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THURSDAY, OCTOBER 13, 1870

NATURAL HISTORY SOCIETIES

I.

EXISTING Natural History Societies, or Field Clubs, may be divided into two classes : those which have already a definite scientific position, and aim especially at working out the flora and fauna of their country or district ; and those which have for their object the popularising of the various branches of Natural Science, always with due regard to scientific exactness. The first consist chiefly of professed naturalists ; the second of intelligent persons who have some desire to gain a little insight into the wonders with which they are surrounded. Some societies combine the two ; and these are, perhaps, the most useful of the three classes. Although taking a somewhat lower tone, our second class is to the full as important as the more advanced one ; and if by its means our fellow-countrymen obtain even a slight knowledge of some branch of Natural History, something will have been done to diminish in some measure the mass of ignorance on matters connected with Natural Science which still prevails among educated people. Apropos of this, we may mention one instance which has lately come to our knowledge. Some people, of average education and intellect, who had resided for fifteen years in a country district, had brought to them a full-grown larva of the Privet Hawk-moth. Having no idea of its nature,—although one suggested that it was a "locust!"—but a sort of dread of its mysterious appearance, and of the horn on its tail, a council of war was held, and, it being considered too large to "squash," the unfortunate creature was forthwith placed in a pail of water, where it remained for eight or ten hours. At the end of this time a naturalist intervened, and the caterpillar was rescued from its bath ; when, strange to relate, it positively lived for three or four days, but died while passing into the state of pupa.

Having had some practical experience in the working of more than one local society, and somewhat special opportunities for becoming acquainted with the *modus operandi* pursued by others, a few notes on some of the more salient points which they present may be of some interest, and possibly of some use, to those who purpose taking part in establishing such a body. On the present occasion, we will confine ourselves to those societies which, either from the long period for which they have been established, or from other favouring circumstances, have attained a definite position, and are chiefly maintained by experienced naturalists, deferring for a future paper some hints and suggestions on the formation of less pretentious bodies.

One of the most important duties which devolves upon a society or field club possessing a fair proportion of working members, is the investigation of the flora and fauna of the district in which it is placed. Agreeing, as all will do, with Linnæus, that "turpe est in patriâ vivere, et patriam ignorare," it is evident that it is mainly through the agency of such bodies that a knowledge of the Natural History of the country generally is to be obtained. For such purposes there is no plan so satisfactory as that which is termed "working by sections." On this system, the society is divided into a number of smaller bodies, each having for its object the investigation and reporting upon some one branch, and consisting exclusively of those who are able and willing to devote both time and attention to the subject. Each section has its chairman and secretary, and holds its meetings independently of the remainder of the society. This plan has two advantages—only those who really *work* will undertake to join a section, and their meetings are kept free from any hindrance arising from the "drones," who, it must be confessed, are to be found more or less in every society, great or small. Besides, the three or four members forming each section can always conveniently meet at each other's houses, a proceeding which could not be so readily carried out if the whole number were assembled for each meeting ; and as the societies which have the advantage of a room specially retained for meetings are but few in number, this consideration is not unimportant.

The thorough and convenient investigation of the Natural History of a district, though an important, is not the only duty of a field club ; the same body may be of yet greater service in aiding in the publication of the facts which have been collected by its members. In this manner local societies have already done good service to science ; thus, in botany alone, we owe to the Tyneside Naturalists' Club, Mr. J. G. Baker's valuable "Flora of Northumberland and Durham ;" to the Holmesdale Naturalists' Club, Mr. Brewer's "Flora of Surrey ;" to the Worcestershire Field Club, Mr. Lees' "Botany of Worcestershire ;" while of similar works in preparation we may mention the "Flora of Herefordshire," by the Woolhope Club (of which Part 1 is already published) ; that of East Kent, by the East Kent Natural History Society ; of Folkestone, by the Folkestone Society ; of Berkshire (a much needed contribution to British botany), by the Newbury District Field Club ; and many more. The Tyneside naturalists certainly stand first in the value and importance of their published proceedings, which, especially since their union with the Natural History Society of Northumberland, Durham, and Newcastle, have attained a scientific position which renders them indispensable to those who would obtain a complete knowledge of the Natural History of the country at large. As a proof that local matters are not neglected in these volumes, catalogues of the Lepidoptera, Mollusca, Zoophyta, recent Foraminifera, and Fossils, have been published in them, and also issued separately at a moderate cost ; and the last volume contains a paper on the "Crustacean Fauna of the Salt Marshes," and a "Catalogue of the Aculeate Hymenoptera," of the two counties. We have been thus particular in commenting on these transactions, as they appear to us to afford a very good example of what the publications of the higher class of field clubs ought to be : essentially local, yet at the same time of sufficient general interest to be really valuable contributions to the Natural History of England. Second only to them in importance are the "Proceedings of the Berwickshire Naturalists' Club," of which the sixth volume is now in progress. This society is of especial interest as being the first local field club established in the kingdom.

Another advantage attending the publication of local floras by field clubs, is that by their means the expenses attendant upon such works fall less heavily upon those who undertake their compilation, and a fair number of subscribers is more readily obtained. Although much has already been done in publishing such works, there is still much remaining to be done; we could wish, for example, that the Manchester naturalists would publish a new and more complete edition of the "Manchester Flora," and that the Liverpool people would issue in a separate and completed form the flora which appeared in part in their journal. These floras, with that of Birmingham, if carefully worked out, with full references to the older writers, would be of a value second only to that of Trimen and Dyer's "Flora of Middlesex," as showing the influence of cultivation upon the botany of a district.

We must not dismiss the subject of publications without a reference to one or two of those emanating from more recently established societies, which have been favourably received. The Woolhope Club has now issued four volumes, copiously illustrated with photographs and coloured lithographs, the contents of which are of somewhat more general interest than those we have already referred to. This being the case, we can but regret that the volumes are inaccessible to the general public; but a limited number only are printed, which are almost confined in circulation to the members of the club. Noteworthy papers are those on the remarkable trees of Herefordshire (adorned with some exquisite photographs), on the fungi of the county, and on its geology; while the antiquarian will find some prominence given to archæology. The Malvern Naturalists' transactions are similar in general features to those of the Woolhope Club, and we observe that the two societies vie with each other in the attention they bestow upon edible fungi. The Birmingham Society has just issued the first volume of its proceedings—a very creditable one—which has the additional advantage of being obtainable by outsiders at the moderate cost of half-a-crown. We need not remark further upon this, as a notice of it lately appeared in our columns.

The general arrangement of meetings, &c., must depend almost entirely upon local circumstances; and the same remark will apply to rules, which should be as few and simple as possible. As we are now speaking only of firmly established bodies, any hints upon these matters are deferred for a second paper.

A WORD ABOUT YALE

THE following account of the Yale University scheme, by Professor J. D. Dana, is taken from the *Yale College Courant*:—

1. The Classical or Academic and the Scientific departments (ordinarily called Yale College, and the Sheffield School of Science) are distinct colleges for the undergraduate students of the University—distinct in teachers, scholars, buildings, apparatus, and special working libraries. They have in common a general library, and the officers meet for the discussion of University questions in a common University Faculty.

2. In each college the first two years of the four* are years of preparatory study without optional or elective courses, except perhaps in place of the higher mathematics of the second year. After the close of the second year a number of elective courses are before the student.

3. In the Academic College—whose special subjects of study are the classics, modern languages, mathematics, astronomy, history, intellectual and moral philosophy, political economy, general literature, &c.—the principles of natural science, physics, and chemistry are taught so far as is necessary to give depth and breadth to an academic education; a general knowledge of the laws or systems of nature, both organic and inorganic, being essential in these days to a true scholar, whatever his purpose in life.

4. In the Scientific College—whose special subjects of study are the various natural sciences, physics, chemistry, mathematics, and the practical applications of these sciences—literary subjects are added, including modern languages (some knowledge of the ancient languages being required for entering), political, moral, and intellectual science, history, physical and political geography, &c.—in order to give in this branch of the University a thorough and well-grounded education, and make the graduate a man of high culture.

5. In the Academic College, optional or elective courses are confined to its special subjects of study: (1) the classics, (2) modern languages, (3) English language and literature, (4) mathematics. None are allowed in the departments of natural, chemical, or physical science, as these subjects are admitted into this college only so far as is necessary to give that breadth and depth to education which every graduate should have.

6. In the Scientific College also, elective courses are confined to its special objects of study—that is, to the natural sciences, physics, geology, metallurgy, mechanics, engineering, &c.

7. The post-graduate courses of the University comprise many distinct departments in the lines of the Academic and Scientific Colleges. Connected with the former, there are (or may be) courses in Latin, Greek, different Oriental languages, linguistics, English language and literature, history, intellectual philosophy, mathematics, astronomy, &c. &c. Connected with the latter there are (or may be): First, in *pure science*, courses severally in the different physical sciences, general chemistry, organic chemistry, mineralogy, botany, zoology, palæontology, geology, mathematics, astronomy, &c.; Secondly, in *applied science*, courses in civil engineering, mechanical engineering, mining and mining engineering, practical mechanics, metallurgy, agriculture and agricultural chemistry, &c.

8. The students of the Academic College take, on graduating, the degree of Bachelor of Arts; and those of the Scientific College that of Bachelor of Philosophy.

The students of the post-graduate courses, after two years of study, in which high scholarship is attained as tested by a rigid examination, take the degree of Doctor of Philosophy; except in the case of students in Civil Engineering, who may receive that of Civil Engineer after one year of study.

The University includes also the Schools of Law, Medicine, Theology, and the Fine Arts. But of these it is not necessary here to speak. Neither of them has, in any part of its curriculum, an undergraduate department analogous to that of the Academic or Scientific College.

* The three-years' course of the Scientific School will probably be made a four-years' course within a year or two.

In connection with the above brief statement I offer the following remarks:—

1. The ranges of studies in the two colleges, the Academic and Scientific, are so diverse in character, that the interests of the students and of education are better subserved by two distinct faculties working separately, than by one single combined faculty. There is not in the Yale scheme that multiplicity of optionals before the students after they have entered the University, which inconveniently subdivides classes, offers inducements to indolence, and tends to break down thorough discipline and study; for, in the act of entering, the student decides as to the range of his optionals; and if afterwards not satisfied (which would seldom be the case) he can join the other college.

2. It might be supposed that the scheme would require an unnecessary duplication of professors. But this is not so at Yale. In the Academic College there are already four instructors in Greek, four in Latin, five in mathematics, physics, and astronomy; and the professors of rhetoric, history, moral and intellectual philosophy, &c., are more than well occupied with their academic labours. The scientific students, if embraced in the Academic College, would actually require as many additional instructors as are needed under the existing system of the University.

3. In some scientific departments in the Academic College (zoology and botany, for example), in which the instruction occupies but a small part of the college course, there is no objection to employing the services of some of the scientific faculty, if this is feasible; and, where possible, the academic faculty may serve the Scientific College. Moreover, while all lecture-rooms had better be separate, the more costly kinds of apparatus may well be used in common, in order to avoid needless expenditure.

4. It may be added that many scientific students commence their training as scholars by first graduating in the Academic College. For the higher training in science, such a preparatory course in the classics is believed to be eminently desirable. They then enter an advanced class in some one of the departments in the Scientific College, and take the degree of Bachelor of Philosophy, or of Civil Engineer; or by special proficiency, after two years of study, that of Doctor of Philosophy. The Scientific College also admits of partial courses of study which do not lead to any degree.

5. The modification in American colleges which is demanded by the vast development of the sciences of nature within the past century—the era of origination for many of them—and also by the contemporary progress of linguistic and other sciences, is accomplished by the Yale scheme through a method which does not sacrifice, in any degree, classical education, and which at the same time combines thorough literary culture with the widest range and highest development of scientific education. The Classical College stands beside the Scientific, open to all who desire to commence with a classical basis; and the Scientific College offers a thorough and liberal education for all who would pursue a more distinctively scientific course.

6. The Yale scheme contemplates no important change in the Classical or Academic College except in the elevation of the department of modern languages and literature; and its ideal with regard to modern languages cannot be wholly realised until a knowledge of French and German is given (like that of Latin and Greek) in preparatory schools, and required for admission to the college.

7. The great change that has taken place at Yale is in the introduction of its School of Science. This school is not the result of any preconceived plan on the part of the University. It is a gradual growth of the past twenty years, urged on by the demand in the land for scientific knowledge among lovers of science, those seeking to become its teachers, and others interested in its practical departments; and it has been carried forward to its present organisation mainly through the labours and judgment of the scientific men who have been slowly gathered into its faculty. More than two-thirds of its endowments are due to private munificence, and the remainder to the National Agricultural and Mechanical Fund.

WALLACE ON NATURAL SELECTION

Contributions to the Theory of Natural Selection. A Series of Essays. By Alfred Russel Wallace. (London: Macmillan and Co., 1870.)

IN the discussions of the French Academy, to which we referred in a recent number, M. Elie de Beaumont ventured to describe Mr. Darwin's theory as *La Science Mousseuse*. The phrase is a good one, and expresses very happily the kind of work for which some of the speakers in that debate are distinguished. But although we too in England are not unacquainted with this kind of popular science, scientific works do from time to time appear which are popular without being frothy, and to this class the present book belongs. While strictly accurate in matter, it is easy in style, and is so free from technical language, that it may be understood by educated men who are not professed naturalists; so that we hope it will be read by a large number of those to whom Mr. Wallace's delightful volumes have made the Malay Archipelago familiar.

The arrangement of the essays (most of which have been published separately) does not, perhaps, bring out their mutual connection so well as might be, and there is no attempt to blend them into a continuous series. Four main subjects are discussed, and each has its own peculiar interest.

The first and second chapters are reprinted as originally written in the East Indies, and, with the eighth, form Mr. Wallace's contribution to the theory of natural selection in general. It is remarkable that the same pregnant idea which Mr. Darwin has for ever united with his name should have occurred independently to another English naturalist on the other side of the globe. The public opinion of the scientific world will no doubt assign Mr. Wallace the full credit which the preface to this volume so modestly claims; and the highest respect is due to his varied and fruitful labours in both hemispheres; but a warmer feeling than respect will be paid to the spirit by which the following passage was prompted:—"I have felt all my life, and I still feel, the most sincere satisfaction that Mr. Darwin had been at work long before me, and that it was not left for me to attempt to write 'The

Origin of Species.' I have long ago measured my own strength, and know well that it would be unequal to the task. Far abler men may confess that they have not that untiring patience in accumulating, and that wonderful skill in using, large masses of facts of the most varied kind—that wide and accurate physiological knowledge, that acuteness in devising and skill in carrying out experiments, and that admirable style of composition, at once clear, persuasive, and judicial—qualities which in their harmonious combination mark out Mr. Darwin as the man, perhaps, of all men now living, best fitted for the great work he has undertaken and accomplished."

The third chapter is on so called Mimicry among Animals, and contains an account of some of the remarkable cases of dimorphism observed by the author and by Mr. Bates, and of those in which one species closely resembles not only leaves and inanimate objects, but other specially protected animal forms. The facts thus established are explained with great ingenuity, and often with equal probability, by the operation of the natural laws of selection. The ways in which even brilliant colouring may become a means of protection are well illustrated, so that this branch of study is made to yield support instead of difficulty to the Darwinian theory. The following chapter, the only technical one in the book, is an application of the same law to explain the various forms and distribution of the group of *Papilionidæ*. It may be compared with Fritz Müller's study of the Crustacea from a similar point of view; and we believe that more solid progress will be made by carefully working out the application of natural selection to restricted and well-known animal groups than by attempting the construction of more comprehensive and imposing phylogenies.

In the seventh chapter Mr. Wallace makes a somewhat similar inquiry into the relation of the colour of birds to the form of their nests, and concludes, from a very wide survey, that when the female is of conspicuous colours, the nest is adapted to conceal her during incubation, while open nests are made by those already sufficiently protected. The exceptions to the rule are candidly stated, and most of them satisfactorily met. That the true law of the habit has been discovered is, perhaps, too much to say; but the evidence is at least enough to lead to further investigation on this interesting subject. Another essay, styled, not very happily, "The Philosophy of Birds' Nests," attempts to explain the building of nests and also the song of birds as the result not of "instinct," but of conscious imitation; gradual improvement being of course brought forward by the survival of the most skilful architects and the constant sexual demand for the best musicians. But not only does Mr. Wallace thus raise nest-making to the rank of an intelligent art, he also shows how much of human construction is simply imitative, and therefore as fairly to be called instinctive as a bird's; while in another passage he shows how the alleged wonderful displays of instinct in savages are really the result of habit and of reason.

