have very little to do.

One would have thought that such a doctrine would be hailed with satisfaction by musicians, as exalting and ennobling the share of art in the generation of high-class music. But, strange to say, it is the musicians who chiefly dispute it, and who would wish to substitute for the heaven-born gift the dry process of scientific deduction.

Our author is of this opinion. He tells us that if by science we are to understand a thorough rational understanding of any subject, musical science has not yet been discovered ; it waits still its Columbus, or its Galileo, or its Cuvier.

This may be in a certain sense true, but the science wanted for the purpose is not *physical* science. We know already pretty well all that physical science can tell us about music ; but there is a science much deeper—namely, that which would investigate the general effect produced by music on the mind, as depending on its composition and style. This is the *psychology* of music, an abstruse branch of æsthetics, and it is this that must tell us, if it can, how music has attained its present power over the feelings and the emotions of mankind. It is only lately that attention has been called to this by competent writers ; what is popularly said or sung about it has seldom any serious meaning.

The idea promulgated in this pamphlet is that all the mysteries of the art may be explained on the principles of *rhythm*—not, as usually understood, having to do with time and measure and accent and so on, but in a more hidden application to the generation of sounds. The system is not completely elaborated, and it is not possible to do more here than give a very general notion of it. The first six chapters treat of rhythms in general ; and the author gives a drawing of a machine for illustrating them. This consists of a series of "Savart" ratchet wheels, which, having different numbers of teeth, can give rise to various rhythmic combinations of their beats. He then deduces "laws" from the consideration of these, of which the following are some specimens :—

"When we listen to a series of isochronous blows, we perceive them at once in binary rhythm, and we therefore call this perception *spontaneous*, *natural*, and *instinctive*.

"We cannot perceive a series of isochronous blows in ternary rhythm, except with the concurrence of the will ; hence we call this perception *voluntary*."

These are simple fundamental laws ; the following are more complicated ones :—

"Whatever is the number of teeth of a wheel, and the velocity at which it revolves, there is always the spontaneous perception of the isochronous series in binary rhythm.

"If, to a series perceived in binary rhythm, we cause another to follow, which has with it any ratio whatever represented by r, this will be at once perceived in the same ratio r, which proves that the brain is endowed with the faculty of comparison.

"In any association whatever of two series of different rhythms, there is the production of a forced perception which compels the immediate perception of the two rhythms."

[1] "Musiconomia : Leggi Fundamentali della Scienza Musicale." By Dr. Primo Crotti, Professor of the History of Music in the Royal Conservatory of Parma. (Parma, 1890.)

In chapter iv. he explains a "physiological hypothesis," that the natural impression given by binary rhythm arises probably from the naturally symmetrical structure of the human body, and the binary action of its functions, such as breathing and the beating of the heart, whereas a ternary rhythmic motion seems something heterogeneous and unnatural. In chapter v. he discusses the effects of rhythms on our organism, simple or natural rhythms giving an agreeable impression, and unnatural or complicated rhythms giving one of a contrary description. Then follows a long chapter of formulæ and complicated arithmetical statements of rhythmical combinations of various kinds.

These remarks, on rhythms generally, occupy two-thirds of the pamphlet; the remaining third is intended to show how they may be applied to the nature and effects of musical sounds. Chapter vii. contains a description of the major musical scale as harmonically deduced by the aid of the monochord; and after that we begin to get a glimpse, though obscurely, of the nature of the general argument. The following extracts may give an idea of it:—

"The only sounds of the scale which are in binary rhythm are the first, 1 : 1, and the last, 1 : 2; and these are in fact the only ones which imply rest. The fifth, 2 : 3, is constituted by a ternary rhythm, and is, in fact, the sound of greatest motion which is contained in the scale. This most powerful motive action gives to this sound the greatest tendency towards the sounds of rest, authorizing it to fall directly on them, however distant from it.

"The ratio 4 : 5, which represents the major third, is constituted by a quinary rhythm—a rhythm of semi-motion which has such an action that while it makes us feel faintly the need to pass to the fundamental, it may almost supply it coming after the fifth."

Thus we arrive at the kernel of the theory, which appears to be that the effects of different combinations of rhythmical blows or noises are assumed to be applicable to the vibrations causing musical sounds, and to account for the effects of such sounds in an emotional point of view. It is something akin to the old Euler doctrine of the "simplicity of ratios," but it professes to be more comprehensive.

It is not carried out very far in this book, but the author promises that if he lives long enough, and has sufficient means, he will complete it in a larger treatise. Then, perhaps, we shall see how it will explain the construction of "Israel in Egypt," Haydn's Quartettes, and Beethoven's Ninth Symphony.

THE MUSEUMS ASSOCIATION.

