THURSDAY, AUGUST 29, 1872

SCHELLEN'S SPECTRUM ANALYSIS

Spectrum Analysis in its Application to Terrestrial Substances, and the Physical Constitution of the Heavenly Bodies. By Dr. H. Schellen, Director der Realschule, I.O. Cologne. Translated from the second enlarged and revised German edition by Jane and Caroline Lassell, edited, with notes, by W. Huggins, LL.D., D.C.L., F.R.S. (Longman and Co., 1872.)

IT is not difficult to deliver interesting lectures or to write an instructive book on spectrum analysis. The rapid succession of brilliant discoveries in this new branch of science, the amount of fundamental facts added by it to human knowledge, especially in the field of the cosmical world, assure the lecturer or writer appealing to the intelligent but not scientific public of useful and legitimate success. But what is not so easy to do is to interest at the same time the *gens du monde* and scientific men, by offering a selection of the most recent discoveries in a bright and literary form attractive to the former, and yet keeping for the latter the appearance of precision, and exactness of the numerical results.

All these conditions are very happily filled in "Schellen's Spectrum Analysis," edited by Mr. W. Huggins from the second German edition. I shall commence by giving a brief account of the chief points of the book.

The first part, introductory, is occupied by a description of the artificial sources of high degrees of heat and light, of which the study is so intimately connected with the chemical and astronomical phenomena embraced in the field of spectrum analysis; various apparatus, for instance, the gas-burner, the magnesium lamp, the Drummond lime-light, the electric spark of the induction coil, the Geissler's tube, and the electric light produced by voltaic batteries are described, and the practical adjustments are briefly but sufficiently referred to for a good understanding of the subject.

The second part is devoted to an elementary abstract of the geometrical and mechanical properties of light. The fundamental analogy between light and sound is developed, in order to explain to a reader unlearned in optics how the colour of a ray is the corresponding element of the pitch of a musical sound, and how it is possible to define a coloured ray by the time of its luminous vibrations. The description of refraction phenomena, especially the paths of rays through a prism, leads naturally to the separating process of the different colours on which spectrum analysis is founded.

Some examples of such an analysis of light by means of a prism are given, amongst which we may mention the screen-projections of the spectra of the electric, sun, or magnesium light; a sufficient number of illustrations enables every one easily to repeat the experiments.

A considerable number of chapters is devoted to the construction of the simple and compound spectroscope. The chief points of this construction, especially the contrivances for the simultaneous comparison of two spectra, the determination of the position of lines in the spectrum are carefully described. Afterwards a practical account of the methods for exhibiting spectra of terrestrial substances, for instance, metallic salts volatilised in a gas-burner, &c., will certainly interest chemists.

The beautiful appearance in the spectroscope of heated gases in Geissler's tubes, their bright lines, and also the important question concerning the change of spectra with temperature and pressure, all these subjects are sketched in general outlines; it is nevertheless to be regretted that an account of the beautiful experiments of MM. Frankland and Lockyer have not a place amongst these descriptions; the difficult problems raised by these experiments are not completely solved, and we by no means can accept every assertion developed in this interesting chapter.

The curious absorption phenomena to be observed in the spectrum analysis of light which has passed through certain liquids, especially of organic origin, deserved a peculiar notice; the author has not neglected to describe one of the most remarkable spectra—the absorption-bands of the blood, and to indicate what advantage natural history is able to derive from such observations even on microscopical objects.

An interesting chapter contains the theoretical and experimental explanation of the reversal of the spectra of gaseous substances. This phenomenon, studied independently by Foucault and Angström, and definitely generalised by Kirchhoff, is perhaps the chief point of the history of spectrum analysis, and certainly the beginning of its utilisation as a powerful method of investigation.

The only practical example of reversal given in the book is that of sodium vapour; but recent experiments have proved that nearly all metallic vapours heated conveniently in the voltaic arc show the reversal of a great number of bright lines into black ones.

The third part of the book, the most important in extent and results, is devoted to the application of the spectrum analysis to the heavenly bodies.

The sunlight, according to its brightness and to the peculiarities of its spectrum, is the best and easiest example to study. The dark lines in infinite number which it shows, called "Frauenhofer lines," from the discoverer, deserve special attention; therefore the author has illustrated the description of the sun-spectrum with two sets of maps. The first is a reduction of Kirchhoff's maps engraved on wood, representing in several tints the lines from *A* to *G*; the second series is a reduction to about half size of the admirable *normal solar spectrum* of Angström, in which the Frauenhofer lines from *a* to $H_1 H_2$ are co-ordinated according to their wave-lengths. The accuracy of these lithographic plates is really wonderful; they will have the great merit of introducing amongst physicists and astronomers the wave-length scale for the designation of lines instead of Kirchhoff's scale, which is an arbitrary one; and in any case they will facilitate the transformation of the data from one to another. I must add that Angström's maps have been introduced into the present edition by the English editor, and that such an addition is certainly one of the greatest attractions of this book for scientific men.

A good abstract of Kirchhoff's and Angström's memoirs on the coincidence of the dark solar lines with the bright lines of metallic vapours leads to the hypothetical constitution of the sun; this problem is so difficult, that it is necessary to leave to every one the responsibility of his own ideas on this subject. I ask, then, for permission to decline any critical notice of this part of the book.

I must mention also a useful description, illustrated with maps, of the telluric and atmospheric lines from the works of Brewster, Gladstone, Angström, and Janssen.

The remaining part of the book is entirely devoted to the most delicate applications of spectrum analysis to astronomy. A preliminary description of the sun-spots, faculæ, and other peculiarities of the surface of the sun, of the prominences round the disc, and so on, is given before the spectroscopic process for analysing these appearances is introduced, and enables the reader to understand very well the difficulties of the problem and the interest of its solution. I must mention especially the interesting account of the three total solar eclipses of 1868, 1869, 1870. A large series of drawings and photographic *fac similes* give the best idea of the phenomena, and show the improvements due to photography and spectroscopy; the relatively great extent devoted to this account is justified by the importance of the subject; the spectrum analysis of the prominences is in fact one of the most considerable results obtained for a long time in the sciences of cosmogony.

Now from this discovery of Janssen's it is easy to observe every day the solar prominences by utilising the bright lines of their spectrum. Janssen's method, discovered in India soon after the eclipse of 1868, was independently discovered again some weeks after by Lockyer, who has the real merit of announcing two years before the possibility of such an important observation, and would very likely have had the honour of priority if he had had beforehand the material means of carrying out his designs.

Schellen's book contains a complete account of the improved telespectroscopes of Lockyer, Respighi, Secchi, Huggins, Janssen, Young and Zöllner, and a beautiful series of coloured sketches, representing some daily observations of prominences all varying, but truly characteristic of their form. I must confess, however, that some of those beautiful pictures seem to me rather too much embellished by the imaginative fancy of one of the observers. The sun-spots and faculæ observed with a telespectroscope give a good number of new facts which have led Lockyer and Secchi to the most important inductions upon the constitution of the sun.

The spectroscope, as it is known, is able to give an exact measurement of the proper velocity of the luminous bodies. A German physicist, Doppler, deserves to be mentioned as the first who called the attention of astronomers to this subject, though a good number of his assertions may be incorrect. After him, Fizeau, a French physicist, to whom we are indebted for the first determinations of the velocity of light on the surface of the earth, showed the errors of Doppler in a little paper not very well known, published in 1849 ("Bulletin de la Société Philomatique de Paris"), and calculated the apparent change of refrangibility which would be produced by the proper motion of some heavenly bodies; but no direct experiment was made before the complete application of spectrum analysis to the sidereal phenomena. In this way Schellen's book gives a good abstract of the works of Huggins and Secchi. In these researches the velocity of rotation of the sun was to be tested as a verification of the general law of the phenomenon. I ought to say, that, the rather discordant results want a theoretical analysis, because the problem seems to me, in the case of the sun, more complicated than it appears at first sight. However, the influence of the velocity of the gas streams, especially of hydrogen, which constitute the greater part of the prominences, is unquestionably verified by Lockyer's observations. In the same way Huggins has proved and determined the proper motion of Sirius by the apparent change of refrangibility of the F line.

The remaining part of the book is devoted to stellar and meteoric spectrum analysis. It is impossible to give a superficial notice of the beautiful researches of Huggins and Secchi, researches which are always going on; the reader will find with interest various important results of these studies—for instance the existence in many stars of a good number of terrestrial substances—hydrogen, nitrogen, magnesium, sodium, &c.

One of the most interesting facts is the observation of the temporary star which appeared in May 1866; the great brightness of the star was due, as indicated by the spectroscope, to an immense mass of incandescent hydrogen.

At the end of the work the author gives some very important observations of Huggins and others on the spectrum of nebulæ; the chief result is the possibility, with the aid of the spectroscope, of distinguishing by the composition of their light the true nebulæ from the clusters of stars.

Finally, a description of the spectrum of the aurora borealis, the identification of its bright lines with some bright lines of the solar corona, a description of various meteors, lightnings, and their spectra, show into what difficult objects this new branch of science has pushed its investigations.

On the whole, this book must be considered as a good type of a "popular work;" it deserves the attention of the public, and the esteem of scientific men; and finally, it recommends itself by a gracious side. It was translated into English by two ladies, who have had the double merit of giving a proof of their good scientific taste, and of showing an example of the help which their sex is able to afford to science.

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OUR BOOK SHELF

Health and Comfort in House-building. By J. Drysdale, M.D., and J. W. Hayward, M.D. (London: E. and F. Spon, 1872.)

Sewer-gas, and how to keep it out of Houses. By Osborne Reynolds, M.A. (London: Macmillan and Co., 1872.)

THE first of these works supplies a want long felt by that section of the public who are desirous of obtaining a good supply of fresh air in their houses, without being subjected to the cold draughts usually associated with almost every system of ventilation. The book is most carefully written, and is evidently the result of much thought, time, and intelligent labour. After reviewing very fairly the systems of ventilation which have been proved to be ineffectual for supplying fresh warm air to the whole of a house, although perhaps very appropriate for single rooms, we are told that the key-note of this new system consists in utilising the kitchen fire, which is almost constantly kept alight in summer and in winter. "Endeavour is made to prevent the air from entering the house at all except by the inlet provided in the lowest story of the house, with conditions available for the warming, cleaning, disinfecting, or otherwise improving the quality of the incoming fresh air, and regulating its quantity; the fresh air is then conducted into the central private hall, which is protected from smells, and all other means of pollution: it is from this private hall that the rooms draw their supply, even when the doors are shut. Having served its purpose in the rooms, the air is drawn off through the ceiling into the foul air chamber, and thence down and behind the kitchen fire, up the chimney-stack, and discharged high up in the open air, all possibility of back draught being prevented by the length and heat of the exhausting-syphon." It is a work which can be highly recommended to the officer of public health, the architect, and the householder, as a guide to the true principles of healthy ventilation. In "Sewer Gas; a Handbook on House-drainage," we have a very simple and original plan suggested for preventing noxious gases and exhalations from drains entering our houses. It is shown that these gases, being specifically lighter than atmospheric air, frequently ascend in pipes, and that they are also occasionally drawn in by the suction caused by the warmth of a house through accidental crevices in the drain pipes. It is proposed to remedy these evils by doing away with all traps except those connected with the pans of closets, and by placing a large trap in the pipe which connects the house drains with the sewer. A plan of this trap is given, showing that it is easily accessible, and can be cleaned at any time by even an inexperienced workman. The subject is one of even more importance than good ventilation. When we recollect that one of the most valued lives in Great Britain has been so recently imperilled from a mere defect in a system of drainage, we cannot too highly estimate the efforts of those who suggest, both by precept and experiment, the adoption of such measures as will ensure the safety of all sensible householders.