This chapter on Instinct in Men and Animals would naturally introduce the last two, in which the working and the limits of the law of natural selection on the human race are considered. This is probably the most difficult, as it is certainly the most generally interesting, of the questions affecting the origin of animal species. Those who are not satisfied with the genealogies of Haeckel, and wait for the more cautious and philosophic conclusions expected from the master of the subject, will scarcely, we think, accept the views propounded in this volume by Mr. Wallace. He points out very clearly how most of the human peculiarities of structure may be supposed to have originated by the survival of the forms fittest for their mode of life, and is fully aware of the necessary change going on at the same time in the various functions, to bring them also into harmony with structure. And he shows with great justice how mental and moral qualities must interfere with the absolute carrying out of the law of natural selection—not only in civilised communities, where it is continually and designedly contravened, but among all savages who take, for instance, the least care of the sick and aged of their tribe. But, beside and apart from the operation of the general law of organic life, with these various modifications and restrictions, Mr. Wallace believes that another and independent cause has been at work in the evolution of the human frame, and that this has been a supernatural one. He maintains that the large size of the brain in man, the scantiness of his hairy covering, the great specialisation of his extremities, and some other peculiarly human characters, cannot be explained, except as the result of the direct action of the Creator's will. In fact, he compares man as he at present exists with such products of artificial human selection as the seedless banana or the London dray-horse; so that, if we may thus express Mr. Wallace's theory, man is God's domestic animal.

A great deal of the metaphysical discussion which occupies the last pages of the volume, including the verses quoted from an American poetess, has, we confess, to our mind, the same "double disadvantage" which the author finds in "the law of unconscious intelligence pervading all organic nature put forth by Dr. Laycock, and adopted by Mr. Murphy," that, namely, of being "both unintelligible and incapable of proof;" but the theory of divine artificial selection supplying the deficiencies of natural selection in the formation of man may, we think, be at once met by the following considerations.

The theory of natural selection does not suppose a kind of large female divinity, whose name is Nature, and whose function is to select from animals and plants those fittest for survival. The theory rests, as Mr. Wallace, in another part of his work, is careful to remind the reader, on certain proved facts (enumerated at p. 302), which necessitate the survival of certain forms by virtue of the proved physical laws which we see in daily operation. But these so called laws are, to all who believe in a Creator, simply the manner of His action. To say that our brains were made by God, and our lungs by natural selection, is really to exclude the Creator from half His creation, and natural science from half of nature. All the phenomena we know are of necessity ultimately referable to the First Great Cause: the object of science is to discover their secondary causes; and if the theory of natural selection does not explain how the larynx or the brain of man were developed, then we must try to find another which will. To fall back for explanation upon the primary

efficient cause of their existence and the design with which they were framed, is only to confuse two distinct branches of inquiry.

At present, however, we may be content to see how far we can work the Darwinian hypothesis, and can only hope that there may be other "contributions" to the theory as interesting and valuable as these of Mr. Wallace.

P. S.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his Correspondents. No notice is taken of anonymous communications.*]

Dr. Bastian and Spontaneous Generation

I FIND that the "Address" which it was my duty to deliver at Liverpool, fills thirteen columns of NATURE. The "Reply" with which Dr. Bastian has favoured you occupies fifteen columns, and yet professes to deal with only the first portion of the "Address." Between us, therefore, I should imagine that both you and your readers must have had enough of the subject; and, so far as my own feeling is concerned, I should be disposed to leave both Dr. Bastian and his reply to the benign and Lethean influences of Time.

But I am credibly informed that there are persons upon whom Dr. Bastian's really wonderful effluence of words weighs as much as if it were charged with solid statements and accurate reasonings; and I am further told that it is my duty to the public to state why such distinguished special pleading makes not the least impression on my mind. With your permission, therefore, I will do so in the briefest possible manner.

The first half of Dr. Bastian's "Reply" occupies seven columns of your number for the 22nd of September. In all this wilderness of words there is but one paragraph which appears to me to be worth serious notice. It is this:—

"In the first place, he does not attempt to deny—he does not even allude to the fact—that *living things may and do arise as minutest visible specks, in solutions in which, but a few hours before, no such specks were to be seen.* And this is in itself a very remarkable omission. The statement must be true or false—and if true, as I and others affirm, the question which Professor Huxley has set himself to discuss is no longer one of such a simple nature as he represents it to be. It is henceforth settled that as far as *visible* germs are concerned, living beings can come into being without them."

If I did not allude to the assertion which Dr. Bastian has put in italics—it is because it bears absurdity written upon its face to any one who has seriously considered the conditions of microscopic observation. I have tried over and over again to obtain a drop of a solution which should be optically pure, or absolutely free from distinguishable solid particles, when viewed under a power of 1,200 diameters in the ordinary way. I have never succeeded; and, considering the conditions of observation, I never expect to succeed. And though I hesitate to speak with the air of confident authority which sits so well on Dr. Bastian, I venture to doubt whether he ever has prepared, or ever will prepare, a solution, in a drop of which no "minutest visible specks" are to be seen by a careful searcher. Suppose that the drop, reduced to a thin film by the cover-glass, occupies an area ½ of an inch in diameter; to search this area with a microscope in such a way as to make sure that it does not contain a germ $\frac{1}{10000}$ of an inch in diameter, is comparable to the endeavour to ascertain with the unassisted eye whether the water of a pond, a hundred feet in diameter is or is not absolutely free from a particle of duckweed. But if it is impossible to be sure that there is no germ $\frac{1}{10000}$ of an inch in diameter in a given fluid, what becomes of the proposition so valuable to Dr. Bastian that he has made your printer waste special type upon it?

I now pass to the second part of the "Reply," which, though longer than the first, is really more condensed, inasmuch as it contains two important statements instead of only one.

The first is, that Dr. Bastian has found *Bacterium* and *Leptothrix* in some specimens of preserved meats. I should have been very much surprised if he had not. If Dr. Bastian will boil some hay for an hour or so, and then examine the decoction, he will find it to be full of *Bacteria* in active motion. But the motion is a modification of the well-known Brownian movement, and has not the slightest resemblance to the very rapid motion of translation of active living *Bacteria*. The *Bacteria* are just as dead as those which Dr. Bastian has seen in the preserved meats and vegetables; and which were, I doubt not, as much put in with the meat, as they are with the hay, in the experiment to which I invite his attention.

The second important statement in the second part of the "Reply" is:—

"Professor Huxley is inclined to believe that there has been some error about the experiments recorded by myself and others."

In this I cordially concur. But I do not know why Dr. Bastian should have expressed this my conviction so tenderly and gently as regards his own experiments; inasmuch as I thought it my duty to let him know both orally and by letter, in the plainest terms, six months ago, not only that I conceived him to be altogether in the wrong, but why I thought so.

Any time these six months Dr. Bastian has known perfectly well that I believe that the organisms which he has got out of his tubes are exactly those which he has put into them; that I believe that he has used impure materials, and that what he imagines to have been the gradual development of life and organisation in his solutions, is the very simple result of the settling together of the solid impurities, which he was not sufficiently careful to see, in their scattered condition when the solutions were made.

Any time these six months Dr. Bastian has known why I hold this opinion. He will recollect that he wrote to me asking permission to bring for my examination certain preparations of organic structures, which he declared he had clear and positive evidence to prove to have been developed in his closed and digested tubes. Dr. Bastian will remember that when the first of these wonderful specimens was put under my microscope, I told him at once that it was nothing but a fragment of the leaf of the common Bog Moss (*Sphagnum*); he will recollect that I had to fetch Schacht's book "Die Pflanzenzelle," and show him a figure which fitted very well what we had under the microscope, before I could get him to listen to my suggestion; and that only actual comparison with *Sphagnum*, after he had left my house, forced him to admit the astounding blunder which he had made.

To any person of critical mind, versed in the preliminary studies necessary for dealing with the difficult problem which Dr. Bastian has rashly approached—the appearance of a scarlet geranium, or of a snuff-box, would have appeared to be hardly more startling than this fragment of a leaf, which no one even moderately instructed in vegetable histology could possibly have mistaken for anything but what it was; but to Dr. Bastian, agape with speculative expectation, this miracle was no wonder whatever. Nor does Dr. Bastian's chemical criticality seem to be of a more susceptible kind He sees no difficulty in the appearance of living things in potash-alum, until Dr. Sharpey puts the not unimportant question, whence did they get their nitrogen? And then it occurs to him to have the alum analysed and he finds ammonia in it.*

And as to the elementary principles of physics—in his last communication to you, Dr. Bastian shows, that he is of opinion that water in a vessel with a hole in it, from which the steam freely issues, may be kept at a temperature of "230° to 235° F. for more than an hour and a half."† I hope that Professor Tyndall, whom Dr. Bastian scolds as authoritatively and as unsparingly as he does me, will take note of this revolutionary thermotic discovery, in the next edition of his work on Heat.

It is no fault of mine if I am compelled to write thus of Dr. Bastian's labours. I have been blamed by some of my friends for remaining silent as long as I have done concerning them. But when, because I have preserved a silence, which was the best kindness I could show to Dr. Bastian, he presumes to accuse me publicly of unfairness, and to tell your readers that my Address "is calculated to mislead" them, I have no alternative left but to give them the means of judging of the competency of my assailant.

Jermyn Street, Oct. 10 T. H. HUXLEY

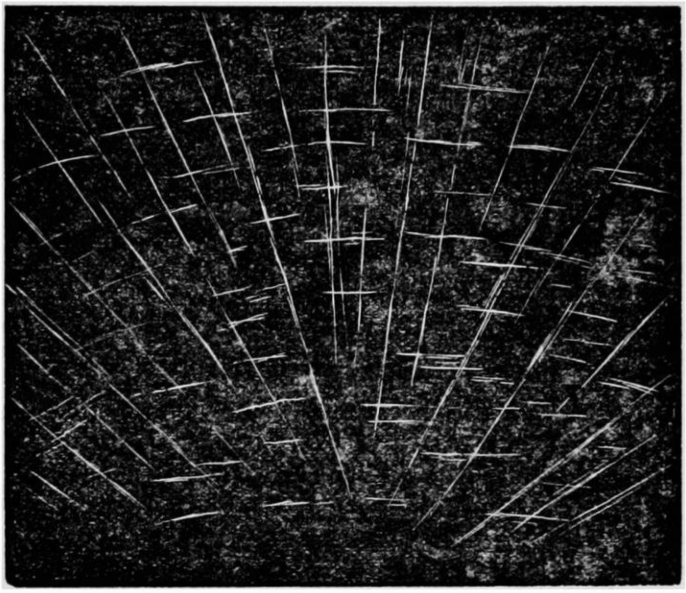
Ozone developed by Humidity and Electricity

IN confirmation of the idea as to the connection of excess of ozone with humidity and electrical action, to which attention was drawn in my previous letter of August 4, I forward you the following observations.

* See NATURE, No. 36, p. 198. † Ibid. No. 48, p. 433.

Between August 19 and September 9, the average of ozone registered was very great, being about eight by Schönbein's test-paper. On the five days ending September 9, the quantity each morning was nine. During the longer period mentioned, humidity was also in excess. Rain fell every day from September 1 to 9.*

The weather during the last month has been very pleasant—we have not had more than one really wet day, and rain has generally fallen in the night. Though there have been no thunderstorms, we have had evidence of their occurrence in other parts by the presence of electrical cumulus. But the most remarkable phenomenon in connection with electricity was the appearance of an Aurora Borealis *in the daytime*, which happened on



the afternoon of September 4. I pointed this out (about 4 P.M.) in the form of thin reddish streaks resembling linear cirrhus, which radiated in a symmetrical manner from the north, at the same time anticipating a luminous appearance after nightfall. This took place: yet the light was not in the northern part of the heavens, but stretched clear across from W. to E. in a broad band of glowing white light. Fainter streaks appeared afterwards in the north. A dark cirrhus mist overspread the sky at the time.

The radiating cirrhus, or Auroral cloud that appeared in the daytime, was crossed by lighter streaks, as in the accompanying sketch.

The day previous this phenomenon was seen at Edinburgh, and also in this neighbourhood, though I did not observe it.

These manifestations, followed each time as they have been lately by change of weather, seem to confirm the theory of Mr. Buchan and M. Silbermann; and I could adduce other observations pointing to the same inference, viz. that the Aurora Borealis is an atmospheric phenomenon, connected with the polarisation of vapour.

Great Malvern, Sept. 12 S. B.

Aurora Borealis

ON going out this evening I saw a very fine Aurora Borealis, which literally covered the whole sky to within 15° of the southern horizon. The streamers were of a yellowish white colour, but at times very decidedly red. They shot up from the east, north, and west strongly, feebly from the south. The radial point was within 5° of Scheat (β Pegasi) A.R. 22^h 56^m., dec. N. 27° 15'±.

This radial point remained constant for about one hour and a half, when it suddenly shifted, at 11.30, to within 5° of the zenith towards the east.

The light was sufficient during the flashes to see my watch, and read the second hand with ease.

Altair (α Aquilæ) was quite blotted out by the glare as it passed over; also the stars in Cygnus and Andromeda.

I used a spectroscope on the light, and found that I could distinguish the bright line near the group of calcium lines (wave-length 5,567) almost anywhere I pointed to in the sky, excepting on the south horizon; while to the north, I not only saw the bright line, but also others apparently near F, one bright, the other very faint.

I hope that there will be other notices in your paper of this very fine Aurora.

My latitude is N. 57° 8' 56". LINDSAY

Dunecht, Aberdeen, Sept. 24

A MAGNIFICENT display of Aurora Borealis was observed here this evening, between 9^h and 12^h P.M. During the early part of the morning the suspended magnets were so much disturbed that I considered it useless to continue a series of absolute determinations of the magnetic elements on which I was engaged. The auroral display when first noticed bore a very striking resemblance to the effect produced by a brisk and squally wind passing over an otherwise calm lake. Magnetic clouds overspread the northern half of the sky, and were abruptly terminated by an irregular arch, stretching from the magnetic E. to W., and passing almost through the zenith. This arch was never very well defined, but it served for some time as an apparent barrier to the rapid passage of the waves of magnetic light from the N. towards 9^h 45^m P.M. The whole N. horizon was brilliantly illuminated, but in some points more so than in others, and from these points broad streamers darted forth, extending often from the horizon to the zenith. Several of these stupendous beams of light, many degrees in breadth, were sometimes seen at once, and occasionally the whole N. horizon shot forth these brilliant streamers. The colour of the beams was often red, but more frequently white, but many changed from white to red, or red to white, before vanishing from sight. The sky at times was partly of a deep red hue.

At 10^h 45^m some of the beams assumed a more stationary character, and radiated from a point some 70° above the E.S.E. horizon. The whole sky then became covered for a short time with the magnetic clouds, which were rarely dense enough to obscure stars of the second magnitude. At about eleven o'clock the phenomenon again completely changed, returning suddenly to its former aspect, of a lake violently agitated by a gusty wind, which brilliantly lit up the thin clouds as it passed rapidly onwards from the N. Towards midnight the activity of the forces considerably abated.

During the storm the vertical force magnet was completely thrown off balance, and the declination and horizontal force magnets suffered considerable perturbations.

Stonyhurst, Sept. 24 S. J. PERRY

Botanists and the Halfpenny Postage

FOR several years I have been in the habit of sending herbarium specimens by "book post," by merely placing the plants between sheets of white cardboard, which were invariably fastened by string, without wrappers, and the address written on the cardboard itself; so that, in fact, the parcel was open at both ends and sides. On Tuesday last I did up a small packet of green or living plants, and sent them to the village post-office. As the parcel weighed under four ounces, I affixed two halfpenny stamps. On calling at the post-office the next day, imagine my disgust at seeing my parcel of plants stuck up in the window to be sundried! Upon inquiry, I found that the postman had very *wisely* declined taking it to the borough office, as "several similar parcels were lying about there now, and would not be forwarded until the senders had prepaid the postage at letter-rate."

I say the postman acted wisely in refusing to take my parcel, because, on taking it to the Newbury post-office myself on Thursday, I found that unless I paid eightpence, or rather put on seven more penny stamps, *double* that amount would have actually been charged to the recipient, at which I should have felt much grieved, as the specimens were really not worth half the amount.

Another gentleman of my acquaintance sent a parcel to the same office with a fourpenny stamp on; this the clerk kindly *defaced*, and returned the parcel as "not sufficiently paid"!

I have read the new rules, and can see no clause bearing on this subject—either for or against herbarium specimens, or other objects of natural history, being sent between cardboard with open ends at the old rate of four ounces and under for one penny, and should therefore be glad of any correct information from you or the readers of NATURE.

East Woodhay, Oct. 7 HENRY REEKS

* The above notes were taken by Mr. R. J. Wood.

Working Men's Colleges

I HAVE only just seen your remarks on Working Men's Colleges, and your suggestion that "men and women should be treated, not as artizans, mechanics, or gentlemen, but simply as men and women." May I, speaking as a member of the College in Great Ormond Street, and also of the younger college here, and having an intimate knowledge of both during the whole of their existences, assure you that both these colleges were opened and have been carried on in the spirit you suggest, and in no other? Certainly, we have never in either college desired to treat *women* as either "artizans, mechanics, or gentlemen."