THE first annual meeting of the Museums Association was held in Liverpool on June 17, 18, and 19, under the presidency of the Rev. H. H. Higgins, M.A. Liverpool was represented by the President, Mr. J. T. Moore, Mr. R. Paden, Mr. J. Chard, Mr. P. Cowell, Mr. H. A. Tobias, and a number of other gentlemen. In addition to the home contingent, the following were present:—Mr. F. W. Rudler, Mr. R. J. Howard, Mr. R. Ashton (Blackburn); Mr. J. Vicars, Mr. J. J. Ogle (Bootle); Mr. W. W. Midgley (Bolton); Mr. Butler Wood (Bradford); Mr. John Storrie (Cardiff); Mr. Montagu Browne (Leicester); Mr. C. G. Virgo (Manchester); Mr. T. J. George (Northampton); Mr. J. W. Carr (Nottingham); Mr. R. Howse (Newcastle); Prof. Boyd Dawkins, Mr. W. E. Hoyle (Owens College); Major Plant (Salford); Alderman Brittain, Mr. E. Howarth (Sheffield); Lieutenant-Colonel Turner, Mr. John Tym (Stockport); Mr. Robert Cameron, Mr. J. M. Bowley (Sunderland); Mr. L. Greening, Mr. H. Roberts, Mr. F. W. Moncks, Mr. C. Madeley (Warrington); Mr. H. M. Platnauer (York).

The proceedings were opened by Mr. J. T. Moore, as Mr. S. W. North, chairman at the last meeting (held in York), was unavoidably absent. The Rev. H. H. Higgins gave his presidential address, and the following papers were read and discussed:—"On Museum organization and arrangement," by Prof. W. Boyd Dawkins, F.R.S.; "Suggestions for aid in the determination of natural history specimens in Museums," by Mr. F. W. Rudler; "A new method of mounting Invertebrates for Museum and lecture purposes," by Dr. H. C. Sorby, F.R.S.; "Notes on the Liverpool Free Public Museum," by Mr. T. J. Moore; "Circulating school cabinets for elementary schools," by Mr. John Chard (Assistant in the Liverpool Museum); "The best means of making Museums attractive to the public," by Mr. R. Cameron; "A plea for local geological models," by Mr. T. J. Moore; "Museum cases and Museum visitors," by Mr. E. Howarth; "Notes on the Moscow Museum," by Mr. Willoughby Gardner; "Winter evening lectures in Museums," by Mr. R. Paden (Assistant in the Liverpool Museum).

Some very pleasant expeditions were made, thanks to the untiring energy of the local Secretary, Mr. H. A. Tobias, who was ably seconded by Mr. Cowell and Mr. McMillan. The members of the Association were most hospitably received; they were entertained at lunch by his worship the Mayor, and received invitations to a *soirée* of the Library, Museum, and Arts Committee, and to a magnificent *conversazione* given by the Japanese Consul, Mr. James L. Bowes.

SCIENTIFIC SERIALS.

American Journal of Science, June.—Prof. Elias Loomis: a memorial address prepared by H. A. Newton at the request of the President and Fellows of Yale College.—The magnetic field in the Jefferson Physical Laboratory, Part II., by R. W. Willson. In the February number of the *Journal* the author gave some observations of the variations of the horizontal intensity in different parts of the Jefferson Physical Laboratory in 1886-87, and upon the disturbance in the magnetic field produced by the presence of iron steam pipes and other iron masses. He now finds from extended observations that brickwork produces a great disturbance of the magnetic field, and thinks, therefore, that in general it would be safer to make exclusive use of wood for buildings and piers intended for refined magnetic measurements.—The electrical resistance of the alloys of ferro-manganese and copper (from determinations made by Mr. B. H. Blood), by Edward L. Nichols. The observations show that ferro-manganese-copper alloys decrease in electrical resistance each time they are subjected to a change of temperature. In one case an alloy containing 80·82 per cent. of copper and 19·12 per cent. of ferro-manganese, was hard drawn in the process of obtaining a strip suitable for measurement. Its specific resistance at 20°, referred to pure copper as unity, was 30·38; this resistance gradually diminished as the strip was repeatedly heated to 100° and cooled to 20°, until after seven such heatings it had fallen to 30·072. The effect of successive annealings upon the resistance of a number of alloys is also described.—Fluid volume and its relation to pressure and temperature, by C. Barus. The paper contains the introductory part of a series of experiments on the compressibility of liquids, in progress at the Physical Laboratory of the U.S. Geological Survey. Taking the results from 0° to 185° as a whole, it follows that if with the observed thermal expansion compressibility be supposed to increase inversely as the first power of the *pressure binomial* $(A + p$, where A is constant), then temperature and pressure must vary linearly to maintain constancy of volume.—On hamlinite, a new rhombohedral mineral from the herderite locality at Stoneham, Mi., by W. E. Hidden and S. L. Penfield.—On a large spring-balance electrometer for mea-uring (before an audience) specific inductive capacities and potentials, by Alfred M. Mayer. The chief characteristic of the excellent piece of apparatus described is that it shows *directly*, and not inferentially, that different dielectrics transmit the force of electricity in different degrees.—Notice of new Tertiary mammals, by O. C. Marsh.