LETTERS TO THE EDITOR

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

Hindrances to Students of Mathematics

IT was the opinion of Dr. Samuel Johnson that everything ought to be persecuted in order that we may know whether it is worthy to live or not. There is, doubtless, a good deal of truth in this opinion, and the idea or the man that cannot endure and overcome a considerable amount of difficulty is of but little value. Still there must be a reasonable limit to persecutions and difficulties, and hence I hope that the praiseworthy efforts of the English mathematicians to improve their text-books of geometry will be successful. In considering such a matter as the improvement of text-books, an extensive knowledge of the experience of all classes of students will be valuable, and as many of the mathematical books profess to be written for those who are not fortunate enough to have a teacher, an account of the difficulties which such a one has experienced may be of some interest.

1. I place first among these difficulties the practice common to nearly all mathematical writers, of restricting the number of axioms or fundamental assumptions, making them fewer than they naturally are. It is worse than useless to attempt to prove something that is self-evident, or which is so nearly so that it is impossible to make any proof illustrate it. In all such cases it would be better to state frankly and clearly that we make an assumption, depending on observation to justify it. An example of this superfluous proof may be found in many of the books on rational mechanics, where we are told that a body cannot move out of the place of the forces, because we know of no reason why it should move to one side rather than the other; therefore, &c. Of useless definitions we have an example in a popular work on arithmetic, where we are told that "time is the measurement of duration," and a few pages further on that "duration is a portion of time." Allied to this is the contemptible habit of those who explain, with kind condescension and with great detail, all insignificant matters, while at the same time they cover up or dodge by some such phrase as "it is evident" the really difficult points.

2. I do not object to a frequent and thorough application of the differential calculus in a text-book, and such an application seems to me better than the coarse processes under which this calculus is sometimes concealed; but there is a habit, common to young writers, of introducing forced and difficult demonstrations where more simple ones would be better. An illustration may be found in one of our best books on astronomy. In the first edition of this book the author gave a long and difficult demonstration of the well-known formulæ for the transformation of rectangular co-ordinates in a plane. The demonstration was made to depend on the solution of functional equations by means of the differential calculus, and is an awkward thing to place at the beginning of a text-book. In the second edition, having removed this demonstration and supplied its place by a simple one, the author has made the first chapter of his book the best synopsis of spherical trigonometry that I know of.

3. An error of the English text-books written by Cambridge men is, I think, the great number of examples given at the close of each chapter. At least one-half of these should be omitted. It is a great mistake to keep the student lingering over the never-ending questions of conic sections, of maxima and minima, &c., and to give him the habit of solving petty problems, when he should be led forward as soon as possible to the study of the memoirs of those who have created the science. In this connection it seems to me a mistake in treating the differential calculus to confine ourselves rigorously to the notion of a limit. Although the doctrine of limits may be the only logical foundation of this calculus, the student as he advances must soon become familiar with differentials, and it is well that he should make their acquaintance in his text-book.

4. A defect, perhaps of teaching rather than of text-book, is the ignorance of all American students of numerical and logarithm calculations, and from my slight observation I infer that such is the case also with English students. It is not uncommon to hear such calculations spoken of with contempt, but there is nothing that gives one a clearer idea of the meaning of analytical formulæ than to make a numerical application of them. In this matter it seems to me that the assistance of a teacher is of much more importance than in dealing with theoretical difficulties, since with these a student must generally be left to himself, while a little advice from a skilful computor will save the beginner much time and trouble.

5. Finally I mention, as a source of some confusion and perplexity to the student, the changes of notation and the introduction of new names. Some such change and inventions will be necessary with the progress of science, but any which tend to mar the symmetry of analytical expressions, and render less easy the reading of the great mass of mathematical literature that we already possess, should be avoided. To call a well-known function a "wonnumetonomy," or a "subcontra-wonnumetonomy," does not of course endow it with any new properties, or make its discussion one whit easier, although we may gain a slight advantage in the way of brevity of reference. For my own part I hope that this introduction of words of thundering sound, and the calculation of almost interminable formulæ, for which no more ingenuity is required than for a numerical calculation, is only premonitory to the invention of a calculus of operations which shall furnish us with shorter and more powerful methods of investigation. ASAPH HALL

Washington, August 16

Jeremiah Horrocks

IN the course of research (for literary purposes) concerning Jeremiah Horrocks, the astronomer, born at Toxteth, near Liverpool, 1619, I have been unable to discover his parentage. Conld any of your readers help me in this matter?

London, Aug. 12 E.

The "Mors Electrique"

WITH reference to your notice of M. Sidot's "Mors Electrique," I may mention that in India it has been proposed to use Magneto Electricity for the purpose of starting a jibbing horse, by passing a spark between two points attached to the breeching. I believe this would be really practicable and useful.

August 9 J. F. TENNANT

MAGNETICAL AND METEOROLOGICAL WORK AT BOMBAY

WE have received from Mr. C. Chambers, F.R.S., the Director of the Colaba Observatory, Bombay, three memoirs, to appear eventually as appendices to the volume; observations dealing with (1) the Absolute Direction and Intensity of the Earth's Magnetic Force at Bombay, and its Secular and Annual Variation, (2) on the Lunar Variations of Magnetic Declination at Bombay, and (3) a description of a new Self-Registering Rain Gauge. In the first memoir Mr. Chambers refers to the diminution of terrestrial magnetic action with increase of height above the ground. He states, "I am aware that experiments have at times been made to determine the effect upon the terrestrial magnetic force, of change of elevation or depression, both upon mountains and in mines; and it may be that such have been made also upon high buildings; but excepting the observations made in the vaults of the Paris Observatory, which I have not seen any discussion of with reference to this point, I believe that no long series of observations—capable of detecting small differences of the kind now pointed out—have been made elsewhere than at Bombay; and that the facts so strongly brought to light by the Bombay observations have not previously been forcibly commented on. It has now been shown—by the discussion of independent observations in each case—that diminution of effect with increase of height extends to—(1) the Secular Variation of Declination, (2) the Secular Variation of Horizontal Force, and (3) the Diurnal Inequality of Horizontal Force. Consistent testimony of this kind—even allowing for the possibility of explaining the first case on a different hypothesis—gives probability to the supposition that the phenomenon of sensible diminution of terrestrial magnetic action with moderate and practically attainable elevations above the earth's surface is general."

The object of the new rain gauge is to produce a complete record of rain-fall by means of photography, with this additional advantage, that whenever a barometer is kept in continuous operation there need be no additional expense in working the rain gauge.

SCIENCE IN JAPAN *

PROF. W. E. GRIFFIS writes us a very encouraging letter from Fukuwi, Japan, where he is giving practical instruction in a chemical laboratory established a year ago. Sixty students attend his daily lectures on chemistry and physics, properly illustrated by experiments, and twelve students do actually practise in the chemical laboratory. What he says of Japan is equally true here in the United States, only that the rubbish of astrology and Chinese philosophy, which prevent rapid progress there, are here represented by notions not less common nor less obstinate. He says:—"In teaching physical science in Japan, one has need to begin at the lowest foundation, to demonstrate everything, and to clear away much rubbish of astrology, Chinese notions of philosophy, falsely so called, &c.; yet the students are fairly intelligent, and promise hopefully to fill, in some measure, the greatest educational need of the country—good teachers."

The following will also merit attention:—"It may please you to know that Japan, just entering upon her course of modern civilisation, has begun by not only assigning a foremost place to physical science in her schools, but has already established several laboratories, in which students receive practical instruction from German and American professors. The chief laboratory in Osaka is presided over by a German professor, having nearly one hundred students. Another laboratory, it is expected, will be established in Yeddo. There is one in the province of Kaga, in charge of a German professor; another, also under a German, is at Shidzoka, in the province of Suruga. The laboratory in Fukuwi, province of Echeyen, has been established nearly a year." This is the laboratory of Prof. Griffis, above spoken of.

It gives us, indeed, great pleasure to record these significant evidences of progress in the far-off Japan. These facts, as well as many others, show that at length commerce, the arts, and physical science, have commenced their missionary career in Japan, and will soon introduce the blessings of civilisation in that great country leaving the Japanese and Chinese gods to take care of themselves, if they can.

* From the Iowa "School Laboratory of Physical Science."

THE "HASSLER" EXPEDITION

THE GALAPAGOS ISLANDS

THE numbers of NATURE for July 11 and 18 contain reports from Prof. Agassiz himself of his *Hassler* Expedition; we are glad to be able to furnish the following continuation of these reports from a writer in the *New York Tribune* who accompanies the Expedition:—

"About sundown on Thursday June 6 we bade good-bye to the Ossipee and to Payta, and, with a fair wind and smooth sea, started for the Galapagos. Darwin's account of this archipelago had excited our curiosity and interest to the highest degree. Of course our visit was all too short to settle the many interesting questions which his narrative suggests. We landed on Charles early Monday afternoon, June 10, and left early Wednesday morning. We landed at Tagus Cove, on Albemarle, Thursday morning, and remained until Friday afternoon. On Saturday at noon we anchored off James Island, and remained until Sunday at 10 o'clock, when we visited Jervis Island, and remained until sunrise on Monday. We anchored at Indefatigable Island on Monday by 9 o'clock A.M., and were detained repairing our engine until Wednesday afternoon, June 19, when we started for Panama. In so brief a visit to so remarkable an archipelago, no conclusions can properly be drawn from what we did not see, and yet one of the most interesting points of inquiry was precisely one that can be definitely settled by negative testimony only—the inquiry whether plants and animals found on one island are wanting on the other islands in the group. That this should be the case is not incredible; even on the continent we sometimes find plants and animals confined to very narrow localities. And although we had a very limited opportunity to examine the five islands on which we landed, our observations, as far as they go, tend to confirm the statements heretofore made that the Galapagos have a fauna and a flora decidedly of an American type, yet decidedly peculiar to themselves, and that even each island differs from the other islands; nay, that this difference extends, in some degree, to the fishes in the bays around their shores.