Secondly, I do not think either college is second, even to the "Berlin Working Men's Club," in *catholicity*. Each college puts forth a programme of what it can give its members, and there is not in either college the slightest effort to induce any member to do anything but what he has a spontaneous desire to do. Neither college "belongs to any religious or anti-religious body." Neither college has any "Shibboleth of any kind whatever."

Thirdly, your suggestion that all the colleges and clubs should be united into one, would have more value in a small town than in London, with its hundreds of miles of streets and its millions of inhabitants.

Lastly, there is an essential difference between a college and a club. The one has a foundation in work, the other in recreation; the chief work of the one is mental, of the other social; in both it is moral. Both are necessary, but they need not necessarily be carried on in the same building.

Another point is that working men *cannot* form a college *for* and *by* themselves, except they scarcely need it. The number of members needful to defray the expenses is so large, and the number of men in London possessing the elementary education requisite to give them an intelligent and persistent desire for such a place is comparatively so small, that I do not think any college in London can be wholly self-supporting for some years to come.

If any of your readers desire to know what kind of work the two colleges are doing, I shall be happy to give them full particulars of the work and of its difficulties, and still more of its need to be done. I think you are in error in speaking of the *extension* of the scientific programme of Great Ormond Street College. I have before me the new programme of that college.

In *this*, the younger college, we have put before our students a larger number of science classes than we have hitherto done, because we are beginning to find that the men who have passed through our night schools and elementary classes give us hopes of doing good in this way. Possibly it is to this that you meant to refer. W. ROSSITER, Hon. Sec.

October 4 South London Working Men's College

[We wrote by the card in speaking of a projected extension of the scientific instruction at the Working Men's College in Great Ormond Street.—ED.]

Lunar Rainbow

I HAVE just witnessed this evening (Monday, 10th, 7.30 P.M.) a magnificent lunar rainbow, distinctly coloured throughout, and with the reflection bright towards the west. The space within the bow appeared lit up by a silvery haze, offering a marked contrast to the inky appearance of the cloud beyond the bow.

The moon was shining brightly as the shower commenced during which the rainbow was seen. It was observed at different times during the evening by several persons.

Cromer, Norfolk J. G. DUTHIE

NOTES

WE have great pleasure in announcing that the American Government have voted 6,000*l.* for the expedition which will be sent to Spain and Sicily to observe the coming eclipse. It will be in the recollection of our readers that our own Government have refused to give either a single ship or a single shilling in aid of our own observations; as we said before, comment is useless.

WE have also a word to add to another instance of American enlightenment which we chronicled last week, namely, the vote of 50,000 dollars towards the construction of a refractor similar to that recently erected by Mr. R. S. Newall at Gateshead. The Superintendent of the U.S. Naval Observatory, Washington, has written to Mr. Newall a letter which we have been permitted to see, in which, after referring to the munificence which has endowed astronomy with such an instrument as the Newall telescope, he requests permission for Prof. Newcombe to inspect it, with a view of judging what devices and mechanical arrangements are best adapted to secure the successful and easy manipulation of the American instrument.

THE death of Prof. Miller has been followed by another heavy loss to Chemical Science in that of Dr. Augustus Matthiessen, one of the rising chemists of greatest promise in this country. The work which he had already done had acquired for him a reputation equalled by few, and exceeded by none of his fellow-workers of his own age; to this we hope to refer more at length next week. He occupied the position of Lecturer on Chemistry at St. Bartholomew's Hospital, and was, at the time of his death, one of the Examiners to the University of London. He was in his 39th year.

THE "fish torpedo" which, as we stated some little time ago, has been for some time subjected to various experimental trials by a committee of naval officers, under Captain Arthur, R.N., was put to a practical proof on Saturday, at Sheerness. The *Oberon*, paddle-wheel steamer, had been specially supplied with a 12-horse power engine and air pumps for filling the torpedo with compressed air, and fitted with a large discharging tube at the bow for launching it under water. The peculiarity of the torpedo is that it will maintain its passage at any particular depth between five and fifteen feet from the surface; the propulsion being entirely submarine and effected at the rate of six or seven miles an hour by the action of the compressed air on a screw propeller. Two torpedoes were run against the *Aigle*, a large hulk lying in the harbour, both from a distance of 140 yards. The first contained a charge of 67lb. of gun-cotton, and hit the hulk, exploding on impact, and making a clean hole, 20 feet by 10 feet in area, and sinking her at once. Nets were placed at 15 feet from the side of the hulk, and the second torpedo run at them, being launched from a framework attached beneath a boat. This torpedo, containing a charge of 18lb. glyoxiline, was caught in the nets and exploded there, doing no damage whatever to the side of the hulk. The machine is the invention of Mr. Whitehead, an English engineer, having works at Fiume, in Hungary.

WE must refer our readers to the October number of the *Astronomical Register* for an account of a discussion on the great Melbourne telescope, at the Royal Society of Victoria. The colonists mistrust their great reflector, and we do not wonder at it, the day for metallic specula is past, and we regret that our Royal Society had anything to do with sending out such an instrument.

THE *Astronomical Register* announces that the post of Government Astronomer at Sydney is vacant by the death of Mr. George K. Smalley.

Now that the Government are accused by a tribunal appointed by themselves, of having built a top-heavy ship "in deference to public opinion, as expressed in Parliament and in other channels" (*sic*) and "in opposition to the views and opinions" of their scientific adviser, might we be allowed to suggest that the more Government attempts to encourage the advancement of scientific ideas and studies among members of Parliament and other channels, the better? The cost of the *Captain* in hard cash would have helped to disseminate a vast amount of scientific education and interest throughout the land had it been properly spent; and now it is quite lost, because the Government are Philistines, and do not like Science, and build top-heavy ships because ignorant members of Parliament and other "channels" clamour for them.

ARTISTS, manufacturers, and others who have not expressed their desire to be admitted as exhibitors at the International Exhibition of 1871, are requested to do so before the 10th of November next. Her Majesty's Commissioners, as already notified to the public, do not intend to award prizes to exhibitors. They will, however, afford every facility to societies and individuals desirous of offering prizes for the encouragement of Art or industry in connection with the Annual International Exhibitions; and are prepared to receive such offers, and to publish the conditions of competition which the donors may wish to prescribe. The conditions are announced of a competition of prizes for the best fan, the first prize of 40*l.* being offered by Her Majesty the Queen. The painters and decorators are completing their work in the fine art galleries. We understand that it is the intention of Her Majesty's Commissioners to invite artists and exhibitors of all fine art works to inspect these galleries shortly.

THE American Association for the Advancement of Science closed its nineteenth meeting on the 25th of August, at Troy, N.Y Owing to the illness of President William Chauvenet, of St. Louis, the Vice-President, Dr. T. Sterry Hunt, of Montreal, presided. The meeting was largely attended, there being about 300 names enrolled on the treasurer's books. The next meeting is to be held in Indianapolis, and the meeting in 1872 will probably be held in San Francisco, upon the invitation of the California Academy of Sciences. The president-elect for the next meeting is Prof. Asa Gray, of Cambridge; general secretary, Prof. F. W. Putnam, of Salem, Mass.; treasurer, Mr. William S. Vaux, of Philadelphia.

WE learn that the building for the New York Industrial Exhibition will be commenced on the 15th of December. Twenty-three acres have been purchased between 98th and 102nd Streets, the purchase money amounting to 2,658,000 dollars. It is intended to make this one of the finest, or perhaps we should rather say *the* finest permanent institution of the kind in the world. The building will probably cost not less than 8,000,000 dollars, and it is the intention of the managers to advertise for designs at an early day. The importance of such an enterprise to New York can hardly be over-estimated. The benefits that have been conferred by the Central Park in opening up a place of resort uncontaminated by beer-saloons and other demoralising agencies has been very great, and the present effort to extend facilities for instructive pleasure and innocent amusement deserves well of all who desire the good of the city.

WE understand that the following are candidates for the Regius Professorship of Natural History in Edinburgh, vacant by the resignation of Professor Allman:—William N. McIntosh, M.D. Edin., F.L.S.: H. Alleyne Nicholson, M.D., D.Sc. Edin., F.R.S.E.; and Wyville Thomson, LL.D. St. Andrew's, F.R.S. We believe we are correct in stating that there is no truth in the rumours that either Prof. Flower, of the Royal College of Surgeons, or Prof. E. Perceval Wright, of Dublin, is a candidate for the chair.

THE authorities of King's College, London, have arranged that the duties of the chair of chemistry, vacant by the death of Prof. Miller, shall be performed, pending the appointment of a successor, by Prof. Odling.

THE First Commissioner of Works intends to have distributed this autumn, among the working-classes and the poor inhabitants of London, the surplus bedding-out plants in Battersea, Hyde, the Regent's, and Victoria Parks, and in the Royal Gardens, Kew. If the clergy, school committees, and others interested, will make application to the Superintendents of the Parks nearest to their respective parishes, or to the Director of the Royal Gardens, Kew, in the cases of persons residing in that neighbourhood, they will receive early intimation of the number of plants that can be allotted to each applicant, and of the time and manner of their distribution.

THE Horticultural Society held a Fungus-show on the 5th inst. for competition for prizes offered by Mr. W. W. Saunders, F.R.S., for the best collection of Edible and Poisonous Fungi. Several exceedingly good collections were shown, which attracted a great deal of attention, many of the visitors being evidently astonished at the large number of common fungi which are warranted by experts to be not only innocuous, but wholesome articles of diet.

ON the 4th inst. a large public meeting was held in the Mechanics' Hall, Dewsbury, for the promotion of Technical Education in Yorkshire. Classes for instruction in drawing and elementary science are to be opened under certified teachers. The inaugural address was delivered by Mr. J. Buckmaster, of the Science and Art Department. After explaining the aid rendered by the Government, he pointed out at some length the industrial and moral advantages derived from the acquisition of scientific knowledge.

THERE has just been started in the city of Baltimore, U.S.A., a society of fifty members, called "The Maryland Academy of Sciences." It is intended to pay special attention to microscopy. The principal officers are Philip T. Tyson, President; John G. Morris, Vice-president; Edwin A. Dalrymple, Corresponding Secretary.

THE annual examinations for degrees in the Queen's University, in Ireland, commenced last week, and will be continued during the greater part of the present week. The examining body of the University consists for the most part of the professors in the different faculties in the three Queen's Colleges. We regret to learn that Prof. Wyville Thomson is unable to take his part in these examinations owing to continued ill-health.

PROF. VERRILL, of New Haven, has just returned from an expedition to the Bay of Fundy. The greatest depth encountered in dredging even as far as fifty miles from the coast, was not beyond 120 fathoms. Very large collections were made, many rare and about sixty new species were discovered, the number of species in Prof. Stimpson's list being more than doubled. We hope soon to have a catalogue of the fauna of the bay from Prof. Verrill.

SIR WALTER ELLIOT is compiling a record of what has been done by local societies in Great Britain and Ireland, towards elucidating the natural history of the districts in which the societies meet. Any information, as when such societies were established and by whom, and details generally as to their proceedings, will, we hope, be forwarded to Wolfelee, Hawick, N.B.

MR. JAMES BRITTEN, of the Royal Herbarium, Kew, and Mr. Robert Holland, of Mobberly, Knutsford, Cheshire, have in preparation a work on the folk-lore connected with plants. Any assistance will be gladly received by either of these gentlemen at the addresses given above.

A WORK is announced on the land and fresh water shells of British India, "Testacea indica, terrestria et fluviatilia," by Sylvanus Hanley, F.L.S., and William Theobald, of the Geological Survey of India. It will be issued by Messrs. L. Reeve and Co., in monthly parts, and will contain sixty to eighty 4to plates.

IN another column we give an abstract of Capt. Carmichael's paper read to the Geographical Section of the British Association, relating to the aboriginal Indians of Central America. Since then, the following interesting information has come to hand. A correspondent, writing from Santa Fe, New Mexico, to the *New*

York Tribune, says:—"Governor Arny, the indefatigable special Indian agent for this territory, has lately returned from a point north of the San Juan country, and reports that during his tour to reach the Utah Indians, his party found the Canon de Chelly in the great Sierras, which was explored for more than twenty miles. Among canons towering precipitously to the height of 1,000 to 2,000 feet, they found deserted ruins of Aztec cities, many of which bear the evidences of having been highly populous. In one of these canons, the rocky walls of which rose not less than 2,000 feet from the base, and whose summits on either hand inclined to each other, forming part of an arch, there were found high up, hewn out of the rocks, the ruins of Aztec cities of great extent. In each of these rocky eyries there remained in a state of good preservation a house built of stone, about twenty feet square, containing one bare and gloomy room, in the centre of which were traces of fire, and also a single human skeleton. The only solution of this enigma thus far advanced is that these solitary rooms were the altar places of the Aztec fires; that from some cause the people at a remote period were constrained to abandon their homes, but left one faithful sentinel in each instance to keep alive the flame which, according to the Indian traditions of these regions, was to light the way of Montezuma, their so long hoped for Messiah, again to his people. A close examination of many of the ruins proved that the builder must have been skilled in the manufacture and use of edged tools, masonry, and other mechanical arts." A good idea of these rocky canons or mountain gorges will be obtained by reference to the description and illustrations of the Canons of the Sierra Nevada, given in NATURE, vol. i. p. 434.

IN directing attention to the recent regulations with regard to scientific teaching in force at Yale College, in our present number, we alluded to the exploring party which left Yale College under the charge of Prof. Marsh. We are glad to announce that their endeavours have been crowned with great success. They spent three weeks examining the geology of the country between the north and south branches of the River Platte, and discovered in Northern Colorado an extensive tertiary deposit, abounding in fossil remains. The formation is identical with the "Mauvaises terres" deposit of Dakota, and apparently forms the south-western border of some ancient fresh-water lake (see NATURE, Vol. II., p. 385, "The Ancient Lakes of Western America"). These beds were traced to the north, and along the North Platte River; several thousand specimens were collected, and among them a number of new species of tertiary mammals.

ARRANGEMENTS are being made to light the stations of Rawul Pindee in India with gas from the local deposits of petroleum, being one of the first examples of their utilisation.

FULLER details have now arrived of the great earthquake we reported as having occurred in Thibet in May, and which extended over a wide area of country.

MR. BROUGHTON, the Government quinologist in India, has been called upon to examine the bark of an indigenous Indian tree, *Hymenodictyon excelsum*, supposed to be a powerful febrifuge. He reports that it contains a bitter principle, identical with æsculin, and also found in the horse-chestnut tree, but of little therapeutic value.

THE experiments in growing Carolina rice in our great rice-country of English Burmah are reported as having failed.

IT may be esteemed a benefit that we have a local press in India, which may collect for us more facts as to natural phenomena, but the acceptance of anything from such sources must be received with caution. New facts about snakes are in this class. The Vellore correspondent of the *Madras Standard* asserts on reliable information that a native woman near that town lately gave birth to a child and a snake, and that another has produced twins, and a third child, which looked like a toy elephant. A very respectable and well-educated Mussulman lately reported the exhibition, we think at Benares, of a mermaid from Japan, which he accepted on the evidence of his own eyes and the statements of the highly respectable Mussulman showmen, and duly reported to the paper of which he is the correspondent.

A GOOD example of the value of agricultural shows and their influence on produce, is shown in India by the Vellore shows, which have now been held for twelve years. At the same time the results show the difficulty of organising cattle-shows there, and how it may be overcome. As is well known, the superstition about the sacred cow is strong in India, and the ryots can hardly be got to exhibit, and the first cows shown were scarcely worth a prize. Now the exhibition of the famous Vellore breed has reached 173 cows and heifers, and a great improvement is visible. It is suggested that the exhibition of Vellore bulls will also be attended with advantage. In India the greatest care is requisite in the most trivial undertakings in dealing with the superstitions of the natives.

THE Cinchona cultivation has so well succeeded in the English hill settlement at Darjeeling, in the Himalayas, that last year 5,000lbs. of bark was sent to London from Cinchona trees planted in 1862 on one plantation. Tea produced, in 1869, 1,319,743lbs. from 10,769 acres of hill land formerly said and reputed to be worthless, and unsuited to give a return to Englishmen. We shall now hear of Indian bark as well as Peruvian, as we know Indian tea to hold its own against Chinese.

CONGRESS has granted 30,000 dollars for the erection of a Government Winter Garden, either at New York or Washington, somewhat similar to that at Kew, but on a smaller scale. This will partake partly of the nature of an economic garden, in which useful plants can be raised and then disseminated far and wide throughout the States.

"THE Reign of Law," by the Duke of Argyll, which has been published so long in England, has at last been republished in America. It is announced as the first American from the fifth London edition, published by C. Leat and Co., New York. We also hear of a Canadian reprint of Prof. Huxley's "Lay Sermons."