THE *American Meteorological Journal* for June contains:—An article on the distribution of cloud over the globe, specially prepared by M. L. Teisserenc de Bort from a former paper on this subject (NATURE, vol. xxxvi. p. 15), with diagrams of mean isonephs for March, which is the clearest month over the globe, aud for July, which, on the whole, is a cloudy month, and also with figures showing the appearance of the cloud bands on the earth, compared with other planets having atmospheres.—Is the diurnal variation of the magnetic needle a meteorological phenomenon?, by Prof. R. Owen. The object of the paper is to show that our atmosphere is the medium influenced magnetically by the sun, in affecting the diurnal movement of the needle. The author thinks that the facts adduced may aid us in understanding why storms in the northern hemisphere rotate from right to left, and advance from lower to higher latitudes.—A translation of Dr. R. Assmann's paper on the climatological influence of influenza.—Report of the meeting of the New Eng-

land Meteorological Society on April 15. The chief subject of discussion was climatic changes, which were considered in two divisions: (*a*) Secular changes, introduced by Prof. W. M. Davis. He stated that secular variations have undoubtedly taken place, but we cannot give specific explanations of them. (*b*) Supposed recent changes, introduced by Prof. W. Upton. Several long series of observations were examined, and, while slight indications of periodicity were found, there was no trace of progressive change.—Trombes and tornadoes, by M. H. Faye (concluded from the May number).—Method of determining the direction of the wind by observation of the undulations at the margins of the disks of the heavenly bodies, especially the sun and moon, viewed through a telescope, by Don V. Ventosa, of the Madrid Observatory. The author states that there are always two points on the limb diametrically opposite, where the undulations travel tangentially to it and in the same direction, while in intermediate regions the waves appear more or less inclined to the limb. These motions indicate by their directions those of the wind which produces them.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 19.—"On the Changes produced in the Circulation and Respiration by Increase of the Intracranial Pressure or Tension." By Walter Spencer, M.S., Assistant Surgeon to Westminster Hospital, and Victor Horsley, B.S., F.R.S.

The authors have made for some time the effect of an increase in intracranial pressure or tension the subject of an experimental inquiry, so far as the increase affects the circulation and respiration.

They conclude that the increase in intracranial pressure influences the circulation and respiration through the diminution in the physiological activity of the medulla which it causes.

The authors first give an historical *résumé* of the work of previous observers.

The following is a summary of the chief results obtained :—

I. *The Heart.*—A considerable increase of the intracranial tension was required to influence the heart; it became slowed and finally arrested. This happened more readily after respiration had ceased, and required a higher pressure to produce it when artificial respiration was employed, whilst division of both vagi nerves abolished any slowing or arrest. The arrest, when produced, continued permanently, unless the pressure was quickly removed, or artificial respiration employed, or the vagi divided. But if the pressure was maintained whilst artificial respiration enabled the heart to start again, then the cardio-inhibitory influence was gradually lost, so that the heart returned from being very slow to its normal rate, or increased beyond the latter until the rate became equal to that seen after division of the vagi. When the vagi were divided at this stage the rate of the heart did not alter.

The Blood Pressure.—A primary rise, small in the dog, larger in the monkey, was followed by a fall distinct from that produced by the slowing of the heart, and not necessarily accompanying it. When the heart started again the blood pressure rose, finally reaching the level seen after division of the vagi, so that no further rise took place when this was done. The power of producing a fall of blood pressure was easily lost. After division of the vagi the blood pressure was raised by increasing the intracranial tension and by artificial respiration, so that it could be maintained at a level between 300 and 400 mm. Hg for considerable periods.

Respiration.—This was likewise impaired and arrested. Its arrest reacted upon the heart and the blood pressure upon it, so that after the rise of blood pressure respiration occurred, even although a much higher intracranial tension was maintained than had been sufficient to arrest it when the blood pressure was lower.

II. By the direct application of pressure in the upper part of the 4th ventricle a slowing of the heart with a rise of blood pressure was caused, whilst respiration continued, so rapid as even to be nearly three times the rate of the heart in some cases. Pressure below the calamus scriptorius arrested the respiration without directly influencing the heart, whilst in the lower part of the 4th ventricle respiration was impeded or arrested along with a fall in blood pressure, and some slowing of the heart, followed by arrest, after the respiration had ceased.

"On the Alleged Slipping at the Boundary of a Liquid in Motion." By W. C. Dampier Whetham, B.A., Coutts Trotter Student of Trinity College, Cambridge. Communicated by J. J. Thomson, M.A., F.R.S., Cavendish Professor of Experimental Physics, Cambridge.

The experiments of Helmholtz and Piotrowski on the oscillations of a metal sphere suspended bifilarly, and filled with various liquids, gave finite values to the slipping coefficients. The theory of the flow of liquids through capillary tubes, applied to these results, show that such an effect would produce a marked change in the time of flow of a given volume of liquid. Poiseuille showed that for a glass tube there was no slip, and it follows that the flow through a gilt tube of about a millimetre in diameter should be twenty times as fast as through a glass one.

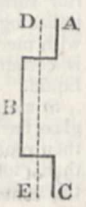
The time of flow of a given quantity of water through a glass tube was observed, and the interior of the tube was then silvered. The time was always the same for the glass and for the silver surface. The velocity of flow was varied within wide limits, and pushed near the point at which the flow ceases to be linear.