"The islands are to my eye much more recent in their formation than Juan Fernandez. Indeed, Narborough and Albemarle have so fresh a look that you could easily believe that there had been extensive eruptions there within the present century. Immense domes, 4,000 to 5,000 feet high, stand upon very flat truncated cones, twelve or fifteen miles in diameter. Over the whole surface of such mountains are scattered craters, chimneys, and small truncated cones. From many of these craters streams of lava have flowed toward the sea, some of them spreading out to miles in breadth and miles in length, and this lava is so fresh and black that as you walk over it you scarce find even a lichen adhering to it; it is a rough field of hard black slags or clinkers. This crust of cooled lava is cracked into rude hexagonal blocks of from six inches to several feet in diameter, and between the blocks you may find cracks so fine that the rain will scarcely penetrate them, or you may find chasms a yard in width and many feet in depth. The thickness of this crust also greatly varies. Here may be a swelling in the ground, a little hillock bursting at the summit, and showing a lava-crust of unknown thickness, and a few yards off a similar hillock, or a black ridge, may show through its openings that it is a mere shell, from which the fluid, molten contents were drained; while the crust was barely thick enough to sustain itself. The general level of the field is thus diversified by innumerable pits, caves, small cones, and craters, which, especially in such hard, rough material, make it a very "hard road to travel." The remaining surface of the mountain is similar, but composed of older lava, in the cracks of which a few scattered trees and bushes find a foothold, and give a meagre clothing to the land. Occasionally a patch of volcanic sand, or sandstone, gives the vegetation a better chance. The more eastern islands of the group are simply like these better parts of the western. There were many indications that our visit was in a time of drouth—for example, an abundant growth of a delicate fern, *Adiantum*, on James Island, was withered to the roots. This drouth may have been one reason why the whole archipelago, with the exception of James, and small patches on Jervis and Indefatigable, had a blasted look. The trees and shrubs were nearly all leafless, and the bark of the two most abundant species was light gray, almost white. Two kinds of prickly pear—*Opuntia* and a cactus more like a *Cereus*—made a striking contrast to this white shrubbery, lifting their solid dark green masses high above the bushes and dwarf trees, particularly on Indefatigable, where all three kinds abounded. I saw in the short rambles which I had to take only one really fine kind of tree; it was a straight trunk, very smooth, glossy bark, vigorous branches, and grew on James Island. It was entirely leafless; but the dead leaves and fruit pods under it showed that it belonged to the great family in which our locusts and coffee bean are placed; it had large trifoliate leaves, and a bright scarlet bean. Another tree of the same family had a very singular appearance; the plant itself looked like a dwarf walnut or butternut; the pod was very thin and narrow, but carried four thin wings half an inch wide, thin as paper, standing at right angles, and extending the whole length of the pod.

"The geologists were quite successful in getting specimens of various animals. Over fifty different kind of fishes were obtained, and of these over three-fourths are peculiar to the Galapagos. Of the Galapagos, from which the islands are named, and in which they once so richly abounded, we only got a few specimens, and those very small compared with those of olden time. They have been so eagerly hunted for their flesh that they have been driven from the more accessible places, and stand a good chance of being altogether exterminated. Their brethren in the sea, the tortuga or sea-turtle, we saw in abundance, and got some very fine specimens. There are, as is tolerably well known, two other reptiles for which this archipelago is famous—two lizards of a genus not found elsewhere, and very peculiar in their habits. The Spaniards called them iguanas, from their resemblance to that reptile in the West Indies and Central America. But they differ so much from their American cousin that they ought to have a name of their own; and if the scientific *Amblyrhyncus* looks too formidable, let us translate it and call the creature a Bluntnose. On Charles Island we found abundance of the crested Bluntnose climbing with great agility over the rocks near Black Beach. The creature is about 30 in. long, nearly black, the old males having a deep red hue on the sides. It swims with great ease by its flat tail, and uses its long fingers and long nails for scrambling on the rocks, holding them while swimming close to the body. There is not a trace of web-footedness about them, and they make no use of the feet in swimming. They live on sea-weeds from the rocks in deep water, and their expression is mild and herbivorous, with a little clear, innocent eye. I was prepared for something hideous, and was agreeably disappointed. In another respect our experience differed from Darwin's, for we sometimes had no difficulty in frightening them into the water, and they came fearlessly swimming about the *Hassler* as she lay in Tagus Cove. These crested Bluntnoses we found upon all the islands. The slightly crested Bluntnose we found only on Albemarle and Indefatigable. Its scientific name might mislead one, for its head is just as much crested as its aquatic brother's. The only differences between them apparent at first sight are these:—The terrestrial animal is somewhat stouter, his nose is longer, his eye brighter, his tail less flattened and less crested, and his colour is a dusky orange, deepening into brown on the hindquarters. His habits of life are very different, as he does not go near the sea, but lives upon land plants, and makes a burrow for himself in the sand and among the fragments of lava. He spreads his hind legs flat on the ground, raises his chest to the height of his fore legs, and then nods and winks at you in a very odd way. It looked to me very much like swallowing, and I thought it possible that the creature, with his head in that position, swallowed air like a toad, as a means of breathing—swallowing into the lungs, not into the stomach.

"One of our most interesting adventures was landing in a little bay full of seals, so tame, or rather so little afraid of men, that we could tramp past groups of sleepers on the beach without awakening half of them, and without apparently frightening half of those that we did awake. They seemed to be fond of crawling under bushes just above high-water mark, and sleeping, two or three in a place, huddled close together. Under one bush lay a mother and her two cubs, so fearless that one of our officers held a piece of cracker to the old one, and she smelled it in his fingers as fearlessly as if she had been a pet dog. The cubs quarrelled with each other as to which should cuddle nearest the mother, and they all three snarled and snapped at the flies in the manner of a sleepy dog, and all this while a party of ladies and gentlemen, creatures as large as the seals, and which the seals could scarce have seen before, stood looking on within touching distance. These seals had much more length of arm, and used their arms more in the manner of a quadruped than I had supposed any seal could do. I saw them walk on the beach with the whole chest clear of the ground, and even jump upon the sand. Their favourite gymnastic exercise, however, was to lie upon their backs and roll in the manner of a horse. The tameness of these seals and of many of the land birds was very surprising; the Bluntnoses were more shy than we had expected. I repeatedly put my fingers within half an inch of little yellowbirds and phebes, and within six inches of mocking-birds. On James Island the birds were so numerous and so tame that while I was trying the experiment whether whistling to a yellowbird would divert his attention so much as to make him allow me to touch him, six other birds—including two mocking-birds—came up and alighted on twigs within two yards of the yellowbird, to see what was going on between us. As for the flies, their tameness and pertinacity of adhesion at the Galapagos goes far beyond all travellers' accounts. I knew a good housekeeper in New England who affirmed that house-flies could not be driven out of a room unless you struck and killed one or two, in order to show the others that you were in earnest. You cannot drive the Galapagos flies from you even with that expedient. The birds and seals are not frightened by being stoned or shot; they don't know what stones and guns mean, and the flies are not frightened or discouraged by having any amount of their comrades killed. When a boat was coming off shore, the usual occupation, in order to prevent carrying the nuisances on board, was for everybody to be picking the flies off themselves (almost as they would burrs), killing them and throwing them into the water from the time of leaving the beach to the arrival on the deck of the ship; and the last fly slaughtered before you go into the cabin is no more afraid of you than the first one you slew at the beach. They are not biting flies—we have escaped trouble from mosquitoes and biting flies during the whole voyage—but they are crawling, tickling, adhesive, tantalising creatures. It was pleasant to find here at the Galapagos a species of penguin, smaller and more sober in dress than our old friends of the Straits of Magellan, but with the same winning, cunning manners that made the birds in the Straits such favourites with our party. And while speaking of the birds of these islands, I would not forget the splendid flamingoes, six feet high, of which we got many fine specimens. They sailed about in parties of twelve or twenty birds together, making long lines of scarlet flame floating through the air. We tried their flesh on the table, and found it the most delicious game, fully equal to the canvasback, as it seemed to us.

"One lesson I must confess to having learned at Indefatigable Island. I saw there indisputable proof that the surf of the sea is capable of rounding angular fragments of lava into pebbles, somewhat resembling in shape (but not at all in polish and grooving) glacial boulders. I had always from boyhood doubted the power of the sea to make angular fragments round: I had supposed that the action of the surf upon such fragments would be simply to pack them into a sort of McAdam's roadway. And even now, having had this proof that under peculiar circumstances the sea can make a tolerable imitation of drift, I am not a whit more ready to believe that the sea made the drift itself. You may prove to me experimentally that flour can be made from wheat with a pestle and mortar, but that will not convince me that the flour markets of the world are thus supplied. There are one or two little colonies on the island, but the colonists have a hard life, and there can hardly be any agriculture there for centuries to come. At present the two main products of the islands are terrapins (galapos), which are almost exhausted, and wild pigs, which are of little worth, and which are destroying the wild plants and animals. The archipelago offers at present a fine opportunity for a naturalist, who desires to make a residence here for several years, and thoroughly explore their structure and their productions, to throw a strong light upon the great modern question of the origin of species, and the doctrines of evolution. Younger than Juan Fernandez, purely volcanic, bringing no seeds with them from the bottom of the sea, not having had time to alter and amend species introduced from the mainland, how did these islands come in possession of their peculiarly organised beings—their Bluntnoses for example? This was the question constantly recurring to me during my visit to the Galapagos, as it had been at Juan Fernandez. Prof. Agassiz gave us a little talk one day on our way to Panama, and discussed the same point. Expressing his warm admiration for Darwin's moral and intellectual character, and earlier scientific labours, he said that he considered his present influence on science very pernicious as favouring the habit of 'filling up the wide gaps of knowledge by inaccurate and superficial hypothesis.' What we need in order to extend our knowledge of the origin of species, is not hypothesis and speculation, but a careful collation of facts, and a careful extension of our observation of facts. The hypothesis that the differences of species were produced by variations taking place in unlimited, in indefinitely long periods of time, is, at all events, strongly negatived by this occurrence of such marked peculiarities of difference from the surrounding world, in an archipelago that belongs wholly to the present geological epoch, and has not existed an indefinite time. It was very pleasant to us all to hear this greatest and most earnest opponent of Darwin rendering with such manifest sincerity his tribute of admiration for Darwin's genius and industry, and confessing with such evident pride his warm personal love toward him. As to the question of the origin of species, I think we were all willing to leave it a question. Darwin's hypothesis of gradual variation of species, and the natural selection for preservation of those whose variations were favourable to them in the struggle for life, seems to me to have few facts to sustain it, and very many to oppose it. At the same time it must be conceded that all the maxims of metaphysics and theology combine in assuring the man of science that he is always right in assuming the utmost paucity of original causes. The universe is certainly framed with infinite skill and wisdom, and there never will be found two different things, where one would answer. If the present existing forces of nature can bring an Amblyrhynchus and an Iguano out of one common parent, it would have been a waste of creative power to make two parents; that concession to the doctrine of evolution is demanded by philosophy and the principle of least action. But the facts of zoology seem to me to indicate clearly that the present acting forces of nature can do no such thing.

THE LATE PROF. DR. F. KAISER

On July 28 last died Prof. Kaiser, Director of the Leyden Observatory.

Kaiser was born on June 10, 1808, at Amsterdam, where he was educated by his father, and, after the latter's death, by his uncle, J. F. Kaiser, himself a zealous promoter of astronomical research. In 1828 young Kaiser, whose love for astronomy had at an early period shown itself, was appointed assistant at the Leyden Observatory, which was then superintended by Prof. Wylenbrock. Till 1837 he remained in this position, improving himself by the study of all the best works in his department, when he was appointed Professor of Astronomy in Leyden University and Director of the Observatory. It is well known that this appointment marks the beginning of an epoch in the history of astronomy in the Netherlands. By unwearied exertions he soon collected some good instruments, and by means of his numerous and partly popular lectures he kindled such an interest in astronomy among the people that, in the year 1856, one of the items in the Budget was the cost of erecting a new Observatory. This he entered in 1860, furnished with many new instruments. This was followed in 1866 by permission, obtained through his never-tiring exertions, to publish "Annals." Notwithstanding that in the spring of this year he was seized with severe chest disease, which became a sad hindrance to his labours, he occupied himself with the editing of the "Annals," and with the improvement of the organisation and instruments of the Observatory. On the 4th of November last he set to work to perform some calculations necessary to complete a lecture for the third volume of the "Annals," on "The Measurement of the Diameters of Planets," and on the day after was seized with a hæmorrhage which made his illness assume a more critical character. Even from this attack he might have rallied with returning spring, had it not been for the death of his wife, with whom he had been happy for 41 years. From that blow he never recovered.