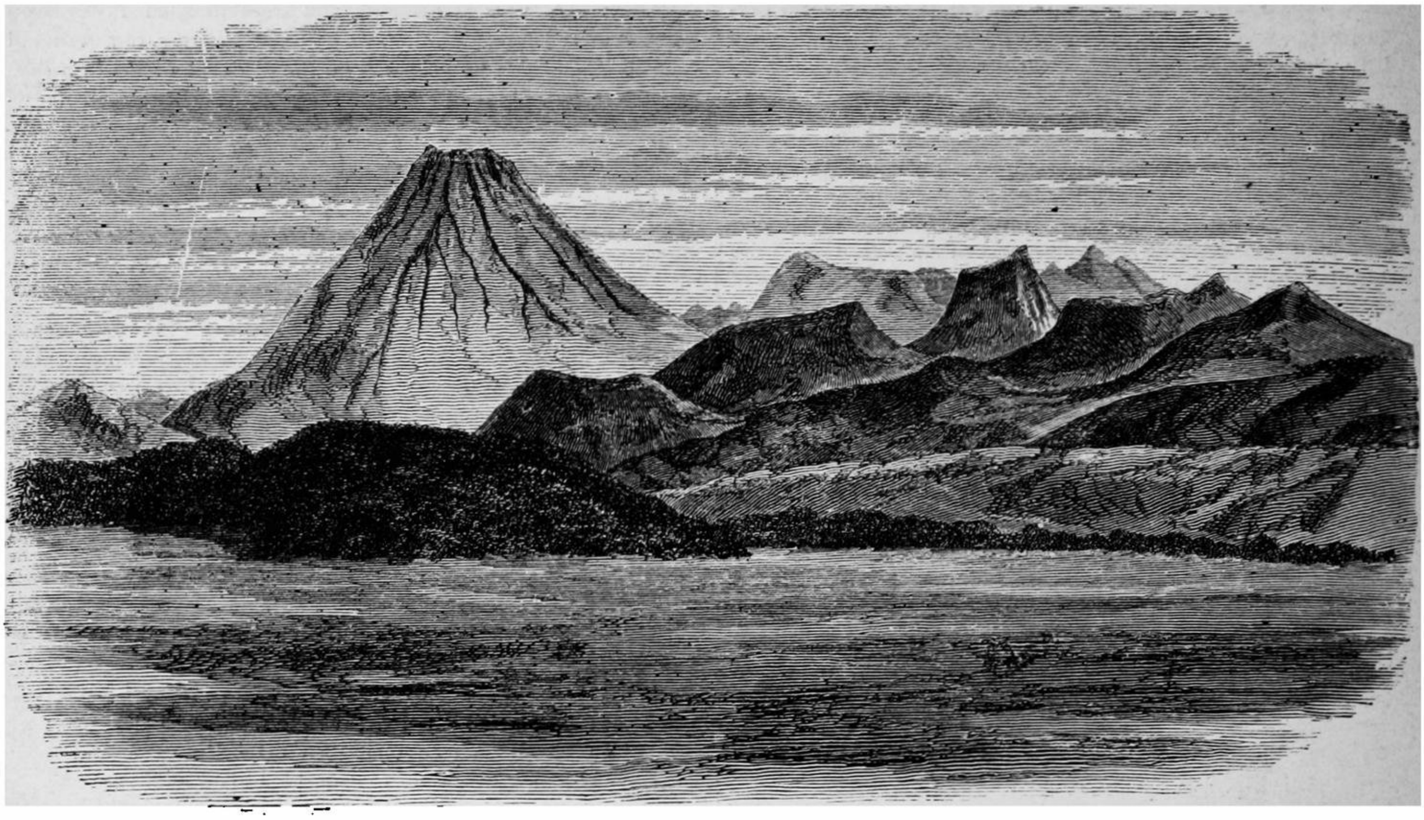
THE cinchona trees are taking well in Jamaica. Experiments on the culture of American tobacco in India are being made by the Maharajah of Burchwan in Midnapore and Cuttack. The last year's experiments with seeds from James River, Virginia were very successful.

ARGENTIFEROUS galena has been discovered in the district of Beerbhoom, in India, by Mr. Ball, of the Geological Survey. The assay of some picked specimens gives 110 ozs. of silver to the ton of lead, and it is considered there is a sufficient quantity of ore to justify working.

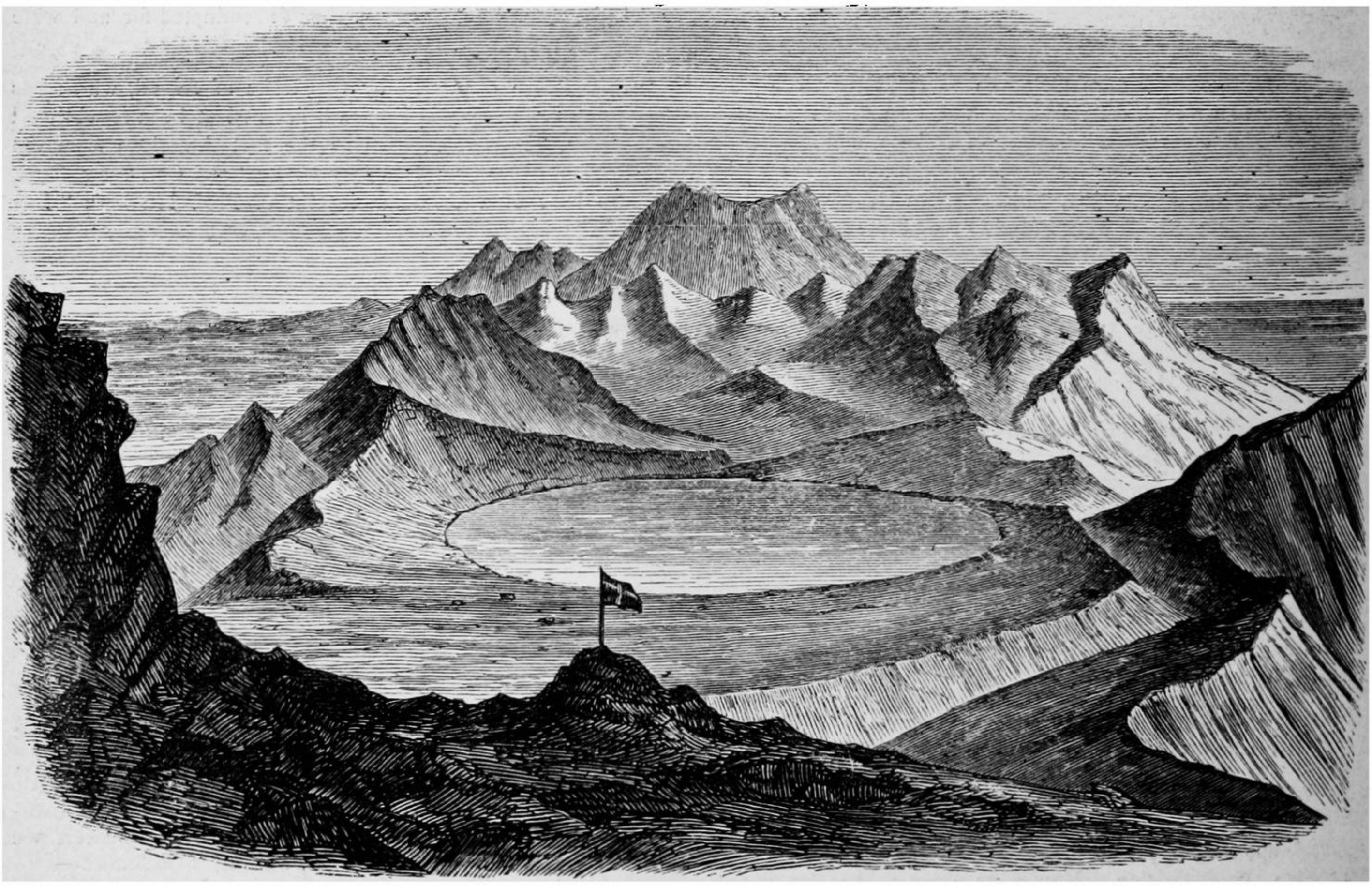
ERUPTION OF THE VOLCANO TONGARIRO, NEW ZEALAND

THROUGH the kindness of Dr. J. D. Hooker, we have received the following important and interesting account of the eruption of this volcano, together with drawings, from the pencil of Dr. Hector, of the most interesting features of the mountain itself, from which we are enabled to copy the accompanying woodcuts:—

Dr. Hector announced, at the meeting of the Wellington Philosophical Society of New Zealand, held July 17th, that Tongariro, the only active volcano in the colony,

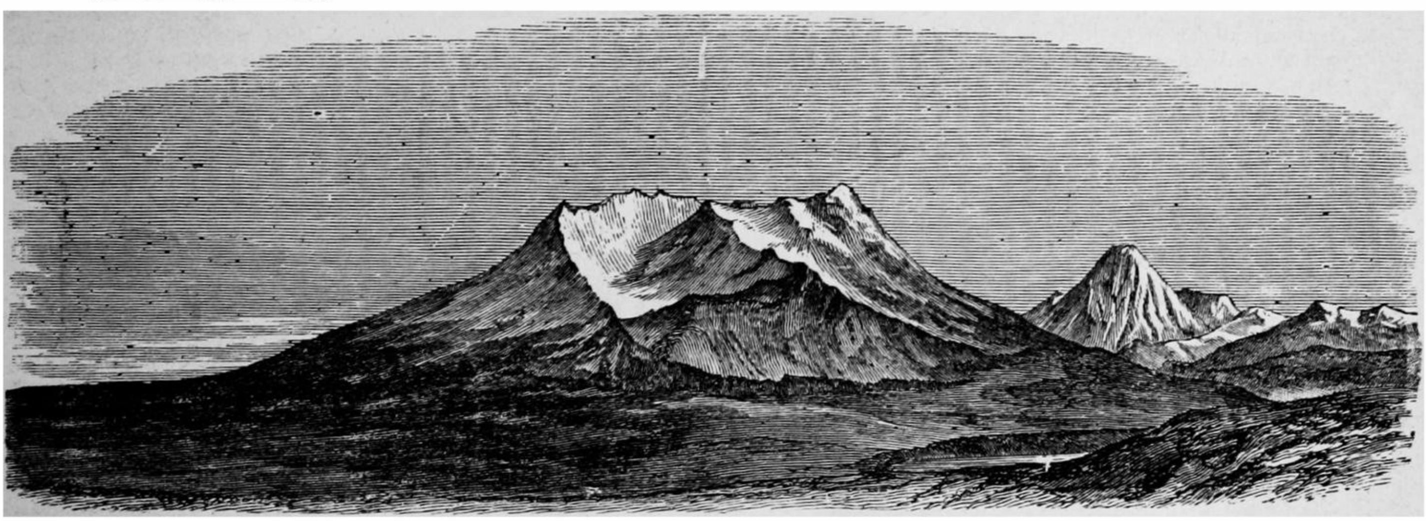


NGAUR HOE CONE OF TONGARIRO, FROM THE EAST



LAKE ON THE TOP OF TONGARIRO, LOOKING SOUTH OVER NGAURUHOE AND RUAPEHU which is situated in the interior of the North Island, had burst into active eruption in the month of April last, and for the first time within the knowledge of the colonists, or even the traditions of the Maories, lava streams have been emitted. On the occasion of previous eruptions, the outbursts have consisted only of ashes and gaseous matters, the former having been spread over a district extending for upwards of thirty miles round the mountain. The volcano is 6,000 feet high, and consists of a group of irregular broken cones, and one very perfect cone, known to the natives as Ngauruhoe. Jets of boiling water and steam continually issue from the north side of the mountain. At an altitude of 3,600 feet, and on the top of Tongariro proper, is a lake 300 yards across, the water of which is of an intense green colour. Ten miles to the south of Tongariro is the ancient trachyte cone of Ruapehu, which is the loftiest mountain in the North Island, having an altitude of 9,600 feet. It is a notable circumstance, that on the 5th of April last, when electrical disturbances were so marked in Europe, and the brilliant displays of Aurora Borealis were generally observed, the corresponding phenomena of the Aurora Australis were extremely well marked in the Southern Hemisphere, attended also by electrical disturbances of unusual character; and on the same evening a well-marked earthquake shock was experienced in the volcanic district of New Zealand, and shortly after the above eruption was reported. The country is very inaccessible at this season, but from the north end of Taupo Lake, where there is now a telegraph station, a distant view is obtained. On the 10th July, the immense volumes of dense black smoke which are being emitted from Tongariro were plainly visible from the hills at Napier, as well as from parts of the surrounding plains. Loud reports were distinctly heard for the previous fortnight, like the boom of heavy artillery, or rather the noise caused by the falling of an immense body of matter, at intervals of five minutes or thereabout. These reports (which are very loud in the vicinity) are sometimes accompanied by a quiver of the earth, and in each case by a great up-burst of flame and red-hot masses like molten rock. A broad stream of red-hot lava is distinctly visible flowing down the side of the mountain in a wavy irregular mass; and in the night the flames issuing from the crater are described as forming a highly interesting and beautiful spectacle.

On the 18th a surveyor reports that he observed, about 1.15 P.M., a sudden column of smoke come out of Tongariro (just as if a steamer was firing up), and soon after it seemed to change to white steam; he stood on a hill about eighty miles distant, and could just see the top of Tongariro to the east of the shoulders of Ruapehu.



RUAPEHU AND TONGARIRO, FROM THE ONETAPU DESERT, ON THE SOUTH-EAST SIDE AT THE SOURCES OF THE RANGITIKEI RIVER

THE BRITISH ASSOCIATION

SECTIONAL PROCEEDINGS

SECTION A.—MATHEMATICAL AND PHYSICAL SCIENCE

The Radcliffe Observer (Rev. R. Main) communicated the *Observations of Shooting Stars made at the Observatory during the past year*, from 1869, August 19, to 1870, August 31.

Since the last report to the British Association, nearly 300 shooting stars have been observed by Mr. Luces at the Radcliffe Observatory, Oxford, distributed as follows:—

27 in the remaining part of August, 1869.
11 on the 1st and 3rd of September.
17 in the month of October.
16 on the 4th and 6th of November.
21 on the nights of the 8th, 9th, and 10th.
None on the 11th in a watch at intervals from $7^h 30^m$ till $12^h 30^m$.

The nights of the 12th and 13th were thickly overcast. On the 14th there was a break from 11^h to 12^h, but no meteors seen; eight were observed on the night of the 15th, between 8^h and $13^h 30^m$, in bright moonlight. On the 28th one was seen.

On December 29 a remarkable meteor, about equal to one-fourth of the full moon, was seen through the window of the sitting-room, with a bright gas-light nearly between the observer and the window. Course from the Pleiades to the south horizon.

None were observed in 1870 till March 30, when one was observed by Mr. Main at $8^h 20^m$, larger than Jupiter, of a brilliant white, and a period of about 5 seconds from the zenith, vertically downwards a little to the south of the prime vertical.

On April 12th, at $11^h 13^m$, one larger than α Lyræ, of a brilliant white, visible 2^s to 3^s from point near Lyræ, northward about 10°.

April 19 at 14^h, 3 in quick succession were seen near α Herculis, of about second magnitude, with a rapid downward motion, one nearly vertical, one slightly inclined to the west, and the other to the east. Watch in bright moonlight till $16^h 30^m$.

Only 7 were seen in May, and 1 in June. On July 8, at $9^h 20^m$, the sky completely overcast and no star visible, a meteor was seen below the clouds at point near Cassiopeia, with a downward motion of about 6°, and bursting at the end of two seconds of time.

Another meteor was seen below the clouds for about half a second on July 15, at $12^h 25^m$, near β Andromedæ, scarcely any stars being visible in that part of the heavens.

About 20 were seen on the night of July 21 by different persons while Mr. Luces was conversing with them, between 9^h and 13^h, but he did not see any till $13^h 43^m$, when one equal to α Lyræ left a point near that star, taking its course, with a long train, towards the north horizon.

Only 5 were seen between this and August 8, when 4 were seen in strong moonlight and clouded sky. 11 were observed on August 9 under the same circumstances; one at $13^h 46^m$, equal to Capella, started from δ Ursæ Majoris with a downward course, of about one second, when it burst, leaving a train visible about two seconds.

On August 10, between $9^h 33^m$ and $15^h 30^m$, 36 were observed, nearly all in the northern part of the heavens, with strong moonlight and clouded sky. One at $14^h 10^m$, equal to α Lyræ, of a bright white colour, burst near β Cygni.

Twenty-six were observed on August 11, between 9^h and 15^h, and on the 12th, 7 between 8^h and $10^h 30^m$, the sky becoming overcast at 11^h.

3 were observed on the 13th, from 10^h to 12^h.
3 on the 15th, from 12^h to 13^h.
7 on the 17th, between $9^h 20^m$ and 12^h.
5 on the 22nd, between $10^h 20^m$ and 12^h.