Other experiments were made on drawn copper tubes, which also agreed with Poiseuille's laws. Even when the interior surface was modified by cleaning with acids and alkalies, polishing with emery powder, coating with oil, or amalgamating with mercury, there was no change in the rate of flow. There is certainly no slip with substances which are wetted by the liquid.

Some preliminary experiments of Piotrowski on an oscillating glass flask, the interior of which was afterwards silvered, were then repeated, and it was shown that, when more precautions than Piotrowski took were used, the friction on the flask was the same, whether the surface was glass or silver.

Physical Society, June 20.—Prof. W. E. Ayrton, F.R.S., President, in the chair.—Prof. A. W. Worthington made a communication on the stretching of liquids. The three known methods by which this may be effected—viz. the barometer tube method, the centrifugal method, and the method of cooling—were described, and the precautions necessary in filling the tubes and in freeing the liquids from air discussed. With non-volatile liquids, such as sulphuric acid, the tubes are put in communication with a good pump, and before sealing, the liquid in the tube is kept at a higher temperature than that in the communicating vessel, in order that a stream of vapour may be passing outwards and carry with it any air liberated from the glass during the process of sealing. Before using tubes by the centrifugal method the author finds it advantageous to subject them to considerable "jarring" at intervals. This usually breaks the liquid column, and liberates a small bubble of air which may then be floated out. By repeating this many times, the adhesion of the liquid is greatly increased. With these precautions he had subjected water to a tension of 7·9 and sulphuric acid to one of 12 atmospheres. The cooling method of Berthelot (*Ann. de Chemie*, xxx., 1852) was then tried. In this method the liquid nearly fills a strong closed glass tube at a particular temperature. On slightly heating, it expands and fills the whole tube, any residual air being dissolved. On cooling again, the liquid remains extended, and still fills the tube until at last it lets go with a violent "click," and the bubble of residual air and vapour reappears. The tension of the liquids tested under these circumstances have usually been calculated from the relative change of volume on the assumption that the coefficient of extensibility is the same as that of compressibility. The author exhibited and described an apparatus by which the tension and the extension can be measured simultaneously. The tension is ascertained from the enlargement of the ellipsoidal bulb of a thermometer sealed into the containing vessel, and the extension calculated from the volume of the bubble after the click. The tension thermometer had been calibrated by internal pressure, and in determining the extension, correction is made for the change of volume of the apparatus. By this method he had subjected alcohol to a tension of 17 atmospheres, and found that the coefficient of extensibility is much less than that of compressibility. It is not clear what causes the liquid to let go of the glass, but it is found that the bubble can be caused to reappear by passing an electric current through a wire sealed in the capillary tube. Sir Wm. Thomson remarked that Prof. Worthington's paper was a curious commentary on the usual mathematical definition of "a liquid" as a substance which offered no resistance to being separated into parts. Speaking of freeing liquids from air, he said the beneficial effect of jarring could