That astronomy has sustained a great loss in Kaiser, all who take an interest in the science must feel. It is to be hoped that ere long a worthy account of his life and labours will be given to the world.

NOTES

THE work of the French Association, which, as we have already announced, meets at Bordeaux from the 5th to the 13th September, comprehends—1st, At least two general meetings; 2nd, Meetings of divisions and lectures; 3rd, Scientific excursions; 4th, Public lectures. Of the last there will be four, the first of which was to have been by the late lamented M. Delaunay, on "The Constitution of the Sun;" his place will probably be filled by M. Cornu. The second public lecture is to be by M. Broca on "The Troglodytes of *Les Eysies*;" the third by M. Levasseur on "Commercial Geography;" and the fourth by Lieutenant F. Garnier, on "The Voyage of the *Cambodge* and the Political and Commercial *rôle* of France in the extreme East." There are to be seven excursions in all, one to the mouth of the Gironde for the purpose of observing the changes in the coast-line; another to the pre-historic remains and bone caverns of *Les Eysies*; the sixth is to Medoc for the purpose of visiting the great vineyards of Château-Margot and Château-Montrose.

THE International Congress of Scientific Archæology was opened at Brussels on August 22, with an attendance of 600 men of science of various nationalities, including Prof. Owen and M. Virchow. After being entertained to luncheon in the Hotel de Ville, the *savans* adjourned to the Ducal Palace, where, at two o'clock the Congress was opened under the presidency of M. d'Omalius d'Halloy, the Belgian senator and eminent geologist, who will soon be a nonagenarian. The opening address was given by M. Dupont, the distinguished director of the Brussels Natural History Museum, who gave a summary of the results of the researches relative to pre-historic times in Belgium. The Executive Committee, under the presidency of M. d'Omalius d'Halloy, was then constituted. The Belgian vice-presidents are MM. Hagemans, van Beneden, and Baron de Wit. The vice-presidents for foreign countries are M. Virchow, for Germany; M. de Quatrefages, for France; Mr. Franks, of the British Museum, for England; M. Nilsson, for Sweden; M. Steenstrup, for Denmark; and M. Conestabile, for Italy. M. Dupont, of the Belgian Museum, was installed as secretary-general. The excellent club known as the *Cercle Artistique et Littéraire* has thrown open its hospitable doors to the members of the Congress. On Saturday, Aug. 24, an excursion under the auspices of the Congress took place to the valley of the River Lesse, a tributary of the Meuse, which it joins not far from Dinant. The purpose of the excursion was to inspect the prehistoric remains which abound in the numerous caverns that exist along the banks of the Lesse. M. Dupont acted the part of guide, and his disquisitions at each particular spot of interest were followed by lively discussions among the geologists present. On returning across the Lesse from inspecting the *Trou de la Naulette*, one of the over-crowded boats had its balance disturbed and went down, happily with no worse result to the passengers than a thorough drenching. Among those on board was Mr. Franks, of the British Museum, who, with another gentleman, gallantly rescued Mme. Royer, Mr. Darwin's French translator. At Sunday's meeting it was decided to hold the meetings of the Congress biennially instead of annually. On Monday, 26th, an excursion was made to Mesvin and Spiennes. The latter place is supposed to have been a manufactory of flint implements, the ground visited being thickly covered with flint splinters and unfinished flints. After luncheon the railway cutting at Mesvin was visited, where some lively discussion ensued, the party subsequently inspecting some pits from which the flint for making tools had been extracted.

THE Government of New South Wales, following the lead of Europe and the United States, has introduced the system of telegraphing the anticipations of the weather, and has established certain stations on the coast for indicating the nature of any expected storm by means of signal masts. These signal masts support two yards, crossing each other at right angles in the direction of the cardinal points of the compass. A violent squall is to be represented by a conspicuous diamond-shaped signal; a heavy sea by a drum; a gale with clear weather is indicated by a diamond-shaped signal over a drum; and one with thick weather and rain by the same signal under a drum. The direction in which the wind is blowing is indicated by the particular yard-arm between which and the mast-head the geometrical signal is suspended. Gales that are general over a large portion of the coast are indicated without the mast-head flags, by the geometrical figures.

WE learn that Professor Nordenskjold, the originator and leader (under the direction of the Royal Swedish Academy) of the Swedish North Polar Expedition, contemplated since 1861 arrived on the 17th of last month at Tromsö, in Northern Norway, and sailed away again in the iron steamer *Polhem* on the 21st. Before leaving that port for the far north he sent a letter to Mr. Oscar Dickson, merchant, of Gothenburg (thanks to whose energetic and liberal support the expedition was enabled to start this year), giving a short description of the means at his disposal. The plan of the expedition is that of wintering on the northernmost islets of Spitzbergen (the Seven Isles), whence by the aid of reindeer sledges an over-ice journey northward will be attempted. The professor is accompanied by two physicians, a naturalist, an Italian naval officer, a first mate, two engineers, ten picked seamen, and four Lapps for attending the reindeer, from forty to fifty of which, with 3000 sacks of reindeer moss and other necessaries for wintering in the Arctic regions, have been taken by another (hired) steamer, the *Onkel Adam*, to the intended winter quarters. The Swedish Government has placed the brig *Gladan* at the professor's disposal till the beginning of winter. This vessel has also started from Tromsö, having on board a house, in which the exploring party is to winter in the Seven Isles; she will return to Tromsö, and hence take back a second cargo, consisting of coals. The expedition is in addition furnished with 1545lb. of paraffin, to serve as lighting and cooking material on the sledge journey. The house contains six living rooms, one of which is to be used as a workshop, a kitchen, pantry, bath-room, and frost-proof cellar. The expedition has also taken from Stockholm three "observation sheds." It is amply provisioned for two years, and well supplied with warm winter clothes, among which are complete suits of Lappish clothing for every person in the expedition. On the sledge journey, amongst other things, rum, paraffin, sleeping bags, tents of tarpaulin, a large sleeping carpet, &c., will be taken. Three boats, weighing respectively 300lb., 200lb., and 150lb., and specially adapted for ice travelling, with sledges, had been shipped at Copenhagen. To assist the Laplanders in the management and supervision of the reindeer, they have with them five reindeer dogs. Three live pigs form also part of the provisions. Finally, the expedition is well provided with all necessary scientific instruments.

PROF. C. H. F. PETERS, of Hamilton College, U.S., has discovered two more new planets of 11·5 and 12 magnitude respectively, provisionally numbered 123 and 122.

THE International Statistical Congress has opened at St. Petersburg its eighth session since it started its work in 1853, and is divided into five sections: the first on questions connected with the census of the population, the second on the movement of the people, the third on industry, the fourth on postal relations and commerce, the fifth on criminal statistics. The Congress is well attended by representatives of all countries, with a good sprinkling of English members. Dr. Farr, Mr. Hammick, and Mr. Lock represent the official part of our members; Mr. Samuel Brown, Mr. Hamilton, Mr. Hendriks, Dr. Mount, M. Tayler, and Mr. Levi, represent the Statistical Society of London; and there are also Mr. Freeman, Mr. Heron, and Mr. Wethered as voluntary members. The Russian Government and the municipalities of St. Petersburg are most liberal in their arrangements for the reception of visitors. A free railway ticket over the Russian territory, and free lodgings in the best hotels, for every member of Congress, have been provided. The Princess Helena gives evening entertainments. The Hermitage and Museums are open, and there are to be excursions to the Exhibition at Moscow, and to the fair at Nijni Novogorod.

THE session of the Physical Science College of Newcastle-upon-Tyne will commence on Oct. 2, and will be divided into the Michaelmas, Epiphany, and Easter Terms. No preliminary examination is required, but students must be above the age of fifteen years. All particulars will be found in the college prospectus, to be had free on application to Mr. W. Bunning, secretary to the college.

THE twenty-seventh annual meeting of the Cambrian Archæological Association has been opened at Brecon, and the Congress will sit up to Friday evening. The President for the year is Sir James Russell Bailey, M.P., of Glamish Park, Cricklewell. The proceedings will be of the usual character, including the reading of papers on subjects of archæological interest, and daily excursions to places of note in the surrounding neighbourhood.

THE *Journal of the Franklin Institute* calls attention to the following interesting lecture experiment:—It is well known that a light ball, as of cork, is sustained for some time near the summit of a vertical jet of water, issuing from an orifice of such a nature that the steadiness of the jet is maintained. The experiment becomes more striking when a vertical blast of air issuing from a large bellows is substituted for the jet of water, as in this case there is no apparent support for the ball, which comports itself in a very amusing manner. When a strong blast cannot be obtained, if a slender wire, about four times the length of the diameter of the ball, be passed through its centre, so as to have one-fourth of its length projecting from one end, and one half from the other, the balancing is more readily obtained, as any considerable change in the relative positions of the centre of gravity and the point of support is prevented by the movements of the rod.

WE learn from the *Journal of the Society of Arts* that the directors of the telegraphic lines of France have recognised the absolute necessity of improving the theoretical and practical knowledge of its clerks, and with this view elementary courses of telegraphy have been arranged in all the chief towns, at which the attendance of the *employés* is obligatory. In addition to this, a superior course of instruction is to be opened in Paris, and those clerks who have most distinguished themselves in the provinces will be sent to the capital to complete their instruction. The courses are all to commence on the first of October.

Harper's Weekly, of August 17, announces the deaths of Mr. Sidney J. Lyon, a gentleman well known for his valuable geological and archæological researches while State geologist of Kentucky; and of Mr. Edmund Ravenal, of Charleston, S. Carolina, and Dr. Hubbard, of Long Island, both eminent conchologists.

WE notice from the *Field* that on September 3 and 4 a sale of the surplus animals of the Zoological Gardens of Antwerp is to take place. The collection to be disposed of includes many of the rarer species of mammals and birds. In the former figures a young Indian rhinoceros, several species of antelopes, mouflons, and a male markhare ("which," says the *Field*, "offers a chance for any one desirous of increasing the size of our Welsh goats"). The birds include ostriches, several species of rare and new pheasants, and a considerable number of the rarer waterfowl, serpents, pythons, &c.

WE learn from the *Times of India* of July 26 that Mr. Mark Fryar, the mining engineer who has been specially engaged to develop the mineraliferous resources of British Burmah, spent the last two months of 1871 in exploring the Mergui district of Tenasserim; and the results of his explorations have just been published by the Etcetera Department as an extra supplement to the *Gazette of India*. Of the coal which exists there Mr. Fryar does not speak at all hopefully. It is deficient in quality, and could not compete with English and Australian coal; besides which, there is no demand for it, the dense forests of Tenasserim being capable of supplying the whole country with fuel for generations to come. Summing up the results of his two months' tour, Mr. Fryar says the most remarkable feature of the districts is the wonderful extent of the distribution of staniferous detritus: "In rivers on the mainland and on islands of the sea, every small dishful of sandy gravel taken up contains palpable traces of black tin-stone;" and he thinks it exceedingly probable that a thorough examination of the hills whence the rivers flow would be rewarded by the discovery of rich veins of tin ore, which could be worked with the most profitable results.