Four on the 24th, 3 on the 26th, 2 on the 29th and 30th, and 3 on the 31st.

The most noteworthy besides those already mentioned were:—

One on August 19, 1869, in strong moonlight, when few stars were visible, from a point near α Pegasi to near γ Pegasi, about equal to α Lyræ, for about two seconds.

On October 6, at $7^h 5^m$, one about equal to Jupiter appeared to burst near the S.W horizon.

On October 27, one as bright as Jupiter, visible for two or three seconds, from ψ Tauri to the Pleiades.

November 4, at $6^h 5^m$, 1 equal to one-sixth of full moon, yellowish, was seen by Mr. Béchaux for about three seconds, with a train about 2° in length, from α Arietis to a point above ε Pegasi.

November 8, at $7^h 43^m$, one of the 1st magnitude, yellow, visible about 3ˢ, with a train from δ Aurigæ to α Draconis, and another at $8^h 10^m$ of the 1st magnitude, white, with a train from α Cygni to β Lyræ, visible for three seconds.

Section B.—Chemical Science

On the Lancashire Alkali Trade.—Mr. William Gossage. This paper chiefly dealt with the scientific and commercial progress of the alkali manufacture in Lancashire during the last nine years. Mr. Gossage regarded as one of the most important facts of the last nine years the passing of the Alkali Act, 1863, an Act which makes it imperative that all manufacturers decomposing common salt for the production of sulphate of soda should condense not less than 95 per cent. of the hydrochloric acid gas evolved by such decomposition; and he said that the means which he devised in the year 1836 for effecting this condensation were now universally adopted by the soda manufacturers, with such success that not only did they comply with the legislative requirements of condensing 95 per cent. of the hydrochloric acid set free, but in many instances the condensation exceeded 99 per cent. Speaking of the benefits arising from the appointment of Dr. Angus Smith to the office of chief inspector under that Act, he considered that it may be fairly expected that when the same amount of care and attention is applied to subduing the bad effects resulting from other noxious vapours, chemical manufactories will be relieved from the charge of occasioning injury to the neighbourhoods in which they are situated. The most important use of hydrochloric acid obtained by this condensation was the manufacture of bleaching powder. At the date of his former paper, the chlorine required for the manufacture of bleaching powder was obtained by the action of hydrochloric acid on native peroxide of manganese; but recently, Mr. Walter Weldon had perfected a process whereby peroxide of manganese is obtained from the chloride of manganese produced by the action of hydrochloric acid on peroxide of manganese. Mr. Weldon's process has been successfully adopted by some of the largest manufacturers of bleaching powder. Mr. Gossage next referred to Mr. Deacon's method of manufacturing chlorine without the use of manganese, and to the circumstance that Mr. James Hargreaves, of Widnes, has also devised means for producing chlorine without the use of oxide of manganese. In his last paper, Mr. Gossage remarked that nearly all the sulphur used in the soda manufacture was re-obtained in combination with calcium, forming what is designated "alkali waste," and he then suggested that this presented a problem worthy of consideration by his juniors. Mr. Ludwig Mond, a German chemist, had now made the nearest approximation to the solution of this problem, with which he (Mr. Gossage) was at present acquainted. Mr. Mond's process had been carried out successfully by various manufacturers, but unfortunately the quantity of sulphur obtained was far short of that in the waste; and he (Mr. Gossage) considered that the problem he had mentioned still remained as an exercise for ingenuity and perseverance. He had also alluded in his paper before the Association in 1861 to the means he had adopted for obtaining copper and silver from the burnt residue of copper pyrites, which had been used for yielding sulphur in the manufacture of sulphuric acid. This mode of working had now been superseded by a process devised and carried out by Mr. Henderson. After contrasting the quantities of soda and other chemicals manufactured respectively in the Lancashire and Newcastle districts in 1852 and 1869, showing the much greater proportionate increase in the former district, he closed his paper by observing that it might reasonably be concluded that Lancashire was now the largest seat of chemical manufactures in this country.

The President, by way of supplementing Mr. Gossage's remarks, said that in the ten years previous to 1861 the increase in the amount of salt decomposed was 300 per cent. The amount consumed in 1852 was 38,600 tons, and in 1861 it had risen to 135,000. Professor Roscoe proposed a vote of thanks to Mr. Gossage for his valuable paper, and said that he was the father of the alkali trade, and that he held a position second only to that of the illustrious Leblanc, the inventor of the early process of making soda. Mr. Spence seconded the proposal, and said that Mr. Gossage was almost the originator of the soda manufacture; he was certainly the originator of some of the most important processes in it.

On the Hydrogenation and Hydriodate of Cyanogen.—Mr. T. Fairley.

On the Distillation of Sulphuric Acid.—Mr. T. Fairley.

On the Time needed for the Completion of Chemical Change.—Dr. Hurter.

On Reciprocal Decomposition viewed with Reference to Time.—Dr. J. H. Gladstone, F.R.S.

On a Method for the Determination of the Amount of Sulphur in Coal Gas.—Mr. A. Vernon Harcourt, F.R.S.

On the Estimation of Sulphur in Coal Gas.—Mr. W. Marriott, F.C.S.

Notes on Thermal Equivalents—(1) *Fermentation.* (2) *Oxide of Chlorine.*—Mr. J. Dewar, F.R.S.E.

On the Discrimination of Fibres in Mixed Fabrics.—Mr. J. Spiller, F.C.S. The author refers to the fact that silk alone, of all the materials ordinarily used in the production of textile fabrics, is soluble in concentrated hydrochloric acid, so that this reagent may be resorted to for testing the purity of silk, and determining the proportion of this substance entering into the composition of a variety of mixed goods. For the purpose of identifying wool in the presence of cotton, flax, jute, &c., it is recommended to immerse the fabric or loosened fibres in a warm aqueous solution of picric acid, which dyes the wool of a bright yellow, without imparting any colour to cotton. Thus, by testing mixed fabrics successively with hydrochloric and picric acids, valuable indications are afforded regarding their constitution. The chemical properties of certain compounds formed in this manner from silk were described, and a photographic application pointed out which turns to account the extraordinary degree of sensitiveness to light exhibited by a modified form of argentic chloride produced by precipitation from such hydrochloric solutions.

The Chemical Section did not sit on Saturday, but a large party of the members, headed by Professor Roscoe, Mr. C. W. Siemen, F.R.S., and Mr. A. E. Fletcher, F.C.S., Alkali Act Inspector, spent the day in visiting various chemical works at St. Helens.

Section C.—Geology

Report on Hæmatite.—Professor Stokes.

On the Green Slates and Porphyries of the Lake District.—Professor Harkness and Dr. Nicholson. The authors pointed out that in the Lake Country there is most commonly the three-fold series of rocks, occurring between the Skiddaw slates, upon which the green slates and porphyries rest, and the Coniston limestone which succeeds them. This series consists of traps, which form the lowest member of the group, and which are very persistent; of ashes, trappian breccias, tuffs, and amygdaloids, which constitute the middle portion of the series, and of hornstone traps, which form the highest portion of the group. The middle and upper portion of the series are by no means so persistent in their mineral characters as the lower member. The upper member was shown to be absent from the series in the Long Sleddale Valley, its place being represented by ashes and trappian breccias, and the middle series, which is usually composed of slaty ashes, breccias, and traps, was shown to be greatly modified in type in the northern portions of the Lake Country. This middle member of the series is well seen in the country south of Keswick in Borrowdale, having its normal mineral character more abounding in ashy beds, here worked for slates. Eastwards from this the slaty ashes become less abundant, and in the districts north of Ulleswater these ashes were almost entirely absent. In the Vale of St. John, porphyry, with comparatively small felspar crystals, makes its appearance in connection with the ashy slates. North-east from the Vale of St. John this porphyry becomes more developed, and the ashes are less abundant. At Eycott Hill, near Troutbeck station, the lower porphyry also occurs very finely exhibited, and containing large crystals of felspar. Near the south-east of Carrickfel', a hill largely composed of syenite rocks is seen, having a highly crystalline character, and exhibiting all the features of Diorite. These rocks the authors regard as highly metamorphic conditions of the porphyry above referred to or resulting from the action of the syenite of Carrickfell. The Caldbeck fells, which form the northern limits of the Lake district, have on their northern side the representatives of the green slates and porphyries well developed. Here there is an entire absence of the ashy slates of the middle series, the place of these being occupied by a porphyry similar to that of Eycott Hill. This porphyry, however, in the neighbourhood of Roughtongill has been so far influenced by the syenite of Carrick, veins of which penetrate it, that it now assumes a crystalline form, and appears as hypersthene rock.

The average thickness of the green slates and porphyries, or their representatives, in the Lake Country, the authors think does not exceed 5,000 or 6,000 feet, a thickness made up of igneous products, which in the north of England represent the upper Llandeilo series, and a large portion of the Caradoc or Bala group.

The authors regard the terms green slates and porphyries as applied to these rocks in Cumberland and Westmoreland, as inappropriate, since they express merely local conditions, and they propose as a substitute the name Borrowdale series.

On the discovery of Upper Silurian Strata in Roxburgh and Dumfries.—Mr. C. Lapworth. South of the great axis of the lower Silurian rocks of southern Scotland, upper Silurians had been determined many years ago by Professor Harkness in the neighbourhood of Kirkcudbright. The author had further detected these beds in a very wide strip of country extending from near Lockerbie to near Hawick, a distance of forty miles, with a maximum width of eight or ten miles. Another large outlier had been detected extending from Ernton Hill to Oxnam near Jedburgh; and a further small outlier high up in the Cheviots at the head of Kale Water. The rocks in all these districts have the facies of the Kirkcudbright series, and the fossils are common to all of them. They consist of *Graptolithus colonus*, *Priodon*, *Flemingii* and *Nillsoni*, *Rhynconella nucula*, *Orthoceras tracheale*, fragments of *Pterygotus*, *Ceratiocaris* or *Dictyocaris*, &c.

On the Age of the Wealden.—Mr. E. W. Judd. The Wealden constitutes one great continuous formation with well-defined palæontological characters. As with the "Poikilitic" series, its beds can only be referred to the different members of our established marine classification by violent and arbitrary divisions. It must therefore stand as one of the terms of that new system of terrestrial classification which Prof. Huxley has shown must be founded. The epoch of the English Wealden commenced towards the close of the Oolitic period; it continued during the whole of the Tithonian (a great system of rocks lately discovered on the Continent), and ceased towards the end of the middle or beginning of the Upper Neocomian. The passage of the Upper Oolite into the Wealden, and that of the Wealden into the Upper Neocomian, was each of them gradual. Fresh water deposits were formed continuously, but not contemporaneously over the whole area of the Wealden, so that in the north-west we find only the lower beds represented, and in the south-east only the upper ones, while in the central portion we find the whole series complete. In the little marine band of Punfield, only twenty-one inches thick, we have the representative of a portion of the Middle Neocomian, a formation only elsewhere found in this country in the middle of the Speeton clay and in Lincolnshire. The fauna of the marine band of Punfield has very striking affinities with that of the coal-bearing strata of Eastern Spain (which are more than 1,600 feet thick), and especially with the middle portion of that series. The North German Wealden, which is quite unconnected with that of England, and is probably the product of another river, is not strictly contemporaneous with the latter, for while it appears to have commenced about the same period, its duration was considerably less, it having terminated the close of the Lower Neocomian.

On the Physical Geology of the Bone Caves of the Wye.—Rev. W. S. Symonds. The author had lately received from Sir J. Campbell fossil bones from Arthur's Cave, on the Great Doward, on the right bank of the Wye, among them the teeth of *Equus fossilis*, and a collection had been sent to Prof. Owen, and been determined by him to belong to the mammoth, rhinoceros, hyæna, reindeer, and the great fossil ox. The caves of the Wye were at a considerable height above the bed of the river. The author considered that the district had been submerged below the glacial seas, the clefts of the precipices and the mountain limestone platform being often covered with boulder clay and angular erratic stones.

On Geological Systems and Endemic Diseases.—Dr. Moffat. From continued observation during a long practice, the author has ascertained that in a carboniferous district goitre and anœmia were prevalent, while these diseases were markedly absent in the New Red Sandstone. This he attributed to the presence of iron in the one set of rocks, and its complete absence in the other.

Report of Sedimentary Deposits of River Onny.—Rev. De la Touche. The author gave an estimate of the rate of accumulation of these deposits from a series of observations.

Notes of a Recent Visit to the Great Tunnel through the Alps and of several points of Geological Interest suggested by the Conditions of the Works in the present nearly complete state.—Prof. Ansted. The operations of the tunnel involved a direct cut through a series of rocks on a line at a great depth below the surface. At the middle of the tunnel there is 5,400 feet of rock above it. Observations on physical phenomena have been made throughout the progress of the works. The temperatures at various distances and depths have been recorded. Borings 10 feet into the rock were made at intervals of 500 metres, and the temperature determined at their extremity. The last observation made in his presence was 20,342 feet from the south end of the tunnel, and 5,000 feet from the surface. The temperature shown was 80·5° F., exhibiting an increment of 1° F. to about 100 feet. Before the value of these observations could be ascertained, the mean annual surface temperature and the depth of the permanent temperature lines must be determined. On the 31st of last month (August) there remained 2,000 out of 40,000 feet of rock to pierce; as the operations progress at the rate of 500 feet per month, the tunnel may be expected to be completed by the end of the year.

On some Points in the Geology of Strath, Isle of Skye.—Profs. King and Rowney. The authors entered into a minute description of the rock structure of the district, from which he drew the following conclusions:—That the ophite of Skye is an altered rock of the Liassic period; that it possesses the same microscopic features as the ophites of earlier geological ages, occurring in Canada, Connemara, and elsewhere; and that igneous action, developing a granitic rock, and producing decided metamorphism in an adjacent deposit, has operated at a later geological period in Skye than in any other part of the British Islands. The authors further maintained that all the features of the so-called organism, *Eozoon canadense*, had been detected by him in the Skye ophites, and asserted that the different structures known as chamber casts, canal system, nummuline layer, &c., were chemical and structural changes, induced by metamorphic action.

SECTION D.—BIOLOGY

On a mode of Reproduction by Spontaneous Fission in the Hydroida.—Prof. Allman, F.R.S. The hydroid in which the phenomenon which formed the subject of this communication had been observed is a campanularian, which in the general form of its trophosome comes near to *Obelia dichotoma*. Since however no gonosome was present in any of the specimens collected, it was impossible to assign to it a systematic position otherwise than provisionally. The remarkable physiological act by which it is distinguished, associated as this is with an important morphological character, would seem to indicate a distinct generic rank, and the author accordingly suggests for it the provisional generic name of *Schizocladium*.

Besides the branchlets, which—as in the hydroids generally—support the hydranths (plypites), others are developed in abundance from all parts of the hydrocaulus. These commence just like the ordinary branchlets, as offshoots from the hydrocaulus, and consist as usual of a continuation of the cœnosarc, invested by a chitinous perisarc. Unlike the ordinary branchlets, however, they never carry a hydranth, but are destined for the multiplication of the colony, by a process of spontaneous fission.

After the entire branchlet has attained some length, the contained cœnosarc continues to elongate itself. In doing so it ruptures the delicate pellicle of chitine which closes the extremity of the branchlet, and extends itself quite naked into the surrounding water.

It is now that the process of fission commences. A constriction takes place in the cœnosarc at some distance below its free extremity, and in the part still covered by the chitinous perisarc. The constriction rapidly deepens, and ultimately cuts off a piece which slips entirely out of the perisarcal tube and becomes a free zooid, while the surface of disseveration soon heals over, and the axial cavity of the free frustule becomes here as completely closed as at the opposite end.

The detached fragment strikingly resembles a *planula* in all points except in the total absence of vibratile cilia. It attaches itself by a mucous excretion from its surface to the walls of the vessel, and exhibits slight and very sluggish changes of form.

The further history of the fission-frustule was traced, and the important and unexpected fact was shown that it never directly develops a hydranth. After a time a bud springs from its side, and it is from this bud alone that the first hydranth of the new colony is developed.

The bud which thus becomes developed into the primordial hydranth remains attached to the fission-frustule which forms for it a sort of hydrorhiza, but which would seem ultimately to perish and give place to true hydrorhizal filaments. In the meantime the primary bud emits others, and a complex branching colony is the result.

The author compared the fission-frustule to the free medusoid element of other hydroids with which it agreed in never becoming directly developed into a new trophosome, but from which it differed in the very important fact of taking no part in the true generation of the hydroid and in giving origin to a new colony only by a simple non-sexual multiplication.