easily be shown by tapping an ordinary "philosophical hammer"; separation of the column always leaves a bubble which can then be floated off. He had also found that, in freeing liquids from air by boiling, it was advantageous to have a long escape tube so that part of the liquid condenses and runs back.—Mr. C. V. Boys read a paper on the measurement of electromagnetic radiation by himself, Messrs. A. E. Briscoe and W. Watson. When Mr. Gregory described his new electric radiation meter on November 1, 1889, one of the authors said that the observed effect might be due to some cause other than expansion by heating, and that if it was a true heating effect it might be measured thermally. The present communication describes experiments undertaken to investigate the question. The first method employed was developed from the idea that if two fine wires be placed near together, and both act as resonators to a primary oscillator, the electrodynamic attraction caused by the electric currents up and down the wires, and the electrostatic repulsion between the charges on them, might result in the relative motion of the two wires. From theoretical considerations based on the assumption that the currents are harmonic in time and space, the authors inferred that the electrodynamic effect would preponderate at the middle of the wires, whilst the electrostatic repulsion would be greatest at the ends. To cause the attractions and repulsions to conspire in producing rotation, cranked resonators, A, B, C (see figure), were made; one was fixed, and the other suspended by a quartz fibre, to turn about a middle line, DE. These were inclosed in a glass vessel, and on starting the oscillator a turning movement was observed in a direction opposite to that expected. This motion was eventually traced to the electrostatic influence of the oscillator, for although the imperfectly conducting surface of the glass acted as a perfect screen from such action when the potentials of the oscillator were varied slowly, it did not do so for changes occurring about 500 million times per second. After adopting means to avoid this disturbance, and constructing lighter resonators, the experiments were repeated, with negative results. From the dimensions of the quartz-fibre used it was estimated that a force of 158 millionths of a grain could have been detected with certainty; this would have corresponded to about $\frac{1}{3\,0\,0}$ of an ampere in each resonator. It is hoped that by further increasing the sensitiveness of the apparatus, and using parabolic reflectors, the effect sought for may be detected. In the second method of attacking the subject, a Joule's dynamic air-thermometer was employed. This consisted of a glass tube with a partition along the middle extending nearly to the ends. If one side of the tube be warmed, convection currents circulate, and deflect an index placed in the steam. A small mirror suspended about one edge, and counterpoised, was used for an index, and was so sensitive that it was impossible to get the air still enough by any ordinary method of screening. However, by the ingenious device of putting the thermometer within a larger tube kept rotating by clockwork, the difficulties were surmounted. A doubled wire placed in one side of the thermometer served as resonator, and on starting the oscillator a large deflection resulted. A similar deflection was caused by applying about $\frac{1}{3}$ of a volt to the ends of the wire. This proved that the effect observed by Mr. Gregory is due to heating. The least rate of heating observable with the air thermometer was found to correspond to one calorie (gramme-water-Centigrade) per 24 hours in the whole tube, or 1 calorie per centimetre of wire in 103 days. Dr. Lodge asked Sir William Thomson whether, when electric pulses travel along parallel wires with the velocity of light, any action could exist between them, for two charged spheres travelling together at that velocity exert no mutual attraction or repulsion. In reply, Sir William said he was inclined to think Mr. Boys's treatment of the subjection was in the main correct, but it was quite possible that at such velocities the ordinary laws might be modified by the fact that the time taken for the force to be propagated from wire to wire is comparable with that required for the pulse to travel the whole length of the wire. As an example of the peculiar effects of rapid discharges, he said he had seen two copper wires which had been flattened against each other by lightning. Mr. Boys thought that in his resonators a condition analogous to stationary waves would exist, for the pulses are reflected from the ends. Dr. Lodge said he had that afternoon observed the action of parallel strips when Leyden-jar discharges were passed through them. The strips gave a kick at each discharge. Mr. Gregory mentioned that, in trying to increase the sensitiveness of his meter so as to measure the variation with distance, he had found that two resonators in proximity interfered with each other. He had, however, succeeded in increasing the sensibility about five-fold. Prof. Worthington asked if it was possible to measure the energy of the oscillator, and also whether the quantity caught by the resonator could be estimated from the solid angle it subtended at the source of energy, wherever that might be. Prof. Perry considered it easier to infer the energy of the source from that received by the resonator. Dr. Lodge said the energy of the source could be easily measured. The power radiated was enormous whilst it lasted, vastly exceeding that of tropical sunshine; and, if it could be made continuous, the apparatus would soon be red-hot. The energy radiated, he said, converges on the resonators, and hence the solid angle method of estimating the amount received would be erroneous. Moreover, the source was not at the oscillator, but at a quarter wave-length from it, and most of the energy returns to the oscillator; only a small fraction is splashed off and sent into space. Small oscillators radiate powerfully because the quarter wave-lengths are small; whereas the slow oscillators or alternators used commercially radiate very little of their energy. The exact law of variation of intensity of radiation with distance was rather complicated, but the theory had been completely worked out by Stokes in 1848. Mr. Blakesley thought the energy that returns to the oscillator would be available for subsequent radiations. Dr. Lodge pointed out that wires or other resonators placed within the quarter wave-length would intercept part of the returning energy.—Two communications—notes on secondary batteries, by Dr. Gladstone and Mr. Hibbert; and an easy rule for calculating approximately the self-induction of a coil, by Prof. J. Perry—were taken as read. In the first of these the authors show cause for believing that the beneficial effect produced by adding sodium sulphate to the ordinary electrolyte is due partly to its facilitating the reduction of lead sulphate and also to its power to diminish local action between the electrolyte and different parts of the lead plates. As regards the chemical actions which take place during the working of ordinary cells, they see no reason to doubt the view put forward by one of them in 1882, that the substance produced in the voltaic reaction is ordinary lead sulphate, $PbSO_4$. They also conclude that the high E.M.F. of a cell immediately after stopping the charging current is due to the inequality of acid strength near the two plates, and the gradual fall of E.M.F. is caused by the equalization of strength produced by diffusion.—Prof. Perry's rule relates to hollow cylindrical coils, and is expressed by the following formula:—



$$\text{L (in secohms)} = \frac{n^2a^2 \div 10^7}{1{\cdot}844a + 3{\cdot}1c + 3{\cdot}5b};$$

where n = number of windings,
a = mean radius of winding in centimetres,
b = axial length,
c = radial depth of winding,

and b and c are less than $\frac{a}{2}$.

The time-constant of such a coil is given in terms of the volume of copper (V′) in cubic centimetres by

$$\frac{L}{R} = \frac{V' \div 1000}{0{\cdot}728a \div 1{\cdot}33c + 1{\cdot}5b};$$

and the conditions for making this small are pointed out in the paper.—A paper by the Rev. T. Pelham Dale was postponed till next meeting.