A LETTER from Bucharest, given in the *Levant Times*, reports a curious atmospheric phenomenon which occurred there on the 25th of July, at a quarter past nine in the evening. During the day the heat was stifling, and the sky cloudless. Towards nine o'clock a small cloud appeared on the horizon, and a quarter of an hour afterwards rain began to fall, when, to the horror of everybody, it was found to consist of black worms of the size of an ordinary fly. All the streets were strewn with these curious animals. It is to be hoped that some were preserved, and will be examined by a competent naturalist.

THE International Congress on Weights and Measures meets at Paris on September 24.

THE cyclone which had been heard of from the Bay of Bengal, broke over Balasore early on the morning of the 1st July. There was a heavy gale from the N.W. at about 2 A.M., and at 4 A.M. the wind veered to the N.E., and blew with tremendous violence, subsequently passing to the E. and S.E., and dying away at one o'clock. The station, which was once one of the prettiest in Bengal, is said now to be a mass of ruins. The destruction of property has been very great. Several thousand people were rendered homeless, and many without food. The telegraph lines were carried clean away for several miles on both sides of Belasore.

THE *Honolulu Gazette* reports the following interesting fact which has recently been observed respecting the growth of coral, and which deserves very careful consideration:—Somewhat less than two years ago a buoy was moored in Kealakekua Bay. Last week the anchor was hoisted in order to examine the condition of the chain. "The latter, which is a heavy 2 in. cable, was found covered with corals and oyster-shells, some of which were as large as a man's hand. The large corals measure four-and-a-half inches in length, which thus represents their growth during the period of two years that the anchor and cable have been submerged. The specimens which we have seen show the nature of the formation of the coral by the coral animals very distinctly. When taken out of the water it had small crabs on it. A question arises whether these crabs live on the coral polypes, or whether they simply seek the branches of the coral for protection. The popular idea is that corals are of extremely slow growth, yet here we have a formation equal to over seventeen feet in a century."

THE BRITISH ASSOCIATION

BRIGHTON, *Thursday, Aug.* 22

THIS year's Congress of the British Association was formally brought to a close yesterday afternoon by a largely attended general meeting held in the Dome, the main purpose of which was to allot votes of thanks to those who had officially done their best to make the meeting successful. One of the best-deserved votes was that to the Mayor and Corporation of the town, who had done all that lay in their power to promote in every respect the comfort and convenience of visitors. If the meeting has not been in all respects a success, it has certainly been from no want of hospitality and courtesy on the part of the Brightonians. Prof. Fawcett proposed the vote of thanks to the distinguished president, Dr. Carpenter. The professor's praise of the president was hearty and well-deserved. In returning thanks Dr. Carpenter paid a well-merited compliment to Mr. Griffiths and Mr. Galton, "his right and left hands, the former his *fidus Achates*."

The following are the grants agreed to this year, with the names of the members entitled to them :—

MATHEMATICS AND PHYSICS	
*Cayley, Prof.—Mathematical Tables	£100
*Thomson, Sir W.—Tidal Observations	400
*Brooke, Mr.—British Rainfall	100
*Everett, Prof.—Underground Temperature (100*l.* renewed)	150
*Griffith, Mr. G.—Gaussian Constants (renewed)	10
*Glaisher, Mr. J.—Luminous Meteors	30
Glaisher, Mr. J.—Efficacy of Lightning Conductors	50
*Williamson, Prof. A. W.—Testing Siemens' New Pyrometer (renewed)	30
*Huggins, Dr. W.—Table of Inverse Wave-Lengths	150
*Tait, Prof.—Thermal Conductivity of Metals	50
CHEMISTRY	
*Williamson, Prof. A. W.—Records of the Progress of Chemistry (100*l.* renewed)	200
*Gladstone, Dr.—Chemical Constitution and Optical Properties of Essential Oils	30
Brown, Prof. Crum.—Temperature of Incandescent Bodies	50
Brown, Prof. Crum.—Electric Tensions of Batteries	25
GEOLOGY	
*Ramsay, Prof.—Mapping Positions of Erratic Blocks and Boulders (renewed)	10
*Lyell, Sir C., Bart.—Kent's-Cavern Exploration	150
Lubbock, Sir J.—Exploration of Settle Cave	50
*Busk, Mr.—Fossil Elephants of Malta	25
*Harkness, Prof.—Investigation of Fossil Corals	25
*Carruthers, Mr.—Fossil Flora of Ireland	20
*Harkness, Prof.—Collection of Fossils in the North-west of Scotland	10
*Bryce, Dr.—Earthquakes in Scotland	20
Willett, Mr. H.—The Sub-Wealden Exploration	25
BIOLOGY	
Lane Fox, Col. A.—Forms of Instructions for Travellers	25
*Stainton, Mr.—Record of the Progress of Zoology	100
*Christison, Sir R.—Antagonism of the Action of Poisons	20
*Balfour, Prof.—Effect of the Denudation of Timber on the Rainfall in North Britain (renewed)	20
MECHANICS	
*Grantham, Mr. R. B.—Treatment and Utilisation of Sewage	100
*Froude, Mr. W.—Experiments on Instruments for Measuring the Speed of Ships and Currents (30*l.* renewed)	50
Total	£2,025

Some of the grants, as the president remarked, were for large sums, but it is gratifying to learn that the sum realised by the sale of tickets this year will more than cover the whole amount. The total number of tickets sold has been 2,533, representing 2,649*l.*

* Reappointed.

Not the least successful, and doubtless to many of the 200 guests, not the least enjoyable of the numerous meetings which have within the last few days been held at Brighton, was the *déjeûner* given yesterday by the hospitable mayor in the banqueting-room of the Royal Pavilion.

The Press arrangements have received very general commendation. Special praise is due to the *Brighton Daily News*, whose reports of general and sectional meetings were unremitting until it came to Mr. J. F. Walker's paper, and what the *Pall Mall* calls the alarming polysyllable "Dinitrobrombenzene." The *News* might, however, have got over the word, which we shall not venture to repeat, "but," it says, "since the communication was full of such words as mononitromonobrombenzene and metamononitromonobrombenzene, we do not imagine a full report would be interesting to our general readers." Our spirited contemporary is probably right, as the *Pall Mall* remarks; half-a-dozen such words might make a handsome day's wage even for the most diligent compositor.

In alluding to Dr. Carpenter's lecture on Chalk to be delivered to-night, the opportunity must be taken of supplying an omission which we unintentionally made last week. We should have mentioned that one of the three general lectures was by Mr. J. M. Duncan, on the "Metamorphoses of Insects."

SECTION A—MATHEMATICAL AND PHYSICAL SCIENCE

On a Periodicity in the Frequency of Cyclones in the Indian Ocean South of the Equator, by Mr. Meldrum.

One of the objects for which the Meteorological Society of Mauritius was established, in 1851, was to obtain extracts from the meteorological registers of vessels visiting the harbour of Port Louis, especially of such vessels as had experienced bad weather in the Indian Ocean.

Accordingly, clerks were employed to copy all the log-books that could be procured.

In 1853 the system of registration was remodelled. Instead of having the observations contained in each log-book recorded separately, all the observations in all the log-books for the same day were recorded on the same page.

As this system has been conducted without interruption to the present time, the Society has now a large collection of observations showing more or less the state of the winds and weather over the frequented parts of the Indian Ocean, in the form of a daily journal, during the last nineteen years; so that a person may find at once what weather prevailed on any day or in any year during that period.

Together with the years 1851-2, therefore, during which the registers were differently kept, we have 21 years' continuous observation, from the meridian of Greenwich to 120° E., and from 23° N. to 45° S.

Adding to the information obtained by the Society throughout these 21 years numerous observations collected by several persons for the previous four years (1847-50), we have a more or less complete record of all, or of very nearly all, the cyclones which have taken place in the Southern Indian Ocean during the last 25 years; for Mauritius is so much in the track of these cyclones, and so much visited by vessels in distress and by others trading between the colony and England, India, and Australia, that it is scarcely possible for any violent hurricane to pass without being noticed.

Taking now, for the present, the area comprised between the equator and the parallel of 25° S., and the meridians of 40° and 110° E., and examining a table of the cyclones that have occurred there from 1847 to 1872, it is found that some years have been remarkable for a frequency and others for a comparative absence of cyclones.

The five years, 1847-51, were characterised by cyclone frequency; then came a period of comparative calm (1852-57), which was followed by six years (1858-63) remarkable for cyclones. The next five years (1864-68) showed a considerable ecrease; and since 1869 there has been an increase, until, for the present year (1872), the number of cyclones is already (28th June) greater than in any year since 1861.

What has now been said is not only borne out by the records of the Meteorological Society, which give detailed accounts of the hurricanes, but also, I have little doubt, by the books of the docks and marine establishments.

Especially in 1847-48, and again in 1860-63, the harbour of Port Louis was at times crowded with disabled ships; whereas in the years 1855-57 and 1866-68 there were very few.

It will be seen that these years correspond pretty closely with the maxima and minima epochs of sun-spots.

For the present I wish merely to call attention to the subject, in order that the connection which I think exists between sun-spot frequency and cyclone frequency may be either verified or refuted by past or future observation.

It appears to me that there is more than a mere coincidence as to time. There are three maxima and two minima epochs of cyclone frequency, corresponding nearly, if not entirely, with similar sun-spot epochs.

To examine the matter fully, it would be necessary not only to know the number of cyclones in each year, but also the extent and duration of each and the force of the wind. If we could thus get an expression for the annual amount of cyclonic energy, and could show that it varied directly as the amount of sun-spots, a connection would be established. One violent hurricane, which lasted ten days and passed over thousands of miles, might have more value than half a dozen smaller and short lived ones. However, having traced a large number of the cyclones in question, I have no doubt that the years of greatest cyclone frequency were generally, if not always, the years of greatest cyclone energy; and that the number of cyclones in a year is a fair expression of the cyclonic activity for that year.

Now, taking the maxima and minima epochs of the sun-spot period, and one year on each side of them, and comparing the number of cyclones in these three-year periods, we get the following results:—

	Years.	Number of Cyclones in each Year.	Total number of Cyclones.
Max.	1847	4	15
	1848	6	
	1849	5	
Min.	1855	4	8
	1856	1	
	1857	3	
Max.	1859	5	21
	1860	8	
	1861	8	
Min.	1866	5	9
	1867	2	
	1868	2	
Max.	1870	3	14
	1871	4	
	1872	7	

Taking two years on each side of the solar-spot epochs, we get:—

	Years.	Number of Cyclones.	Total number.
Min.	1854	3	15
	1855	4	
	1856	1	
	1857	3	
	1858	4	
Max.	1858	4	32
	1859	5	
	1860	8	
	1861	8	
	1862	7	
Min.	1865	3	15
	1866	5	
	1867	2	
	1868	2	
	1869	3	

Assuming that we have got a close approximation to the actual number of cyclones, and that the numbers fairly represent cyclonic energy, it is difficult to avoid the conclusion that the above tables point to a definite law; and that meteorology, magnetism, and solar physics are closely connected. For what holds good with regard to a large tract of the Indian Ocean probably holds good with regard to other portions of the earth's surface.