Observations on Protandry and Protogyny in British Plants.—Alfred W. Bennett, F.L.S. The arrangement of the reproductive organs in hermaphrodite plants, the presence in the same flower of both pistil and stamens, suggested to the minds of the older botanists no other idea than that of fertilisation. It is, however, now generally admitted that, even in hermaphrodite flowers, cross-fertilisation is the rule, self-fertilisation the exception. Two sets of facts have been especially observed,—in particular by Darwin in this country, Hildebrand in Germany, and Delpino in Italy,—to favour cross fertilisation in hermaphrodite flowers; the phenomena of dimorphism and trimorphism, and the special arrangements which render it easier for the pollen to be brushed off by insects visiting the flower than to fall on its own stigma. But, besides these, another arrangement exists by which self-fertilisation is hindered, the simple fact that the stamens and pistil belonging to the same flower are frequently not ripe, so to speak, at the same time. The terms *Protandry* and *Protogyny* used by Hildebrand to express, in the one case the development of the stamens before the pistils, in the other case the development of the pistil before the stamens, are so convenient and expressive that they have been adopted in this paper; the term by which he expresses that the two organs are matured simultaneously, "Non-dichogamy," does not seem so happy, and the author proposes to substitute for it *Synacmy*—the phenomena of *Protandry* and *Protogyny* forming together that of *Heteracmy*.

The most frequent arrangement appears to be that the pollen commences to be discharged from the anthers at a longer or shorter interval before the maturing of the stigma. In some cases there still remains a certain quantity of pollen in the anthers when the stigma is ready to receive it; in other cases, the anthers have either withered up or entirely dropped off before fertilisation of the ovules can possibly take place. Synacmy, or the contemporaneous maturing of the reproductive organs, is nearly as frequent as protandry; while protogyny is a phenomenon of far less common occurrence. The two extremes among the species observed may be stated to be *Campanula rotundifolia* and *Scrophularia aquatica*. In some Natural Orders, as *Leguminosæ* and *Labiatæ*, all the species examined, with scarcely an exception, range themselves in one or other of the three classes; while in others, as *Rosaceæ*, they are distributed over all three, and in some instances, even closely allied species of the same genus differ in this respect, as, for instance, *Potentilla* and *Ranunculus*. Careful observations might even, the author thinks, in some cases, derive from this point a useful diagnosis of difficult species.

In those Natural Orders in which the flowers are furnished with two sets of stamens of different lengths, it is most usual for the longer ones to discharge their pollen at an earlier period than the shorter ones, and they probably have different functions to perform. This is commonly the case with *Cruciferæ*, *Carophylleæ*, *Geraniaceæ*, and *Onagrarieæ*, but not, apparently, with *Labiatæ* or *Scrophularineæ*. The same phenomenon is found in those orders where the numerous stamens are arranged in different whorls, as *Ranunculaceæ* and *Rosaceæ*. The author then gave an account of a number of observations on British wild plants.

SECTION E.—GEOGRAPHY

The Ruined Indian Cities of Central America.—Captain Carmichael. The author commenced by giving an account of the impression caused on first beholding these ruins, and showed how the question involuntarily suggested itself as to the originality of their architectural designs, and stated that a certain familiarity of trait and outline was invariably recognised; and that in his opinion, formed from personal investigation, the architecture of the Aboriginal Indians of Central America was but a diversified reproduction of that of Eastern countries. He then pointed out a number of similarities in their architecture, designs, customs, &c., to nations of the East; and showed how, as a general rule, it was very difficult to explore these ruins owing to the hostility of the existing tribes of Indians.

As regards their antiquity, he assigned to many of them an earlier foundation than that accorded to them by Stephens and Squier, and adduced some very convincing, if novel, proofs in support of his theory. The picture he drew of the palaces of Quiché in Guatemala fully bore out the statement of Torquemada that they rivalled those of Montezuma; and he showed that if that city—one of some eight hundred years' standing—was in such a perfect state of conservation some fifty years ago, that the padre of a neighbouring Indian village who then walked among its streets and palaces, imagined himself in Spain, what must be the era of those numerous cities compared with which Quiché was modern?

He then pointed out the great length of these ruined cities, and added that in connection with this a remarkable fact had seemingly been overlooked by most Central American writers, viz., that the stone buildings whose ruins we now find extant were used as temples, palaces, and public offices generally, the poorer inhabitants living in huts of a perishable nature; an arrangement which represented an almost incredible amount of population. He then analysed the various elements composing the architecture of the ruined buildings and monuments, and gave an interesting account of the various uses to which the teocali and tumuli were put by the Toltecan and Aztec priests, viz., for sacrificial and burial purposes, to serve as beacons, for warlike defences, &c.; and explained the relations between the temples and alcazars or palaces, and offered a few hints as to the deciphering of the hieroglyphics, a subject to which he has paid much attention, and for which he is specially qualified from his knowledge of the Maya or Indian language, showing that they were chiefly the works of the Indian priesthood; and, above all, were intended to inculcate moral and religious precepts, chronological events being made quite subservient to them. He then referred briefly to the round towers which contained the estufas for the sacred fire of Montezuma, in connection with the worship of the Sun, and passed on to explain the nature and significance of the various hideous and awe-inspiring idols to whom the human sacrifice was offered on the summit of the teocali, and stated it as his belief that these idols, as well as the planed stones, were carved with clay or flint instruments, as he had often found flint and obsidian implements, but in no instance an instrument of metal.

Referring to the state of decay in which they were mostly found, he stated that there were ruins which had never been visited by the Spaniards at the time of the conquest, and expressed it as his opinion that their crumbling and ruinous condition was mainly brought about by the earthquakes so prevalent throughout Central America, in conjunction of course with the action on them of time and the elements. He gave a most interesting account of a ruined city in British Honduras, called Xmul, which he claims to have discovered, and concluded by pointing out the great extent of unknown and untravelled districts in Central America, particularly in Guatemala, as presenting a fine field for future geographers and naturalists, and expressed it as his firm conviction that there existed at the present day an Indian city—yet to be discovered—whose inhabitants occupy the same splendid palaces and temples as in the days of the Spanish Conquest, whose priests inscribe fresh precepts on their tablets, and who would then read to us their now mystical hieroglyphics. He supported the statement by describing an exploration he made in the southern district of British Honduras westwards towards Guatemala, where, after several days' perilous river navigation and further journey on foot, he discovered in the neighbourhood of the Coxcomb Peak the remains of an abandoned maize plantation, and saw smoke ascending from the distant forest; and believes that the tribe of Indians who occupy this part of the country, which was before considered to be uninhabited, have some connection with the mysterious Aztec city he spoke of.

Mr. H. Howorth corroborated the date of the foundation of the city of Quiché, as verified by a Mr. Spencer, who had also read a hieroglyphic on the lintel of a doorway at Palenqué. Mr. Spencer had also discovered great similarity between the names of the signs of the zodiac and the arrangement of the calendar of the Aztecs and those in use in Thibet. Several members present took part in a discussion, to which Captain Carmichael replied, adding that he had recently returned from California, where he had heard a Japanese and a digger Indian of Nevada, then brought together for the first time, converse intelligibly.

Section G.—Mechanical Science

On the Sewage of Liverpool and Neighbourhood.—Mr. J. N. Shoolbred, C.E. In this paper the author said it was calculated that about 900,000*l.* had been expended in drainage and sewage works in the borough of Liverpool. Of this about 600,000*l.* might be set down as requisite for drainage (the primary object); 300,000*l.* would, therefore, represent the amount due to conveyance of water-closet sewage; and setting aside 20 per cent. upon this as interest, together with a large amount for depreciation and repairs, &c., there would be 60,000*l.*, or about 2*s.* 4*d.* per head, as the annual expense due to the removal of the water-closet sewage. Taking the length of sewerage over the whole of the borough of Liverpool, the probable average distance that the sewage has to travel from its entrance into the sewer till its discharge into the river Mersey is about one mile and a half, or perhaps even more, inasmuch as the inhabited portions of the town mainly lie back away from the river. Liverpool and its neighbourhood are favoured by nature with above the average amount of facilities; first, for the collection of its sewage by water carriage, and then in finding, at a comparatively short distance, an outlet in the river Mersey for the larger portion which it is deemed advisable to get rid of in this manner. Again, Liverpool is fortunate in having an outlet which, at least for the present, secures immunity to the town from the unpleasant consequences which sometimes arise from creating an acknowledged sewage nuisance; while, should the town itself at any time prefer to derive some benefit out of this refuse which it now throws away, Liverpool possesses, at no great distance, a most suitable and extensive site for utilising its sewage by irrigation upon the land, with at the same time a certain market in itself for the vegetable produce of that irrigation. The author then detailed the arrangements made in 1866 and since, or in progress, for the concession of the Liverpool sewage to companies whose object is to use it in irrigation upon sewage farms; and he also described the nature of the lands which are, or may be, used for sewage irrigation.

On Sewers in Running Sand.—Messrs. Reade and Goodison, Civil Engineers. This paper formed a very natural sequel to the preceding one, inasmuch as it dealt with the difficulties of constructing sewers in the sands between Liverpool and Southport, the district traversed by the Liverpool, Crosby, and Southport Railway, and the means which the authors had adopted in order to overcome those difficulties. The whole of the district referred to is one mass of sand, resting on a bed of moss and marl, varying from ten to twenty feet deep below the surface. It has no natural drainage, and in wet seasons in the lower portions or slacks, flushes of water form, in consequence of the elevation of the shore line of sand-hills. After enumerating the manifold difficulties which they had to encounter, the authors described at considerable length the appliances which they ultimately resolved upon using. The primary object which they wished to attain was to get a dry subsoil wherein to lay the pipes, that the cement joints might have time to set and become water-tight, and by securing more time for the laying of the pipes, laying a greater length at a time, and the prevention of disturbance or drawing of the pipes while preparing the next excavations, to ensure greater certainty and perfection in the gradients and junctions, and consequently improve the general system of pipe sewerage. From the experiments which they have made with the subsoil drains, they have thoroughly satisfied themselves as to their efficiency. The subsoil drains are in fact a foundation for the pipes of the sewer, and the sewer itself can be as readily constructed upon them as if the ground were perfectly dry. They have begun to use the subsoil drains in the sewerage works which they are carrying out at Birkdale, a length of 10,000 yards.

On the Ashpit System of Manchester.—Alderman Rumney. The authorities of Manchester have at all times objected to the general use of water-closets in cottage dwellings. In the first place, because they believed that in the limited space available in houses occupied by the working classes, they would prove a greater nuisance than the privy and ashpit outside; secondly, because of the loss of valuable manure which would be occasioned; and thirdly, because, looking at the rapid increase of population in the district, and the limited area of the watershed, the time would come when all the water available would be required for domestic and manufacturing purposes, and could not be wasted in water-closets. Adhering, then, to the dry in opposition to the wet system, the corporation has for some time been engaged in the attempt to improve the existing privies and ashpits, and to discover the best form to be adapted in all new property erected within the city. In the construction of ashpits, the object of the Health Committee appointed by the corporation was to prevent as far as possible the decomposition of the excreta, and consequent generation of gases passing off into the surrounding atmosphere; and as decomposition is accelerated by moisture, they determined that all ashpits should be made dry, excluding the rainfall by covering them over, and the drainage from the yard by requiring the floors and walls to be made water-tight; they required also that the ashes from the pit should be placed daily in the ashpit for the purpose of condensing as far as possible the ammoniacal and other gases, and preventing organic matter impregnating the air in the immediate vicinity. In addition to these arrangements, it was foreseen that in summer time, when decomposition is most vigorous, and the supply of neutralising ashes most scanty, a closed ashpit might become a greater nuisance than an open one, and a ventilating shaft or chimney was determined upon, to be carried from the top of the ashpit up to the side of, and a little above, the eaves of the house, for the purpose of carrying off all the gases and light vapours, and allowing them to mix with the surrounding atmosphere at an elevation which would not injuriously affect the inmates of the dwelling. In the Appendix to the Report of the Medical Officer of the Privy Council just printed, Dr. Buchanan and Mr. Radcliffe express themselves in high terms regarding the new system. Already upwards of 1,500 new privies and ashpits have been erected under the supervision of the committee; the occupants of the houses are perfectly satisfied, and are constantly expressing their approval.

When the reading of the papers was concluded, a long and animated discussion followed, the speakers being Professor A. Reynolds, Mr. Brierly (of Blackburn), Professor Ansted, Mr. Rawlinson, C.B., C.E., Mr. Glazebrook, Mr. Hawkesley, C.E., Professor A. W. Williamson, and Mr. Hope, V.C.

The first paper in this Section on Saturday gave rise to a very unpleasant occurrence, in which the President, according to general report, adoped a rather unusual proceeding. His treatment of the author was somewhat unceremonious. The paper was entitled

On a new Heat Engine.—Mr. A. W. Bickerton, F.C.S., Associate of the Royal School of Mines. After the author had well-nigh done reading his paper, the President quite unexpectedly stopped him, and told him that he had been talking absolute nonsense. If he (the President) had seen his paper first, he would not have permitted it to be read, as there was no time to discuss a thing which was radically fallacious. The idea of an engine worked by the expansion of nitrogen under the influence of heat was fallacious in principle and practically impossible. A gentleman in the body of the room said he had listened to the paper with great interest, and regretted that it had not been allowed to be concluded. This remark was received with applause by the audience, and still greater applause followed when the author said, in retiring, that time would show whether the President or the principle was right. It seems clear that, having been accepted by the Committee of the Section, and the title of it placed upon the programme of business, the paper was entitled to be read. We are glad to lay a short abstract of the "burked" paper before our readers, expressing no opinion, further than that opinion should not be stifled.

The principle of the engine is as follows:—Crude nitrogen gas is heated in a serpentine system of tubes until the pressure is double that of the air. It is then admitted into a cylinder in which it presses forward a piston, and is allowed to expand. Next it passes into an apparatus where it is cooled, and consequently diminished to half its bulk. The cooling is effected in a new arrangement, which is so constructed that the whole of the heat above that of the external air is transferred to an equivalent volume of air passing in an opposite direction. This heated air is then used as a blast for the fire, $\frac{1}{10}$ going to the hearth of the furnace through a tuyere, and $\frac{4}{10}$ mixing with the products of combustion immediately above the fire, so as to complete any imperfect combustion, and also to modify the temperature of the whole mass, so that it may not be likely to injure the iron of the gas tubes, and the remaining $\frac{5}{10}$ being introduced into the system at a point further on. The construction of the system of tubes is such that, by the time the products of combustion reach the open air, they shall have parted with nearly all their heat, and transferred it to the nitrogen contained in the tubes, and hence a chimney draught cannot be used, and the blast has to be produced by a blowing engine. The nitrogen, after having been cooled to half the volume it occupied in the first cylinder, is then compressed and forced into the system of tubes at the point furthest from the fire. It is this forcing the gas back again into the system of heating tubes that appears absurd; but it must be remembered that the gas while leaving the heating tubes occupies twice the space it does when being forced back, hence it fills a cylinder of twice the area, and the force that may now be disposed of is equal to half the pressure exerted in the larger cylinder. But the other half of the power is not lost, it is simply conveyed back to the heating tube, and is used again. The only losses that can arise are those which are incidental to all engines, such as radiation, conduction, &c., inasmuch as there is avoided the enormous loss of heat that usually goes up the chimney, together with the still greater loss that is constantly being carried away by the condensed water,—an amount in itself six times as great as that converted into work in the steam-engine. The inventor considers that he does not expect too much if he expects his new heat engine to convert 60 per cent. of the heat of combustion into work, a duty that is fully 500 per cent. above that of well-constructed steam-engines.

Of course, as the author was not permitted to finish the reading of his paper, no discussion was taken upon it.

REPORTS OF COMMITTEES

THIRD REPORT OF UNDERGROUND TEMPERATURE COMMITTEE

Mr. G. J. Symons, whose observations, extending to a depth of 1,100 feet in a well at Kentish Town, were reported at last meeting, has since repeated his observations at several depths.

The first 210 feet of the well (which is eight feet in diameter to the depth of 540 feet) are occupied by air, and in this portion of the well the second series of observations give temperatures exceeding those observed in the first series by from 2° to 5°, the excess diminishing as the depth increases. The second series were taken in July and August, whereas the first series were taken in January. It is evident that, in this portion of the well, in spite of the precautions taken to exclude atmospheric influences, by boarding over the well and erecting a hut over it, the temperature varies with the seasons, the variations being in the same direction as in the external air, but smaller, and diminishing as the depth increases, but still amounting to 2°·2 at the depth of 200 feet.

We can feel no certainty that even the mean annual temperature in this portion of the well represents the temperature in the solid ground. On the contrary, the mean temperature in the well at any depth is probably intermediate between the temperature of the solid ground at that depth and the mean temperature of the external air.

It is well that such observations should have been carefully made and recorded in this one instance, if only for the sake of warning; and they show that we cannot expect to attain the object for which the committee has been appointed by observations in large shafts filled with air.

Mr. Symons has also repeated the observations at 250 feet (which is 40 feet under water), and at the depths of 600 feet, 750 feet, and every fiftieth foot from this to 1,100 feet, which is the lowest point attainable on account of the mud, which extends 300 feet lower. The differences from the results obtained last year are + ·2, − ·3, − ·4, − ·2, − ·2, 0, − ·1, − ·1, 0; which, upon the whole, strongly confirm the correctness of the observations.