Anthropological Institute, June 10.—Prof. Flower, C.B., F.R.S., Vice-President, in the chair.—The Chairman exhibited a "ula" or fetish brought by the Rev. L. O. Warner from the neighbourhood of Lake Nyassa.—Mr. Theodore Bent read a paper on the nomad tribes of Asia Minor. The paper referred in the first place to the heterogeneous mass of nationalities on and around the Cilician plain, but took only one point for discussion—namely, the religion of the Ausairee around Tarsus, identifying this cult with that of the Ali-ullah-hi of Northern Persia, and proving that most nomads, from the Mediterranean to the Caspian, belonged to this secret religion. The dogmas of the religion were set forth as obtained from three sources, namely: (1) account of the renegade Suleiman; (2) studies amongst the Ali-ullah-hi; (3) researches amongst the Ausairee of Tarsus.—The Rev. E. F. Wilson read a few notes on some North American Indians.—

In a paper entitled "A Contribution to a Scientific Phrenology," Mr. Bernard Hollander presented the result of further investigations into brain-functions—the first series of which has been published in the Journal of the Anthropological Institute of August 1889—showing again a striking similarity between modern experimental researches and the observations made by the founders of the phrenological doctrine. (*a*) The centre for visual perception and ideation [first occipital convolution]—considered by some physiologists to be the centre for the "concentration of attention"—corresponds with the localization of "concentrativeness," by Geo. Combe. (*b*) Mr. Herbert Spencer, who in the *Zoist*, vols. i. and ii., published his phrenological observations, considers the area, which Dr. Gall noted to be connected with visions and hallucinations, to be the centre for the revivification of ideas, which in its unnatural actions is accompanied by a difficulty in distinguishing revived impressions from real perceptions. The localization is the same as Dr. Ferrier's centre [12], the excitation of which causes such movements of eyeballs and head as are "essential to the revivification of ideas." (*c*) Excitation of the third and fourth external convolutions in jackals and cats is accompanied by retraction of the ear, a sudden spring or bound forward, opening of the mouth with vocalization and other signs of emotional expression, such as spitting and lashing the tail as if in rage. Dr. Gall located in the same area the "carnivorous instinct," termed "destructiveness" by his followers, and considered by Prof. Bain to be merely another name for the irascible emotion. Though the investigations are by no means finished, Mr. Hollander expressed the hope that an examination of his two communications to the Institute may induce men of science to reconsider the antiquated system of phrenology, which has hitherto failed to recommend itself to the scientific world.

Geological Society, June 18.—Dr. A. Geikie, F.R.S., President, in the chair.—The following communications were read:—The Borrowdale plumbago, its mode of occurrence and probable origin, by J. Postlethwaite.—Notes on the valley-gravels about Reading, with especial reference to the Palæolithic implements found therein, by O. A. Shrubsole. The following deposits containing implements are described:—A. *North of the Thames*. (i.) Gravel at Toot's Farm, Caversham; 235 feet above sea-level. (ii.) Clayey gravel by side of Henley Road, Caversham; 168 feet above sea level. (iii.) Subangular gravel at Shiplake; 200 feet above sea-level. B. *South of the Thames*. (i.) Gravel at Elm Lodge Estate, Reading; 197 feet above sea-level. (ii.) Gravel on disturbed beds at Redlands; 157 feet above sea-level. (iii.) Comminuted flinty gravel at Southern Hill; 223 feet above sea-level. (iv.) Gravel at Sonning Hill; 185 feet above sea-level. (v.) Gravel at Ruscombe, Twyford; 165–170 feet above sea-level. The author concludes that the highest gravels (235–280 feet above sea-level) do not, so far as is known, contain any traces of man, and that a considerable amount of valley-erosion occurred before the deposition of the earliest gravels which have furnished human relics. Further, he considers that the deposits indicate the occurrence of a severe climate at an early stage, and its recurrence at a later one, viz. during the deposition of the gravels found at a height of 197 feet and 144 feet respectively above the sea-level. He believes that many of the implements found in the lower levels at Reading have been derived from gravels of various dates and different levels, which have been swept away by denudation, and that this will account for the mixed character of the types of implements. After the reading of the paper, Mr. Monckton said he had noticed great variability of the gravels around Reading, and would like to learn whether it was possible to trace the subdivisions shown in the section of the pit at Grovelands for any distance laterally. Mr. Abbott could not understand from the section displayed that the Groveland gravel belonged to the Thames system. The author maintained that the variations could, to some extent, by traced laterally. The appearance of dip towards the Kennet in the section referred to by Mr. Abbott was misleading. He did not expect contemporaneous and identical valley-gravels to be discovered on the Oxford and Berks sides of the river in the way suggested. At the point in question the levels were very different.—The next meeting of the Society will be held on Wednesday, November 12, 1890.