Is it not probable, also, that if there is such a connection as is here suggested between the sun-spots, or sun-cyclones (as they have sometimes been called), and earth-cyclones, there is a similar connection between the sun-spots and cyclones in the other planets?

On the Spectrum of Hydrogen, by Arthur Schuster, student of Owens College.

In a paper communicated to the Royal Society, I have shown that nitrogen has only one spectrum; the band spectrum usually obtained at low pressures being due to oxides of nitrogen. I have since subjected hydrogen to a similar investigation, and although my experiments may not seem to give an absolute proof of the correctness of the opinion advocated chiefly by Angström, they show clearly, I think, to what causes we have to ascribe the different results obtained by different observers. The changes through which the spectrum of hydrogen passes when the pressure is gradually diminished are, according to Wüllner,* as follows: the spark of the small induction coil begins to pass under a pressure of 135 mm.; the colour of the spark is white, but only under a pressure of 100 mm. it becomes sufficiently intense to be examined. The spectrum is a continuous one with shaded bands. This spectrum gradually increases in brilliancy down to a pressure of 30 mm. If the pressure is diminished still more the three lines $H\alpha$, $H\beta$, $H\gamma$, rise more and more from the continuous ground and the band spectrum gradually disappears. Under 3 mm. pressure only these three lines are seen, but if we continue to exhaust the tube, the continuous spectrum reappears in the green. Finally at the lowest pressure under which the spark passes a third spectrum of brilliant lines is seen. A short historical sketch will show in how far the above statement is in harmony with the results of Plücker, and will justify at the same time the course of experimenting which I have pursued.

The spectrum of hydrogen obtained by the passage of the induction current through vacuum tubes was first examined by Plucker in the year 1858, and described by him as follows:†—

Hydrogen gave a comparatively simple spectrum, in which five bands of about the same width are most prominent; a violet band A at the limit of the spectrum. Three bands in the green, B forms the limit towards the violet, and D towards the yellow. C is double the distance from D than from B. The fifth band E is in the yellow. The most intense of the three green bands is D, the colour of which is already yellowish. Next in intensity is C, and then comes B. The red is very prominent and extends over a wide space; a well-defined broad black line situated near its external limit; another broad black line separates it from the yellow band E.

The description of this spectrum agrees in its general features with the continuous spectrum described by Wüllner, and it is therefore important that already in August of the same year Plücker‡ publishes a second paper, in which he says that the above experiments had only been preliminary ones, and that the hydrogen had not been pure. Pure hydrogen, he says, shows only three lines, a red one, a greenish blue one, and a violet one which is less bright. Plücker makes repeatedly the remark that the purer the hydrogen the more concentrated is its light § on the above three lines, and he expresses the opinion that the bands seen in impure hydrogen are due to air. Later on,‖ when he was looking out for different spectra of the same gas, he found that this spectrum cannot be due to air, and must therefore be a second spectrum of hydrogen. It must, however, be remarked, that Plücker never found this spectrum so well developed as Wüllner, and this cannot be due to the fact that he did not examine it under the same circumstances, for he describes ¶ the change which the spectrum of hydrogen gas undergoes when the pressure is increased, and only mentions the expansion of the lines. Although the Leyden jar was introduced in these experiments, and the second spectrum would not therefore have appeared, it is not to be expected that such a widely different spectrum which changes entirely the colour of the spark should have escaped the notice of such an observer as Plücker when he was looking out for different spectra. The most important recent contribution to the history of this spectrum has been made

* Fortchrift der niederrheinischen Gesellschaft zur Feier des 50 jahrigen Subilaums der Univ. Bonn.

† Pogg. Ann. civ. p. 113.

‡ *Ibid.* cv. p. 76.

§ *Ibid.* cvii. p. 507 and p. 518.

‖ Ph. Trans 1865, vol clv.

¶ Phil Mag. xlii. p. 395.

by Angström,* who found that when the spark passing through a hydrogen vacuum giving the band spectrum, and at the same time, the three well.known lines (as is generally the case), is examined in a revolving mirror, two different images are obtained corresponding to the two spectra. Two different discharges must therefore take place in the tube, one of very short duration, which corresponds to the line-spectrum, and one which lasts much longer, and corresponds to the band spectrum. As this spectrum is, moreover, according to him, identical with the spectrum of acetylene obtained by Berthelot, Angström thinks himself justified in ascribing this band spectrum to acetylene.

My own experiments lead to the confirmation of Angström's supposition that the second spectrum of hydrogen is due to hydrocarbon. Generally two distinct causes, which we shall consider separately may introduce a hydrocarbon into the vacuum tube :—

1. The gas passing through india-rubber tubes will carry with it small pieces of india-rubber.

2. All the tubes are more or less greasy, and it is almost impossible to remove this greasiness entirely.

These two causes are sufficient to produce such effects as are observed by Plücker, but the spectrum obtained in consequence of these impurities will necessarily vary so much with different tubes, that the presence of impurities will soon be recognised as it was by Plücker. Such constant effects as those observed by Wüllner must, however, be due to a more constant cause, and we have not to look out long for such a cause. When Wüllner examined the spectrum of oxygen, he discovered two new spectra, and even before Angström had expressed his doubts as to the correctness of these spectra, Wüllner had found out that they were due to carbon or carbon compound, which were introduced into his vacuum tubes by the greased stop-cocks by which they were shut. Thus by the results obtained with oxygen it is proved that carbon compounds were introduced into his vacuum tubes, and we have only to consider whether these carbon compounds, which were sufficient to change entirely the spectrum of oxygen, are sufficient to make themselves perceptible in hydrogen. But Berthelot has shown that benzole mixed with a large quantity of hydrogen gives a spectrum of bands, and that acetylene when mixed with a sufficient quantity of hydrogen is not decomposed by the electric current.

It seems at first sight improbable that a gas passing through an india-rubber tube should carry with it a sufficient quantity of solid particles to change the appearance of the spectrum ; but Tyndall,† in his experiments on actinic clouds, mentions the effect produced by an india-rubber joint through which the gas subjected to examination had passed. The quantity of matter carried away by a current of air passing through an india-rubber tubing is not so small as might at first sight appear. The following experiment shows this. Take a piece of such tubing, and fix a small piece of glass tube to one of its ends. If the air is now sucked in through the glass tube the taste of india-rubber will make itself at once perceptible, although the mouth is not in direct contact with it. When I examined the spectrum of hydrogen, which had thus passed through an india-rubber tubing, the spectrum did not vary sensibly under different pressures. The colour of the spark was whitish, even under a pressure of 2 mm. The spectrum, evidently the band spectrum, described by Wüllner, did never show itself so well developed as is described by him, and resembled much more the spectrum as observed by Plücker. In different vacuum tubes the spectrum had the same appearance ; and I concluded therefore that the cause of impurity must lie in the tubing, which was therefore removed.

The vacuum tube was now fitted into the receiver containing the hydrogen, and sealed off at one end as soon as filled with the gas. This way of proceeding, however, presented many practical difficulties, and generally, therefore, another way was adopted. A drop of water was introduced in the vacuum tube, and after the vacuum had been made, the water was boiled, and the tube exhausted again, this being repeated until all the water had been evaporated and the air driven out. The spark decomposed the vapour, and the spectrum of hydrogen was thus obtained. Its appearance now varied much with the different vacuum tubes. One of them was carefully washed, first with sulphuric acid and then with distilled water. The spectrum obtained in this tube showed the continuous spectrum only so faintly that I think it would have escaped the notice of any observer who was not looking out for it. The influence on the colour of the spark was, however, much greater. The spark did not show that saturated red colour characteristic of hydrogen, but it was always somewhat whitish. This, however, is the nearest approach to the pure spectrum of lines which I could obtain. It is thus rendered at least highly probable that organic impurities are the cause of the observed spectrum of bands, and Angström's supposition that it is acetylene is very plausible. Wüllner examining the spectrum of acetylene, says that it is identical in the red and yellow with the second spectrum of hydrogen, but that it differs from it in the green and blue. He concludes that the acetylene is decomposed into hydrogen and carbon, that the hydrogen shows its yellow bands, and the carbon its green and blue bands. Now these green and blue bands are not at all due to carbon, but to carbonic acid, as stated by Wüllner himself, and only prove that carbonic acid was present. That the acetylene was decomposed is a supposition, which is in contradiction to Berthelot's results, mentioned above.

In order to ascertain whether the last traces of air remaining in the tube might not have an influence upon the spectrum of hydrogen, I tried to obtain the spectrum of ammonia, for this is the only compound which might possibly be formed, as aqueous vapour is always decomposed. Plucker says that ammonia also is decomposed into its elements, but I succeeded in obtaining its spectrum by the following arrangement :—A few drops of a strong solution of ammonia in water are introduced into the vacuum tubes, and the induction current is allowed to pass while the pump is being worked. Thus a vacuum is obtained sufficient to allow the passsage of the current, and at the same time the gas is constantly renewed. The spectrum of ammonia is very remarkable ; while nitrogen shows a spectrum of more than 70 lines, and the four lines of hydrogen are distributed over the whole spectrum ; a combination of these two gases when luminous gives out a perfectly homogeneous light. The colour of the spark is greenish yellow, and when examined by the spectroscope, it shows a broad band of exactly the same colour. The red and blue part of the spectrum is completely dark, while in the yellow and some parts of the green a faint continuous spectrum is seen. The wave-length of this band was determined by interpolation to be 5,686 to 5,627 x^{th} metres, and the band is therefore placed at the more refrangible end of the strong terrestrial absorption band called by Brewster δ. The spectrum of ammonia bears a strong resemblance to the spectrum of sodium, when at a high temperature its lines begin to widen.

Wüllner has discovered a third spectrum of hydrogen, which is a spectrum of lines, and appears under the lowest pressure which can be obtained. Not having a Sprengel's pump at my disposal, I could, unfortunately, not obtain this spectrum, and I merely mention here that it appears, from various remarks of Plücker, that he examined hydrogen under the precise circumstances under which this third spectrum ought to have come out. Thus, he says,* that hydrogen allows the induction spark to pass at a lower pressure than any other gas. At another place he says that when a tube filled with dry air is exhausted as far as possible, the lines of *hydrogen* and silicium appear, the lines of hydrogen being due to the hygroscopic condition of the glass. Angström believes this spectrum of lines to be due to sulphur. This is in harmony with the fact that small pieces of caoutchouc (containing sulphur) form part of the sources of error ; but Wüllner has shown that although all the lines of his spectrum of hydrogen seem to coincide with strong lines of sulphur, some strong lines of sulphur do not appear, and according to Wullner, the spectrum has in its general character no resemblance to that of sulphur. At any rate, it seems improbable that if this spectrum is really due to hydrogen, it should have escaped the notice of Plücker.