The temperature at 1,100 feet is 69 8, which, if we assume the mean temperature of the surface of the ground to be $\left\{\begin{matrix}50^\circ\\49^\circ\end{matrix}\right\}$, gives a mean increase downwards of $\left\{\begin{matrix}\cdot0180\\\cdot0189\end{matrix}\right\}$ of a degree Fahrenheit per foot, or 1° for $\left\{\begin{matrix}55\cdot5\\52\cdot9\end{matrix}\right\}$ feet.

The curve in which temperature is the ordinate and depth the abscissa, exhibits considerable irregularities till we reach the depth of 650 feet, beyond which it is nearly a straight line, and represents an increase of ·0187 of a degree per foot.

The strata penetrated by the well to the depth to which our observations extend, consist of clay, sand, chalk, and marl, besides flints. (See tabular list appended.)

Mr. Symons, in his report, calls attention to the anomalous position of a column of water, increasing in temperature and, consequently, diminishing in specific gravity downwards, and suggests the inquiry why the warmer and lighter portions do not ascend to the top. The proper reply seems to be that the diminution of specific gravity, amounting to less than one part in 50,000 per vertical foot, does not furnish sufficient force to overcome liquid adhesion, and the water is thus able to remain in unstable equilibrium.

Mr. Symons intends during the remainder of the present year, verifying those of his observations which have not yet been repeated, and concludes his report by remarking that it appears desirable to ascertain by observations from year to year, whether the temperature at a given depth (say 1,000 feet) remains constant or is subject to minute changes, periodical or otherwise—a suggestion which appears fully worthy of being carried out.

Mr. Wm. Bryham, manager of Rosebridge Colliery, Ince, near Wigan, has taken very valuable observations during the sinking of that colliery, which is now the deepest excavation in Great Britain. The principal results have already been given in a paper to the Royal Society by Mr. Edward Hull, director of the Geological Survey of Ireland, who had previously published some important contributions to our knowledge of underground temperature, and has now consented to become a member of this committee. Some of the depths have however been remeasured since Mr. Hull's paper was read, and we are now enabled, through the kindness of Mr. Bryham, to furnish a rather more accurate report.

The temperatures observed, and the depths at which they were taken, are as follows:—

Depth in Yards.	Temperature Fahrenheit.
161	(64½)
200	(66)
558	78
605	80
630	83
663	85
671	86
679	87
734	88½
745	89
761	90½
775	91½
783	92
800	93
806	93½
815	94

All these temperatures, except the two first, were observed during the sinking of the shaft, by drilling a hole with water, to the depth of a yard, in the solid strata at the bottom. A thermometer was then inserted, the hole was tightly plugged with clay so as to be air-tight, and was left undisturbed for half an hour, at the end of which time the thermometer was withdrawn and read—a mode of observation which appears well adapted to give reliable results. With respect to the temperatures at 161 and 200 yards (which are enclosed in brackets to indicate uncertainty), Mr. Bryham says that he has some doubt as to the correctness of the thermometer with which they were taken, and that they were not taken in the shaft at the time it was sunk, but in the seams at the depths named.

Asuming the surface temperature to be 49°, we have, on the whole depth of 815 yards, or 2,445 feet, an increase of 45°, which is at the rate of ·0184 of a degree per foot, or a degree for every 54·3 feet.

On plotting the temperature curve, including the two observations marked as doubtful, we find that it naturally divides itself into four portions, which are approximately straight lines.

The most remarkable of these portions is the second from the top, extending from the depth of 161 yards to that of 605 yards. It embraces 1,332 feet, and shows an increase of only 1° for every 86 feet.

The third portion, extending from the depth of 605 yards to that of 671 yards, covers only 198 feet, and shows an increase of 1° for every 33 feet.

The lowest portion extends from the depth of 671 yards to 815 yards. It covers 432 feet, and shows an increase of 1° in 54 feet.

The topmost portion will be affected by the assumption we make as to surface temperature. Assuming this as 49°, it shows an increase of 1° in 31 feet.

It is interesting to compare the Rosebridge observations with those previously made by Mr. Fairbairn at Astley Pit, Dukinfield, Cheshire, which have been described by Mr. Hull in "The Coalfields of Great Britain," and by Mr. Fairbairn himself in the B. A. Report for 1861. The results have been thus summed up by Mr. Hull:—

1. The first observation gives 51° as the invariable temperature throughout the year at the depth of 17 feet. Between 231 yards and 270 yards the temperature was nearly uniform at 58·0. And the increase from the surface would be at the rate of 1° F. for 88 feet.

2. Between 270 and 309 yards, the increase was at the rate of 1° for 62·4 feet.

3. Between 309 and 419 yards, the increase was at the rate of 1° for 60 feet.

4. Between 419 and 613 yards, the increase was at the rate of 1° for 86·91 feet.

5. Between 613 and 685 yards, the increase was at the rate of 1° for 65·6 feet.

The result of the whole series of observations gives an increase of 1° for every 83·2 feet.

Mr. Fairbairn's own summary is as follows:—"The amount of increase indicated in these experiments is from 51° to 57¾°, as the depth increases from 5⅔ yards to 231 yards, or an increase of 1° in 99 feet. But if we take the results which are more reliable, namely, those between the depths of 231 and 685 yards, we have an increase of temperature from 57¾° to 75½°, or 17¾° Fahrenheit. That is a mean increase of 1° in 76·8 feet."

Mr. Fairbairn here, by implication, throws doubt on the alleged invariable temperature of 51° at the depth of 17 feet, a determination which in itself appears highly improbable, seeing that at Greenwich the thermometer, whose bulb is buried at a depth of 25·6 feet, exhibits an annual range of 3°·2, while that at the depth of 12·8 feet exhibits a range of 9°. But even if we assume the mean surface temperature to be 49°, we have still upon the whole depth an increase at the rate of 1° in 80 feet, as against 1° in 54·3 feet at Rosebridge.

Mr. Fairbairn's paper gives also the results obtained at a second pit at Dukinfield, which agree with those in the first in showing an exceptionally slow rate of increase downwards. The temperatures at the depths of 167½ yards and 467 yards were respectively 58° and 66½°, showing a difference of 8½° in 299½ yards, which is at the rate of 1° in 106 feet. The increase from the surface down to 167½ yards, assuming the surface temperature as 49°, would be 9°, or 1° in 56 feet, and the mean rate of increase from the surface to the bottom would be 1° in 80 feet, the same as in the first pit.

A tabular list of the strata at Rosebridge is appended to this report. A full account of the strata at Dukinfield is given in Mr. Fairbairn's paper (B.A. Report, 1861).

With strata so nearly similar and in two neighbouring counties, we should scarcely have expected so much difference in the mean rates of increase downwards. In this respect, Rosebridge agrees well with the average of results obtained elsewhere. Dukinfield far surpasses all other deep mines or wells, so far as our present records extend, in slowness of increase.

This implies one of two things, either that the strata of Dukinfield afford unusual facilities for the transmission of heat, or that the isothermal surfaces at still greater depths dip down in the vicinity of Dukinfield.

Mr. Hull has called attention to a circumstance which favours the first of these explanations, the steepness of inclination of the Dukinfield strata. He argues, with much appearance of probability, that beds of very various character (sandstones, shales, clays, and coal), alternating with each other, must offer more resistance to the transmission of heat across than parallel to their planes of bedding, as Mr. Hopkins has shown that every sudden change of material is equivalent to an increase of resistance; and it is obvious that highly inclined strata furnish a path by which heat can travel obliquely upwards without being interrupted by these breaches of continuity.

To this suggestion of Mr. Hull's it may be added that inclined strata furnish great facilities for the convection of heat by the flow of water along the planes of junction. It appears likely that surface water, by soaking downwards in this direction, may exercise an important influence in assimilating the temperature at great depths to that which prevails near the surface. Mr. Hull's own statement of his views is given in the foot-note below.*

Mr. McFarlane has been prevented from continuing his observations near Glasgow during the past year by the press of business incident to the removal from the old to the new college.

Mr. F. Amery, Druid House, Ashburton, Devon, has taken some observations with one of the Committee's thermometers in the shaft of a mine which had been unused for a year, and was nearly full of water. The shaft is 12ft. × 7ft., and descends vertically for 350ft., after which it slopes to the south at an angle of 50°, continuing to the depth of 620ft. The water stood at 50ft. from the surface. Mr. Amery observed the temperature at every 50th foot of depth in the vertical portion, and found it to be 53° at all depths, except at 250ft. and 200ft., where it was 53·4 and 53·2 respectively. A copper lode crosses the shaft at the depth of 250ft.; and it appears to be generally the case in the Cornwall and Devonshire mines, that copper lodes exhibit a high temperature, a circumstance which Prof. Phillips explains by the conformation of the strata, which is such as to cause water from greater depths to make its way obliquely upwards by following the course of the copper lodes.

The nearly constant temperature observed from the surface to the bottom of the shaft seems to indicate a large amount of convective circulation. In this respect small bores have a decided advantage.

Mr. G. A. Lebour has taken observations with one of our thermometers in several shafts and bores near Ridsdale, Northumberland, made for working coal and ironstone. Mr. Lebour does not report the temperatures observed, which he characterises as discrepant and utterly valueless, owing, he believes, to the numerous water-bearing beds which they cut through, and the very varying temperature of these waters. Having now, however, found a dry bore, he hopes to make a useful series of observations next winter.

* "Rosebridge Colliery occupies a position in the centre of a gently-sloping trough, where the beds are nearly horizontal; they are terminated both on the west and east by large parallel faults, which throw up the strata on either side. The colliery is placed in what is known as 'the deep belt.'

"Dukinfield Colliery, on the other hand, is planted upon strata which are highly inclined. The beds of sandstone, shale, and coal rise and crop out to the eastward at angles varying from 30° to 35°. Now, I think we may assume that strata consisting of sandstones, shales, clays, and coal alternating with each other, are capable of conducting heat more rapidly along the planes of bedding than across them, different kinds of rock having, as Mr. Hopkins's experiments show, different conducting powers. If this be so, we have an evident reason for the dissimilar results in the case before us. Assuming a constant supply of heat from the interior of the earth, it could only escape, in the case of Rosebridge, across the planes of bedding, meeting in its progress upwards the resistance offered by strata of, in each case, varying conducting powers. On the other hand, in the case of Dukinfield, the internal heat could travel along the steeply-inclined strata themselves, and ultimately escape along the outcrop of the beds.

"I merely offer this as a suggestion explanatory of the results before us, and may be allowed to add that the strata at Monkwearmouth Colliery, the thermometrical observations at which correspond so closely with those obtained at Rosebridge, are also in a position not much removed from the horizontal, which is some evidence in corroboration of the views here offered."—*Proc. Roy. Soc.*, Jan. 27, 1870.

One of the Committee's thermometers has recently been sent to Mr. John Donaldson, C.E., Calcutta, who has expressed his desire to aid in scientific observation, and being now engaged in examining for coal and iron under Government, is likely to render us effective service.

Shortly after the last meeting of the Association, the secretary of this committee addressed a letter to Prof. Henry, secretary of the Smithsonian Institution, U.S., requesting his co-operation in furthering the object which the committee have in view, at the same time forwarding one of our protected thermometers.

In June of the present year an answer was received from Prof. Baird, assistant secretary in charge, to the effect that Prof. Henry's ill-health during the present season had prevented his communicating to us the results of his labours in response to request.

The letter addressed to Prof. Henry made special reference to an artesian well of extraordinary depth which was understood to be in course of sinking at St. Louis, and at the same time a letter was addressed, and a special thermometer sent, to Mr. C. W. Atkeson, the superintendent of the work of boring at St. Louis. No reply has been received from Mr. Atkeson, who appears to have left St. Louis before the letter arrived; but letters have been received through the Smithsonian Institution from Dr. Chas. W. Stevens, superintendent of the County Insane Asylum at St. Louis, this being the institution for whose uses the well was sunk, together with a very interesting newspaper cutting, consisting of Mr. Atkeson's report on the works. The boring of the well was commenced (at the bottom of a dug well 71½ feet deep) on the 31st of March, 1866, and was continued till the 9th of August, 1869, when the work was stopped at the enormous depth of 3,843½ feet, exceeding by more than one-half the depth of Dukinfield Collery. The strata penetrated consisted in the aggregate of 63 feet of clay, 6 feet of coal, 380 feet of shales, 2,725 feet of limestone, and 620 feet of sandstone.

A cast-iron tube of 11½ inches bore was first put down, reaching from the top and secured in the limestone at the bottom. This tube was then lined inside with a wooden tube, reducing the bore to 4½ inches. A 4½-inch drill was put down through this tube on the above-mentioned date. The bore was afterwards enlarged to 6 inches, and subsequently to 11½ inches to a depth of 131½ feet. A sheet-iron tube was then put down, extending from the top to this depth, and the bore below was enlarged, first to 6 and afterwards to 10 inches diamenter, to the depth of 953 feet. A sheet-iron tube, 79 feet long, was then put down, which rests on the offset at the bottom of the 10-inch bore. The 4½-inch bore was then enlarged to 6 inches to the depth of 1,022 feet, and a wrought-iron tube of 5 inches bore, weighing more than six tons, was introduced, reaching from the top and resting on the offset at the bottom of the 6-inch bore, thus securing the work to this depth, and reducing the bore to convenient size to work in. The 4½-inch bore has been continued to the depth of 3,843 feet 6 inches without further tubing.

At the depth of 3,029 feet the first observation of temperature was taken, and the reading of the thermometer was 107° F. This first observation is stated by Dr. Stevens to be specially worthy of confidence, as having been confirmed by several repetitions, or rather, to use Dr. Stevens's own words, "this was the maximum of several trials." It was taken, as well as those that followed it, by means of a registering thermometer (kind not mentioned); but in answer to our inquiries, Dr. Stevens states, upon the authority of the carpenter who attached the thermometer to the pole by which it was lowered, "that no means were taken to defend the bulb from pressure." In the absence of further information (and Mr. Atkeson himself has not yet spoken), we can place no reliance upon the temperature recorded, as the thermometer had to bear a pressure of ⅝ of a mile of water.

The temperatures registered at lower depths, the deepest being 800 feet lower, were all, strange to say, somewhat lower than this, a circumstance which is all the more remarkable because the pressure (which tends to make the reading higher) must have increased with the depth. At the bottom, or rather at 3,837 feet, being 6½ feet from the bottom, the temperature indicated was 105°. Either of these results, taken apart from the other and compared with the surface temperature, would give a result not improbable in itself. The mean temperature of the air at St. Louis appears to be about 53°, but it seems desirable to avoid publishing calculations till the data are better established.

Unfortunately, the apparatus which was employed in boring has all been removed, after the insertion of two wooden plugs, with an iron screw at the upper end of each, one at the offset at a depth of 1,022 feet, and the other at the offset at the depth of 953 feet, for the purpose of separating the fresh from the salt waters. These plugs were driven in with great force, and can only be withdrawn with the aid of a series of poles and other appliances, such as were used in the boring, which will be rather costly. The poles alone are estimated to cost 1,152 dols., or about 200*l.* If the plugs were withdrawn—and, according to Dr. Stevens, there is nothing but the expense to prevent—the whole well would be available for observation. The committee will make every effort to prevent so rare an opportunity from being lost.

The Secretary has also been in correspondence with Messrs. Mather and Platt, of Salford Iron Works, respecting a boring at Moscow, for which they have furnished machinery, and which is to be carried to the depth of 3,000 feet. They refer to General Helmerson, of the Mining College, St. Petersburg, as the best authority to whom application can be made for particulars of the Moscow boring as to temperature, &c. The secretary has accordingly written to General Helmerson, endeavouring to interest him in the objects of the committee, and offering to for ward thermometers. No reply has yet been received.

An element which it is necessary to know, with a view to the correct reduction of our observations, but which in many instances it is difficult to obtain by direct observation, is the mean annual temperature of the ground, at or near the surface. Instances frequently occur in which the temperature at the depth of 200, 300, or it may be 500 feet is accurately known, while the temperature in the superincumbent strata can only be guessed at. This is the case at the Kentish Town well, and partially at Rosebridge and Dukinfield collieries.

It is very desirable that in connection with temperatures at great depths there should in each locality be an accurate observation at the depth of from 50 to 100 feet. At such depths in the solid ground before it has been disturbed by mining operations, one observation suffices to give a good approximation to the mean temperature of many years. At depths of two or three feet it is necessary to observe, once a week, or so, throughout a year, in order to get the mean temperature at that depth for that year; and this may differ by a considerable amount from the mean of a series of years.