Royal Microscopical Society, June 18.—Mr. Frank Crisp in the chair.—Mr. Mayall mentioned, in explanation of the delay in bringing forward the report of the new objective, that, before the Committee met officially to examine the objective, it had been agreed to support the report by the production of photo-micrographs of the various objects used as tests. They were, however, disappointed to find that the visual and actinic foci were not coincident, and at the request of Prof. Abbe the objective was returned to Jena. After a lapse of several weeks, Dr. Czapski replied that he had not found any trace of a "chemical" focus non-coincident with the visual focus, and the objective was again forwarded to London. The Committee then met, and the same fractured valve of *P. angulatum* was focussed accurately and then photographed, and it appeared quite sharp in the photograph. The transit of the objective from London to Jena had somehow got rid of the "chemical" focus. Unfortunately, the slide had become seriously deteriorated, so that the critical tests which they intended to photograph could no longer be tried. They were therefore compelled to await the arrival of another slide, which Dr. Van Heurck had most kindly sent, but which the Committee had not yet been able to examine.—In the absence of Mr. Pringle, the new photo-micrographic apparatus recently made to his instructions by Messrs. Swift and Son for the Royal Veterinary College, was described by Mr. Mayall.—Mr. E. M. Nelson exhibited upon the screen two photographs of the bordered pits of pine-wood. He thought these pictures showed clearly that the pits were of the nature of clack valves, and probably served the purpose of checking the downward pressure of fluid in the vascular system. He also showed some new photographs of diatoms × 1350, including one erratic form, which he proposed calling *Craspedodiscus punchbowlii*, from its resemblance to a punch-bowl.—Mr. Mayall gave a summary of the contents of a paper, by Dr. Charles E. West, of Brooklyn, on early binocular instruments.—Mr. Dowdeswell's paper, entitled "A Contribution to the Study of Yeast: Part I., Baker's Yeast," was read. Culture-tubes, containing specimens illustrative of the subject, were handed round for inspection.—Mr. C. D. Sherborn read some portions of a paper which had been prepared by himself, conjointly with Mr. H. W. Burrows and the Rev. G. Bailey, on the Foraminifera of the Red Chalk of Norfolk, Lincolnshire, and Yorkshire.

PARIS.

Academy of Sciences, June 30.—M. Hermite in the chair.—On the partial eclipse of the sun of June 17, by M. J. Janssen (see Our Astronomical Column).—On an attempt at oyster-culture carried on in the fish-pond of the Roscoff Laboratory, by M. de Lacaze-Duthiers.—On the photographic spectrum of Sirius, by Dr. Huggins. A new group of the ultra-violet series of lines is described, extending from λ 3199 to λ 3338.—On the application to great falls, in canals, of locks with oscillating liquid columns, and on a method of utilizing the automatic oscillating tube without its being blocked when the fall is considerably increased, by M. A. de Caligny.—On the residual charge of condensers, by M. E. Bouty. The author describes some experiments made with mica condensers. Among the results obtained are: (1) That a charge absorbed between the times θ and $\theta + t$ by a condenser which does not leak is identical with the residual charge liberated between θ and $\theta + t$ by the same condenser charged during a very long time. (2) This residual or absorbed charge is proportional to the electromotive force of the charging battery.—Researches on the application of the coefficient of optical rotation to determine the nature of the compounds which are produced by the action of malic acid on neutral tungstates of soda and potash, by M. D. Gernez. The experiments show: (1) That, both with salts of soda and potash, a regular increase of negative rotation occurs with solutions of increasing strength until a maximum of $-7^\circ 7'$ is reached, when equal equivalents of the two bodies are used. (2) A diminution of the rotation with change of sign and a positive maximum of $+2^\circ 42'$ for one equivalent of acid to two equivalents of the salt. (3) A diminution of the rotation with change of sign and a negative maximum of $-2^\circ 1$ when the solution contains one equivalent of acid to three equivalents of the salt.—On the action of titanium chloride on metals, by M. Lucien Lévy.—On the decomposition of rocks and the formation of arable land, by M. A. Muntz.—The author has found nitrifying micro-organisms universally distributed, even occurring on the bare rocks of mountain peaks, and attributes to them a considerable share in the work of breaking down rock-masses into soil.—On the development of the blastoderm in the isopodous Crustacea (*Porcellio scaber*, Latr.), by M. Louis Roule.—Crystallographic and optical properties of pyroxene obtained by means of superheated water, by M. A.

Lacroix. The conclusion is drawn that all its properties are sufficiently characteristic to identify artificial pyroxene with that of volcanic rocks.—The identity of composition of some sedimentary phosphates with apatite, by M. Henri Lasne. Phosphates from various sources and of different geological ages have been found to consist essentially of calcium fluophosphate of the same percentage composition as apatite, together with varying amounts of clay, calcium sulphate, &c.—On the reproduction of sillimanite and the mineralogical composition of porcelain, by M. W. Vernadsky. Kyanite and andalusite are transformed into sillimanite when raised to a white heat; the same mineral, or some body very like it, is shown by the author to be produced on heating together an intimate mixture of dry SiO_2 and dry Al_2O_3. He further proves that the products of decomposition by heat of topaz, dumortierite, and kaolin are composed in great part of the same substance, and that the crystalline portion of porcelain consists also of this mineral.—On the fauna of pyritic Ammonites of Djebel-Ouach, province of Constantine, by M. G. Sayn.—Craniectomy on a microcephalous subject, by M. Lannelongue. A remarkable operation on a female, aged four years, is described, resulting in a considerable amelioration of the condition of the patient.—On a new system of representing geographical relief, by M. Eugène Guillemin.