If we inquire now what bearing these results have on the general question of double spectra, we must remark that two different subjects have been mixed together. We have first bodies which are gases at the ordinary temperature, such as nitrogen, hydrogen, oxygen. The question, whether these bodies can give different spectra under different circumstances, must, I think, be answered in the negative. This was the opinion expressed by Angström from the beginning ; and although this physicist clearly obtained all the results mentioned by Plücker and Wüllner, they seem always to have left the conviction in his mind, that they are due to impurities. But there are other bodies, such as iodine, sulphur, and bromine. The existence of two spectra, in the case of iodine and sulphur, seems to be satisfactorily established by the researches of Mr. Salet. One of the

* Phil Trans. 1865.
† Tyndall, "Radiant Heat," p. 341.

* Phil. Trans. 1865.

spectra is the reversal of the absorption bands of the vapour of these bodies; while the others are spectra of lines. In the coloured vapours, the molecular constitution must be much more complex than in gases, and it is, therefore, not astonishing that such a coloured vapour should exert an absorptive influence resembling more that of a liquid than of a gaseous body. It would, therefore, show absorption bands, and if luminous, it will not show a spectrum of lines, but a spectrum of bands. At a higher temperature, however, when the vapour becomes a gas, the spectrum may change to one of lines. As a fact bearing upon the subject, I may mention the discovery made by Kundt, that nitrogen tetroxide gives the same absorption bands, whether in the form of a liquid, or in that of a vapour.

Preliminary Report of the Committee on Inverse Wave-Lengths.

The reference of spectral lines to a standard scale of wave-numbers, instead of to a scale of wave-lengths in air of a given pressure and temperature, or to any of the other scales in use, has very marked advantages. The scale of wave-numbers furnishes to the theoretical inquirer the ratios between wave-lengths, —which are what he chiefly wants—in the simplest and most conspicuous form; since a series of rays, of which the wave-lengths are in geometrical proportion, will be represented by equidistant lines upon the map. Accordingly the committee decided on reducing to wave-numbers all the wave-lengths, whether of solar lines or of the rays of incandescent vapours, which have been determined with sufficient precision. Mr. C. E. Barton has offered his services gratuitously for making the necessary reductions, and has made considerable progress with the solar spectrum. A specimen of the catalogue of solar lines was appended to this report, containing the lines from E to *b*. It is intended that this catalogue shall contain the most useful information available—namely, references to the position of each line on Kirchhoff's or Angström's maps, details of the processes by which the standard wave-numbers have been deduced, and indications of the intensity, width, and origin of each ray whenever these have been determined. The rays will, moreover, be bracketed into the groups that strike the eye in looking at the spectrum, and a number will be assigned to each group which will sufficiently indicate its position on the standard scale. It is estimated that the two catalogues—namely, the catalogue of the principal lines of the solar spectrum, and the catalogue of rays of incandescent vapours, will cost about 60*l*. The committee think that they could render the second catalogue more perfect if they were in a position to employ a competent person to revise and extend the determination of the rays of incandescent vapours, and they therefore suggest that this revision be made a part of their functions, and that an addition of 50*l*. be made to the grant for this purpose. This would increase the sum to be granted this year to 150*l*. The committee accordingly recommend that they be reappointed, and that this sum be placed at their disposal, in addition to the balance at present in their hands.

SECTION B—Chemical Science

Thursday, Aug. 15.—At the close of the President's address, Dr. Wright read the *Report of the Committee for Investigating the Chemical Constitution and Optical Properties of the Essential Oils used for Perfumes*, which was followed by a short discussion, in which Mr. Hanbury pointed out the necessity of paying particular attention to the characters of the samples of the various oils taken for experiment, and he instanced several essential oils classed under the same name but of widely different origin and possessing wholly different properties. He was under the impression that sufficient care had not been taken in the selection of the samples with which experiments had hitherto been worked.

Prof. Mallett, of Virginia, U.S., exhibited some specimens of fused metallic arsenic which he had prepared by fusing the metal under great pressure. The fact that arsenic can thus be fused has already been determined by Landolt.

Prof. Mallett also gave an interesting *résumé* of his experiments on the nature of the gases occluded by meteoric iron. The method employed by him was essentially that of Graham, the meteorite being heated in a vacuum and the evolved gases removed by the Sprengel pump. The nature of the iron remaining was carefully examined, and it appeared that the heat modified the metal in a remarkable manner, principally as regards its capability of being forged. The original meteorite could be readily forged and beaten out into a tolerably perfect blade for a paper-knife, but on strongly heating the iron so as to drive off the occluded gases (principally hydrogen, carbonic acid, and carbonic oxide) it became cold-short, and could not be forged even with extreme care. The cause of the remarkable alteration in the tenacity of the metal gave rise to some discussion, from which it generally appeared that it was due to an alteration of the schreiberite in the meteorite.

Mr. W. L. Carpenter gave a short account of the methods employed in the recent dredging operations for collecting deep sea water. In the discussion which followed Prof. Crum-Brown described the method to be followed in the forthcoming expedition. The apparatus had been proved to work exceedingly well in shallow water, but it remained to be seen how far it could be used in the open ocean and under great pressure.

Prof. Thorpe exhibited a modification of the filter-pump recently described by Mendelejeff. It acts upon the principle of the hydraulic ram, and by means of a fall of water of less than a yard a vacuum of nearly 700′ can be readily obtained. The modification consisted in the nature of the valve employed and in the method of determining the degree of exhaustion. The instrument has the advantage of portability and readiness of construction over the older form of Bunsted (which requires a fall of water upwards of 30 ft.), and is likely to come into general use.

Dr. Russell read a paper prepared by Dr. Moffatt on the tube ozonometer, which elicited some discussion as to the value of ozonometric observations conducted by means of iodide of potassium papers. The use of such papers was generally condemned by the members of the Section; but the meeting arrived at no definite conclusion respecting any other way in which the liberation of iodine may be utilised as a measure of ozone.

Mr. C. J. Woodward exhibited and described a very simple and cheap modification of Hofmann's Apparatus for the Electrolysis of Water.

Friday, Aug. 16.—Prof. G. C. Foster presented the *Report of the Committee appointed to investigate Siemen's Electrical Pyrometer*. The Committee had principally confined themselves to the determination of the constancy of the resistance of the platinum coil at high temperatures. Before the instrument can give perfectly concordant results it is absolutely necessary that the coil should be heated and cooled a great number of times. As some further alteration in the instrument was contemplated, the Committee recommended that a further application should be made to the Association in order to continue the investigations. In the discussion which followed, Mr. Dewar suggested the employment of a spectroscope with a compound prism of quartz and calc spar in the measurement of high temperatures.

Prof. Williamson read the *Report of the Committee for Superintending the Monthly Report on the Progress of Chemical Science.* The meeting cordially testified to its sense of the value of the Chemical Society's work in furthering the spread of chemical knowledge by the publication of its admirable series of abstracts of chemical memoirs published in the leading journals. Dr. Williamson assured the Section that the movement was rapidly becoming self-supporting, and that in a few years it would be no longer necessary to request the Association to supplement the funds at the disposal of the Chemical Society for the purpose.

Mr. Dewar described some experiments on the determination of the specific heat of carbon at high temperatures. The method of calorimetric measurement differed in no essential particulars from that usually employed. The temperatures employed were those of boiling zinc (1040°) and of the oxyhydrogen blowpipe which Mr. Dewar, by the method of Poullet and Deville and Troost, found to be about 2200° C. Between 0 – 1030 the mean specific heat of carbon was found to be 0·32, between 0 – 2000 upwards of 0·4. Mr. Dewar explained the variation in the temperature of the oxyhydrogen flame as obtained by Bunsen himself by the difference of pressure under which the combination of the two gases occurred in the two sets of experiments. His results on the specific heat of carbon in the main agree with those recently published by Weber. Starting from the difference in the heat of combination between carbon and oxygen to form respectively carbon dioxide, and monoxide, and making a certain assumption for the latent heat of carbon, Mr. Dewar arrives at the conclusion that the boiling point of carbon cannot possibly exceed 8000° C, and in all probability is somewhat near 7000° C.

Dr. Gladstone read a paper, prepared in conjunction with Mr. Tribe, *On the Mutual Helpfulness of Chemical Affinity, Heat, and Electricity in Producing the Decomposition of Water.* Dr. Gladstone commenced by describing the action of various metals upon water: some are able to eliminate the hydrogen from water, whilst others, and by far the larger number, are unable to do so. Zinc, if perfectly free from foreign metals, is without action on water; but if it be brought into contact with another metal even more stable in regard to its action on water, the electrical tension *plus* the chemical tension upsets the equilibrium between the atoms in the molecule, and hydrogen is eliminated. The effect of varying the distance between the plates was carefully measured, and it was found that the chemical action increased slowly up to a certain point, after which the action rapidly increases as the metals are brought into closer contact. Copper deposited on zinc foil is a very effective combination, and its action is materially accelerated by the meeting; thus, at 2° C. only 1 cb c of hydrogen was evolved per hour; 62 cbc were illuminated per hour at 55°, whereas at 93° C. as much as 528 cbc were produced. With magnesium and copper the action is even more marked. These re-actions afford methods of preparing exceedingly pure hydrogen, and they will doubtless be found useful in many operations of reduction.

Mr. Weldon described his process for the manufacture of chlorine by means of manganite of magnesium. The manganite is first produced by neutralising an acid solution of manganese chloride with Greek stone. By treatment with hydrochloric acid the manganite yields chlorine and magnesium and manganese chlorides. The solution is run out of the steel into an iron pot, and is afterwards boiled down until it reaches a temperature above 300° F., when it is run into a blind furnace and evaporated to dryness. On heating the dried residue chlorine and hydrochloric acid are evolved, and the manganite of magnesium is reproduced.

SECTION C.—Geology

The first paper was that by Prof. E. Hull, *On the Raised Beach of the North-east of Ireland.* All along the eastern coast of Ireland, from Dublin Bay northwards, there are to be found at intervals distinct evidence that the coast has been raised in recent times. This evidence is divisible into two kinds; first, the occurrence of a narrow fringe of varying elevation, forming a terrace extending for some distance inland from the coast, and composed of stratified sands and gravel, containing marine shells belonging to species now inhabiting the Irish Sea; and secondly, the existence of old sea-worn cliffs, forming the inland margin of these terraces, which are now beyond the reach of the highest tides. In the north of Ireland these cliffs are penetrated by caves, which have yielded bones of animals, some of which are extinct in that part of the country, while the gravels of the old beach contain amongst the sea shells worked flints in considerable quantity in County Antrim, which prove the elevation of the coast to have taken place since the human period.

The height attained by the beach above the present sea level is about 8 ft. in the south, but it rises gradually northwards, and there attains a height of 20 ft. The author considered this to be of the same age as the twenty-five feet beach of the west coast of Scotland, which falls somewhat in level towards the Solway; southwards this decrease in level continues, till the evidences of a raised beach almost disappear towards the estuary of the Mersey. The identity, therefore, of the phenomena on both shores is evident, and is a matter of some interest in the physical geology of these islands.

In the discussion which followed, Prof. Harkness, Mr. Pengelly, and the Rev. W. H. Crosskey took part, the last speaker insisting strongly upon the necessity of following these accumulations inland, and not confining our observations to the more attractive sections along the coast.

Mr. Jas. Howell then described the *Super-Cretaceous Formations of the Neighbourhood of Brighton*, in which the various deposits of the district were minutely described. Attention was called to the outlines of Tertiary beds on Furze Hill, and to the still smaller patches scattered over the Downs. The author, during the numerous excavations made in draining the town of Brighton, had observed that wherever brick-earth occurs with "Coombe rock" it is always the newer deposit of the two. From the deposits met with in the lower parts of the town, Mr. Howell concluded that the Brighton valley, at least as far up as the London and Lewes Road, was once covered by the tides.