In the Report of the Scottish Meteorological Society for the quarter ending December 1862, there is a comparison of the mean temperature of the air with that of the soil at the depths of 3, 12, and 22 inches, at four stations, from observations extending over five years; and in the Journal of the same society for the quarter ending December 1865, there is a comparison of the temperature of drained and undrained land from one year's observations, undertaken for this purpose at two stations, and including also a comparison with the temperature of the year. The mean temperature of the air for each day is, in these comparisons, assumed to be the simple arithmetical mean of the maximum and minimum, as indicated by self-registering thermometers 4 feet from the ground. From these observations, it appears that the mean annual temperature of the soil was in every case rather above that of the air, and that the excess was greater for sand than for undrained clay, and was greater for drained land than for the same land undrained.

The greatest excess occurred in the case of the 22-inch thermometer at Nookten (Vale of Leven), where both surface and subsoil are sandy and dry. The five yearly means at this station were:—

Air 46·1; soil at 3 inches 46·3, at 12 inches 47·3, at 22 inches 48·0; giving an excess of 1·9 for the temperature at the depth of 22 inches as compared with air.

The smallest excess, in the case of the 22-inch thermometers, observed for five years, was at Linton (East Lothian) where it amounted to 0·7; but the observations on the effect of drainage gave for the year of observation an excess of only 0·2 at the depth of 30 inches in light sandy but undrained soil under a rye-grass crop, at Otter House near Loch Fyne, the corresponding excess for drained land of the same kind and in the immediate vicinity being 0·9.

The mean temperature at the depth of 3 feet at Professor Forbes' three stations at Edinburgh, from five years' observations, gave an excess of 0·55 above the mean temperature of the air at Edinburgh as determined by Mr. Adie's observations.

Observations on soil temperature in England are much needed, but the Greenwich observations give an excess of soil above air temperature falling within the limits above quoted, the excess at 3 French feet being 1·7, while at 24 French feet it is reduced to 1°. The soil of which the Observatory Hill is composed, and in which the thermometers are sunk, is dry gravel, and the unusual circumstance of decrease of temperature downward observed in the comparison of the 3 feet and 24 feet thermometers, seems to indicate that the surface of the hill is warmer than the surrounding land.

In the present state of our knowledge, then, it appears that when the temperature of the earth has been observed at a depth of some hundreds of feet in any locality in Great Britain, and has not been accurately determined at a less depth, some knowledge of the rate of increase downwards may be obtained, by assuming provisionally that the mean temperature of the surface is about a degree higher than the mean temperature of the air, supposing the latter to be known.

It is to be wished that the Meteorological Society would, from the ample materials in their possession, publish a map of annual isothermals for Great Britain; and the objects of this committee would be greatly furthered by an extensive series of soil temperature observations at the depth of about 3 feet.

The committee are anxious to carry into effect Mr. Hull's proposal (quoted in their last Report) to bore down from the bottom of a deep mine; and as Rosebridge Colliery appears to be an eminently suitable locality for such an operation, the Secretary has consulted Mr. Bryham respecting its practicability and probable cost. Mr. Bryham's reply is that there would be no difficulty in carrying out the proposal at Rosebridge, that to make preparations and bore 300 feet would, on a rough estimate, cost £150, and that the second 300 feet would probably cost about the same sum.

The committee would earnestly appeal to the liberality of the Association to enable them to put this design in execution, and they would remark that the sooner it is carried out, the more valuable the results obtained will be, as the mine has been but recently opened to its present depth, and the influence of atmospheric temperature will every year become more sensible in the strata below.

SCIENTIFIC SERIALS

In the *Annalen der Chemie und Pharmacie* for May 1870, we find several important papers, of which the following are abstracts:—"Investigations on some derivatives of cinnamic acid, by Carl Glaser." In this lengthy and most interesting paper is described the Phenylpropiolic acid $C_9H_6O_2$, a new acid which differs from cinnamic acid by containing H_2 less. It is obtained either by the action of sodium and CO_2 on β bromstyrol, or by the action of alcoholic potash on a bromcinnamic acid. On heating with water to 120°, it splits up into CO_2 and acetenylbenzol $C_2H\ C_6H_5$, which latter can also be obtained by the abstraction of 2 HBr from dibromstyrol. Silver, copper, and sodium derivatives of this remarkable hydrocarbon are described, from the latter of which, by the action of CO_2, the author succeeded in regenerating phenylpropiolic acid. The paper concludes with an account of some Cl and Br derivatives of styrol.—"On mercuryditolyl," by E. Dreher and R. Otto. A white crystalline compound obtained by the action of Na_2Hg on bromtoluol. The authors did not succeed in preparing the corresponding mercury compound from the isomeric brombenzyl.—Note on the behaviour of dibenzyl at high temperatures, by the same authors. This compound is split up according to the equation

$$2 \left\{ \begin{matrix} CH_2C_6H_5 \\ CH_2C_6H_5 \end{matrix} \right. = 2\ C_6H_5CH_3 + \underset{\text{Toluylen}}{\left\{ \begin{matrix} CH\,C_6H_5 \\ CH\,C_6H_5 \end{matrix} \right.}$$

"Note on the conversion of Thiophenol (Phenylic sulphydrate) into Phenylic disulphide," by the same authors. This is effected by distilling the mercury compound of the former, when it splits up into mercury and the bisulphide, which is probably due to the decomposition taking place at a temperature at which the affinity of Hg for S does not yet come into play, since the homologous toluol and benzyl compounds, which require a much higher temperature, give mercuric sulphide and a monosulphide.—"On two isomeric pentachlorbenzols and bichlorbenzols-chloride," by R. Otto. A short description of the mode of preparation and properties of the above compounds. The existence of two pentachlorbenzols, which now seems to be placed beyond all doubt, is of great interest, as it is one of the very few facts irreconcileable with Kékulé's benzol theory, which does not admit of the existence of more than one.—"On sulphotoluid," by R. Otto and Gruber. Obtained by the action of sulphuric anhydride on toluol.—"On aceto-mercury monomethyl and aceto-mercury monethyl," by R. Otto. These two compounds are prepared by the action of acetic acid on mercuric methide and ethide respectively.

$$\left. \begin{matrix} CH_3 \\ CH_3 \end{matrix} \right\} Hg + \left\{ \begin{matrix} CH_3 \\ CO\,OH \end{matrix} \right. = \left. \begin{matrix} CH_3 \\ C_2H_3O_2 \end{matrix} \right\} Hg + CH_4$$

—"On the preparation of organic sulphur compounds by means of sodic hyposulphite," by the same author. Alcohol heated with a concentrated solution gives mercaptan; ethylic iodide mercaptan and ethylic sulphide; chlorbenzyl gives benzylic mercaptan and sulphide.—"On diamidonitro phenylic acid, a new derivative of picric acid," by Peter Griess. This acid is prepared by the reduction of picric acid with ammonic sulphide.—"On azobenzol sulphuric acid," by P. Griess. A product of the action of hot fuming sulphuric acid on azobenzol. By fusion with potash, phenoldiazobenzol $C_{12}H_{10}N_2O$ is obtained, which on treatment with ammonic sulphide, is converted into oxybenzidin $C_{12}H_{12}N_2O$.—"On ozone and antozone," by C. Engler and O. Nasse. In this lengthy paper are described a long series of experiments, all of which seem to prove conclusively the non-existence of the third modification of oxygen, called by Schönbein and others antozone, and which the authors prove to be hydric peroxide formed by the oxidation of water, which was present in all those cases where the so-called antozone has been observed by ozone.—"On the constitution of arbutin," by Hugo Schiff. The author considers arbutin to be derived from one atom glycose + one atom hydroquinone − H_2O, and describes a number of acetyl and benzoyl derivatives in support of his views.—"On the action of hypochlorous acid on allylic chloride," by H. v Geyerfell. The author has obtained the compound $C_3H_6OCl_2$ by direct addition of the elements of hypochlorous acid to allylic chloride. This on reduction with sodium amalgam yields a liquid, probably allylic alcohol. (?)—"On a new method for the estimation of grape sugar," by Karl Knapp. This method is based on the fact that an alkaline solution of mercuric cyanide is entirely reduced to metallic mercury by grape sugar. By direct experiment it was found that on boiling, 400 mgr. $Hg(CN)_2$ are reduced by 100 mgr. sugar. The solution is prepared by dissolving 10 grm. pure dry $Hg(CN)_2$ in water, adding 100 cc. of a sodic hydrate solution of 1·145 sp. gr., and diluting to 1,000 cc. Pure grape sugar is prepared by recrystallising the commercial dried at 100°, from absolute alcohol. The experiment is performed by heating 40 cc. of the mercury solution—this amount corresponds to 100 mgr. sugar—to boiling in a porcelain dish, and then adding sugar solution to complete precipitation of the mercury, the end of the reaction being ascertained by placing a drop of the liquid on to a piece of the finest Swedish filter paper, covering a small beaker containing some very strong ammonic sulphide; a brown spot is observed so long as mercury remains in solution. The advantages of this method over Fehling's are, that being equally accurate, the test solution is exceedingly easy to prepare and perfectly stable, a shorter time is required for the estimation, and that the foreign bodies which mask the pure colour of the cuprous oxide are without influence on the reduction of the mercuric cyanide.—"On some isopropyl compounds," by R. D. Silva. In this notice are described isopropylic succinate, benzoate, nitrite, and nitrate, all prepared by the action of isopropylic iodide on the respective silver salts of the acids.

The *Journal of Botany, British and Foreign*, for September contains a paper by Dr. H. Trimen on Early Icelandic Botany, including an account of Rotböll's observations on the new or little-known but rare plants found in Iceland and Greenland, which appears to have been overlooked by Professor Babington in his "Revision of the Flora of Iceland." It was published in 1770, and adds a few species to the number stated by Professor Babington to be indigenous to Iceland. We have also one of Mr. J. G. Baker's careful and useful contributions to British systematic botany, an account of the British dactyloid saxifrages, which he states to form a complete series of varieties from *S. cæspitosa* to *S. hypnoides*, without any clearly marked gap at any point between the extremes; and the line of progression substantially straight, very little if at all complicated, as in the case of *Rubus*, by cross-relationships. The order of sequence is as follows: 1. *S. cæspitosa*, 2. *S. Sternbergii*, 3. *S. decipiens*,

4. *S. quinquefida*, 5. *S. hypnoides*. A table of their geographical distribution is subjoined. Two or three other short original articles and notes are also included, and the official report for 1869 of the botanical department of the British Museum.

THE *Geological Magazine* for October (No. 76) commences with a long paper, illustrated with two plates, by Mr. D. Mackintosh, on the surface-geology of the Lake district, relating chiefly to the effects of glacial conditions observable among the mountains of Cumberland and Westmoreland.—Mr. T. Davidson contributes a third series of descriptions of Italian tertiary brachiopoda, including numerous species of the genera *Rhynchonella* and *Crania*, which are figured on the accompanying plate.—In a paper on the chalk of Kent, Mr. G. Dowker, following Mr. Whitaker, distinguishes the Margate chalk as constituting the highest section of the chalk observable in that district, and gives a list of the fossils which it contains. The author proposes a division of the Kentish chalk into six sections.—A fourth and last paper is by Mr. H. B. Medlicott, on the mode of occurrence of faults in strata. The remainder of the number is, as usual, occupied by reports, reviews, &c.

SOCIETIES AND ACADEMIES

NORWICH

Norfolk and Norwich Naturalists' Society, Aug. 30.—Mr. Stevenson read a valuable paper communicated by Prof. Newton, of Cambridge, on the method adopted by his brother and himself for registering Natural History phenomena. The Register, a volume of which was on the table, was kept at Elveden, near Thetford, during a period of ten years, and its great value consists in the variety and completeness of the information with regard to each species of bird found in that neighbourhood, and the slight amount of labour required to keep up the daily record. This is effected by the use of signs extremely simple in their construction, but conveying an amount of information never before dreamed of in registers of this description: a life history from day to day of each species is given; all the rare and occasional visitors recorded, and the most striking botanical phenomena are all noted fully and explicitly, but in such a way as to occupy barely five minutes in doing. What a boon this decrease in labour alone is to the conscientious recorder, he who has had to post up his register after a hard day's work in the field will be in a position fully to appreciate. Some of the results obtained from the study of the register are highly valuable, as, for instance, the migratory habits of the song thrush, and we strongly recommend the paper, which will be published in the Transactions of the Society, to the consideration of naturalists, feeling certain that important results would be obtained by the comparison of registers kept on Prof. Newton's plan in different districts of the county. Mr. Stevenson also read a note with regard to a habit of the rook, which appears to have attracted very little attention, viz., that of throwing up the indigestible portions of its food in the form of large pellets, after the manner of hawks and owls. Several of these pellets, or "quids," picked up on the cliffs at Cromer and Sherringham, consisting mainly of the indigestible husks of barley, with a few pebbles and fragments of small beetles, were exhibited, all having been found near the edge of the cliffs, together with rooks' feathers, showing that the birds had been preening themselves during the process of digestion. A number of interesting plants found in the neighbourhood were exhibited by Mr. Bircham. At the suggestion of Mr. Southwell, a subcommittee was formed to take into consideration the formation of a list of the natural productions of the county; and it is hoped that help for this purpose will be rendered by kindred societies and naturalists resident in the county. The President announced that Mr. J. H. Gurney, jun., who has been travelling in Algeria, would read a paper on the birds of that country at the next meeting of the Society, on September 27th.

PARIS

Academy of Sciences, Sept. 5.—M. Cave presented a second note on the generative zone of the appendages in monocotyledonous plants.—M. de Saint-Venant communicated a note by M. Boussinesq, supplementary to his memoir on periodical liquid waves, and showing the general relations between the internal energy of a fluid or solid body and its pressures or elastic forces.—A note was presented by M. W. de Fonvielle on a theory of Mariotte's on barometric oscillations, relating to the rising of the mercury when the wind is from the north and north-east, and its fall when the wind is from the south and south-west.—M. Delaunay communicated a notice of the discovery of a new comet by M. Coggia, at Marseilles, on the 28th August.—A note on the composition of nadorite by M. Flajolot, was presented by M. Combes. The mineral may be regarded as a combination of oxide of lead and oxychloride of antimony, in accordance with the formula $Sb^2\ O^2\ Cl\ 2Pb\ O$.—M. Claude Bernard communicated a memoir on the venom of the scorpion, by M. Jousset. The author has experimented with the poison of *Scorpio occitanus*, by inoculating it upon tree frogs. He found that it acts directly upon the red globules of the blood, depriving them of the power of passing each other freely, and thus causing them to become agglutinated to each other, and obstruct the circulation. The extent of the action of the poison is dependent on its quantity.—M. Zaliwski noticed a battery of zinc and carbon giving a maximum of intensity for twelve hours. The zinc is immersed in a solution of hydrochlorate of ammonia, the carbon in a mixture of nitric and sulphuric acid.

BOOKS RECEIVED

ENGLISH.—Advanced Text-book of Zoology: H. A. Nicholson (Blackwood and Sons).—Thayer Expedition: Scientific Results of a Journey in Brazil: L. Agassiz (Trübner and Co.).—Physical Geography: J. K. Laughton (Potter).—The Food, Use, and Beauty of British Birds: C. O. Groom-Napier (Groombridge and Sons).—Treatment and Utilisation of Sewage: Prof. Corfield (Macmillan and Co.).—Arithmetic, Parts 2 and 3, Sonnenschein and Nesbit (Murby).

FOREIGN.—(Through Williams and Norgate)—Helgoland: Nord-seestudien; Ernst Hallier.—Fauna öfver Sveriges och Norges Ryggradsdjur: Wilh. Lilljeborg.—Der Laacher See und seine vulkanischen Umgebungen: Dr. Jacob Noggerath.—Die Sculptur und die feineren Structur-verhältnisse der Diatomaceen, Heft 1.: Fritsch und Müller.—Iconographia familarum naturalium regni vegetabilis, Heft xx.: Dr. Schnitzlein.—Note sur un Foyer de l'Age de la Pierre polie: E. Perrault.—Mollusques tertiaires, Fasc. i.: F. Bayan.—Erster Nachtrag zum Lehrbuche der Aufbereitungskunde, mit Atlas: von Rittinger.—Natur und Gott: H. Baumgärtner.—Ueber Eis und Schnee: G. Studer.—Texture, Structure, und Zell-leben in den Adnexen des menschlichen Eies: Dr. Winkler.—Grundzüge einer Spongien-fauna des atlantischen Meeres: Dr. O. Schmidt.—Les Houillères en 1869: A. Burat.—Geographisches Jahrbuch III. Band, 1870: E. Behm.—Wissenschaftlich-technisches Handbuch des gesammten Eissengiessereibetriebes: E. F. Dürre.—Ueber die wachsende Kenntniss des unsichtbaren Lebens: Dr. Ehrenberg.—Botanische Untersuchungen über die Alkoholgährungspilze: Dr. M. Reess.—Verhandlungen der schweizerischen naturforschenden Gesellschaft in Solthurn, 1869.—Mittheilungen der naturforschenden Gesellschaft in Berne, 1869.

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