BERLIN.

Physical Society, June 13.—Prof. Du Bois-Reymond, President, in the chair.—At the opening of the meeting, Prof. Schwalbe referred in the warmest terms to the loss the Society had sustained by the death of Director F. Gallenkamp, who had for many years acted as its Librarian.—Prof. Vogel spoke on photography in natural colours as attempted at first by Seebeck, then in succession by Becquerel, Niepce, St. Victor, Poitevin, Zenker, and most recently by a Hungarian named Verres. He exhibited a series of photographs in colours obtained by Verres, which, however, showed conclusively that he has not solved the problem, since, although the reds appear as red in the photographs, so also do the yellows and greens appear as red, and the blues as an undeterminate colour. These photographs, on the other hand, mark a distinct advance in colour-photography, since they are fixed, while those of Zenker, although more strikingly coloured, were not fixed. The speaker criticized Zenker's views on the mode of formation of a coloured photograph, and expressed his disbelief in the possibility of any *one* substance being so changed by rays of different wave-length as to emit, from various parts of itself, rays of exactly corresponding wave-length.—Prof. Kundt exhibited a spiral of bismuth, as employed by Dr. Lenand to demonstrate the influence of a magnetic field upon the electrical conductivity of this metal; he further showed by experiment how considerable this influence is, and pointed out that it provides a means of measuring the intensity of the field.—Prof. Lampe explained that some years ago he had announced to the Society that a problem on maximal attraction of a point dealt with by Gauss had been previously propounded and treated by Playfair. More recently he had found that even Playfair was not the first to deal with this problem, but that a partial solution had been obtained by De Saint Jacques in 1750.

Physiological Society, June 20.—Prof. Du Bois-Reymond, President, in the chair.—Dr. I. Munk gave a *résumé* of the present state of knowledge as to the absorption of fat. The fact that fats with a high melting-point, such as stearin, are not absorbed is usually adduced in support of the supposed importance of emulsification; on the other hand, some of the speaker's own experiments had shown that a small amount (5–7 per cent.) of this fat may be absorbed. In support of the saponification of fats he described some recent experiments made on the patient with a lymphatic fistula (NATURE, vol. xli. p. 504) and on dogs. Thus, for instance, when spermaceti was administered to the patient after prolonged fasting, the lymph became cloudy and milky in the third or fourth hour of digestion. Analysis of the whole lymph secreted during thirteen hours showed that 15 per cent. of the spermaceti had passed into the lymph, not, however, in an unchanged condition, but as palmitin, showing that the spermaceti must have been decomposed in the alimentary canal, and that the palmitic acid of which it is partly composed must have become united with glycerin. He made further experiments with oleate of amyl-alcohol, hoping to verify the decomposition of this fat by observing that the animal exhibited symptoms of poisoning with amyl-alcohol: this was, in fact, observed. The above compound could not, owing to its pungent taste, be given in sufficiently large doses to the patient with the lymphatic fistula to be conclusive; but an analysis of the lymph secreted from the fourth to the twelfth hours showed that it contained, not the compound of oleic acid and amyl-alcohol, but olein—a further proof of its decomposition before absorption. So many difficulties stand in the way of the view that all fats are saponified before absorption, that the speaker considered the various points in connection with the process of fat absorption as still undetermined.—Prof. Ewald gave an account of the sudden death of a patient following upon the introduction of a flexible gastric sound; a subsequent *post-mortem* showed that the cause of death was rupture of an aortic aneurism. He then proposed as a subject for discussion the question as to whether the rise of blood-pressure which led to the rupture was due to the slight abdominal pressure or to some psychic excitation. The majority of those who joined in the discussion regarded the former as the causative factor of the rise of aortic blood-pressure.

BRUSSELS.

Royal Academy of Sciences, May 6.—M. Stas in the chair.—The following communications were presented:—On the conditions of the act of chemical combination; modifications arising from the presence of inactive dissolvents; extract of a letter from M. Menschutkin, Professor of Chemistry at St. Petersburg, to M. Louis Henry. Prof. Menschutkin has studied the combination of $(C_2H_5)_5N$ with C_2H_5I in the presence of inactive dissolvents, for example, hydrocarbons, simple ethers, ketones, &c. The experiments show that such substances exercise a considerable influence on the velocity of combination, it being found that if 1 represents the constant of velocity of the reaction noted above in hexane, C_6H_{14}, this constant for the same combination in $CH_3—CO—C_6H_5$, all other things being equal, is 847·7.—The state of vegetation on March 21 and April 21, 1890, in Gembloux, Huccorgne, Liége, and Spa, by Prof. G. Dewalque. The observations that have been obtained of herbaceous plants are very discordant. It is estimated, however, that vegetation was from 6 to 8 days behind on March 21, and 4 or 5 days behind on April 21.—On the characteristic points of some remarkable lines in conics, by C. Servais.—On the curvature in curves of the second degree, by the same author.—Note on the development in series of sine, cosine, and exponential functions, by Prof. Alphonse Demoulin.

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