Mr. W. Topley followed with an account of the *Sub-Wealden Exploration.* He first gave a brief description of the Weald and of the beds therein exposed, dwelling more particularly upon the lowest known rocks, the Ashburnham beds, in which the boring commences. He then described the older rocks as exposed in and around the coal-fields of Bristol and South Wales on the west, and the Belgian coal-fields and the Lower Boulonnais on the east. These rocks, it was stated, would certainly pass beneath the Weald, and along with them would probably occur workable coal measures, but the exact position of these last is a great uncertainty. The thickness of rock at the bore-hole, before reaching the Palæozoic beds, might be only 700ft. or it might amount to 1,600ft. The author drew special attention to the parts taken by Mr. Godwin-Austen and Mr. Henry Willett in this exploration. To the philosophic papers of the former we owe our knowledge of the underground range of the older rocks, and to the energy and perseverance of the latter is due the fact that speculation on this subject is about to give rise to actual experiment.

Mr. Godwin-Austen traced the area occupied by the old coal forests of Western Europe, and described the means by which this once united area had become broken up into separate basins. The axis of Artois and the coal-fields along its line were then more particularly noticed. He stated that carboniferous limestone had been found at a small depth in the Pays de Bray, beneath Kimmeridge clay, the whole of the lower members of the oolite series being there absent. In the area between the Pays de Bray and the Boulonnais, and under the Weald on the west of that, it was possible that coal-measures might be preserved. He protested against the sub-Wealden exploration being represented as a "search for coal;" its only object was to explore the rocks underlying the Weald.

Mr. Henry Willett gave an account of the origin and progress of the undertaking, stating that it was planned in honour of the first visit of the British Association to Sussex. He repeated Mr. Godwin-Austen's protest as to this being a search for coal, and said that this bore-hole was only the first of a series which would ultimately be necessary to complete our knowledge of the range of the Palæozoic rocks. He added that the subscriptions to the fund now amounted to 1,900*l*.

Mr. Harry Seeley entered at some length into his reasons for disbelieving that the coal-measures ever covered this area; but he, in common with other geologists, was very glad of the experiment now being made, as its results would have a very high scientific value, although commercially it would, he believed, prove a failure.

The remainder of the time was occupied by the reading of Mr. G. A. Lebour's paper *On the Geological Distribution of Goitre in England.* The author had by inquiries and correspondence collected a great amount of information upon the distribution of this disease, and his facts are of the more importance, as no information can be obtained upon the subject from Government statistical returns. He traced in detail the range of goitre over the various formations, and showed that the accepted beliefs on this subject were frequently erroneous. Thus, as regards magnesian limestone, which is commonly believed to be a very goitriferous rock, he showed that goitre was by no means so common there as in some other formations. Again, whilst on some regions occupied by carboniferous limestone the disease abounds, in others, where the general character of the rock is apparently the same, it is entirely absent. In searching for a general cause regulating the distribution of goitre, the author rejected as insufficient that generally given—the hardness of water. He showed it to be more probable that metallic impurities in the water were the cause. The carboniferous limestone was characterised by goitre almost in exact proportion to the metalliferous nature of the rock. Districts where ferruginous water occurs very commonly have goitre, particularly where the iron is derived from the decomposition of iron pyrites.

Friday, August 16.—The proceedings of this section opened with the reading by Mr. Pengelly of his *Report on Kent's Cavern, Torquay.* Specimens of bones and flint implements during the preceding year were exhibited to the meeting. Mr. Pengelly afterwards read a note *On the Occurrence of Machairodus latidens at Kent's Cavern.* This animal had been found there many years ago by Mr. M'Henry; but doubts had often been expressed as to the accuracy of this observation, and it was highly satisfactory to find that recent researches had confirmed M'Henry's discovery.

Mr. Evans made some remarks upon the flint implements found during the past year.

Prof. A. Gaudry described the various species of Machairodus, and Mr. W. Boyd Dawkins remarked upon the range of this animal, stating that the genus certainly occurred in the forest bed of Norfolk, although the species there was doubtful.

Dr. Carpenter followed with his paper *On the Temperature and other Physical Conditions of Inland Seas, considered in reference to Geology.* The general results obtained by recent deep-sea soundings were first described, the author afterwards passing to the special subject of the paper. Where seas were shut off by a narrow and comparatively shallow barrier from the great ocean it was found that the lowest bottom temperature of such seas was controlled by the lowest winter temperature of the surface. The bottom temperature of the Red Sea is about 71°, and since it appears that the distribution of reef-building corals depends not so much upon depth as upon temperature, we may expect to find them living at much greater depths in the Red Sea than anywhere else in the world. The great rivers flowing into the Mediterranean bring down a great quantity of organic matter, and the decomposition of this carries off much of the oxygen from the deeper water. Probably to this fact is owing the scarcity of life at great depths within that sea.

The author pointed out the bearing of these and similar facts upon geological speculation, and in these remarks he was followed by Prof. Phillips, who spoke of the great light which Dr. Carpenter's researches were throwing upon geology, explaining as they did how great areas of sea-bottom might be almost destitute of life, just as we find great deposits of rock to be.

SECTION D—Department of Zoology and Botany

Report of the Committee appointed for the purpose of promoting the Foundation of Zoological Stations in different parts of the world.

The Committee report that, as stated in the Report of the last meeting, the Zoological Station at Naples will be ready and in working order at the beginning of January 1873, the progress of the construction being such as to enable Dr. Dohrn to make this assertion.

This undertaking has received much official and private assistance, not only from public authorities, but in a very high degree from private persons. The Committee feel obliged to acknowledge especially the extraordinary services rendered by Mr. W. A. Lloyd of the Crystal Palace Aquarium in giving every assistance to Dr. Dohrn in so far as technical difficulties are concerned.

Special care has been taken to secure donations to the library of the Station. The eminent firm of Engelmann in Leipsig has presented all its works on Biology not previously possessed by Dr. Dohrn. Veweg in Brunswick has also sent all his publications on Biology. Theodor Fischer in Cassel has done the same. Important donations are promised by Dr. Alexander Agassiz of Cambridge, Mass., comprehending the publications both of his father and himself.

To secure the development of the library on a greater scale, it will be necessary to make general applications. For this purpose Dr. Dohrn, assisted by several of the greatest German publishing firms, is preparing an appeal to all German publishers, and he hopes also to succeed with a similar demand in Italy. The Committee hope that the British Association will lend its moral support to a similar demand in this country, not only by granting a complete set of its own publications, but by recommending a similar act to other Scientific Bodies and private persons.

The Committee are further glad to announce that some steam-navigation companies are prepared to grant a free passage to the naturalists and free transport for the goods to and from the station. As transactions are still pending between these Companies and Dr. Dohrn, the latter does not think it desirable to publish details on this point, or to mention the names of the Companies in question.

Dr. Dohrn contemplates a new step for the purpose of returning a larger income for the Naples Station. He is about to offer to several Governments, Universities, and Scientific Bodies, working tables in the laboratory of the Station for a certain annual sum. This sum would confer on the subscribing Government, University, or Society, the right of appointing a naturalist, who, on presenting a certificate to the administration of the Station, would be furnished with a working table, and admitted to a participation in all the very extensive advantages of the Station.

The Committee think well earnestly to advocate this new step of the administration of the Naples Station, the more as it lessens the burden of the single naturalist, enabling even such as are destitute of means to profit by the manifold advantages of the Station, while it secures a fixed income to the Station which would be employed in improving the technical and other means of investigation.

Mr. Lankester gave some additional account of the Zoological Station about to be established by Dr. Dohrn at Naples. During the present year he had personally had the opportunity of seeing the arrangements which were in progress.

"On the narrow strip of coast which separates the park of the Villa Reale from the sea, a large stone building is at present being erected at Naples, quietly and almost unnoticed—at least the Neapolitan press has paid no attention to it. The strength of the foundations—it has taken three months to lay them—shows that they are intended for an edifice of considerable size and durability; and on making inquiries I have learnt that this is the Zoological Station, which has been occasionally mentioned by Italian, German, and English journals during the last few months. It has been organised and is being built by a young German naturalist, Dr. Anton Dohrn, of Stettin, who, until a few years ago, was a *privat docent* at the University of Jena. He has paid nearly the whole of the expenses, which amount to about 50,000 thalers (7,500*l.*), out of his own pocket, the only assistance he has received having come from a few personal friends, who have lent several thousands of thalers for the purpose. The following is a short sketch of his plan:—The ground floor of the building, which covers an area of almost 8000 square feet, contains a great aquarium, which will be opened to the public. Dr. Dohrn hopes that the money thus obtained will not only suffice for all the expenses of the aquarium, but also afford a surplus to be employed in covering a part of the requirements of the upper story, which is to be exclusively devoted to scientific purposes. Besides the officials and servants employed in the aquarium, several young zoologists will be attached to the Station, and receive a regular salary from the director, Dr. Dohrn. Thus, a number of new positions will be opened up for young scientific men. But this is not all. As the only duty of these zoologists will be to devote themselves to certain branches of scientific work, and their exertions will be carefully directed and organised, as has long been the case in astronomical and meteorological observatories, there is every reason to hope that scientific research will be greatly facilitated and advanced by their labours. In the upper story of the Zoological Station laboratories will also be prepared for the use of naturalists coming from other parts of Italy and from abroad. For this purpose a large scientific library will be founded, Dr. Dohrn's very considerable private collection serving as a nucleus, and about twelve tables, fully furnished with the necessary appurtenances, established. Each of the latter will be provided with a number of tanks supplied with a constant stream of sea-water. Sea-fishing and dredging will be conducted on an extensive scale by means of several boats, to which, if the necessary means are forthcoming, a small steam-yacht will be added. The animals taken will be given to the zoologists for scientific treatment. It is more than doubtful whether all these rich and expensive conveniences can be furnished to zoological visitors without any pecuniary compensation; but I hear that Dr. Dohrn has drawn up a plan which will enable even naturalists of limited means to enjoy the advantages of the Station. He proposes to offer one or more tables to various governments and scientific societies for a fixed annual sum. These tables, and all the scientific resources of the Station, will at once be placed at the disposal of any naturalist who brings a certificate from the government, university, or scientific body to which the table has been let. This plan, among its many other advantages, seems to be a successful attempt to solve the difficult question as to how it is possible to unite a complete self-administration on the part of scientific bodies with the reception of pecuniary assistance from their governments.

"Dr. Dohrn speaks in the most grateful manner of the assistance rendered him by the German authorities in Italy, especially by Mr. Stolte, the consul-general at Naples, while at the same time he warmly acknowledges the interest in his undertaking displayed by the government of Italy, more particularly Signor Correnti and Signor Sella, the late and the present Ministers of Public Instruction. The difficulties in the way of the execution of his plan were neither few nor small, as may be gathered from the fact that, in spite of the readiness displayed by the municipal authorities of Naples, more than two years elapsed before a definitive contract could be concluded between the town and Dr

Dohrn with respect to the cession of a suitable site for the building."

Report of the "Close Time" Committee.

The Committee re-appointed at Edinburgh, for the purpose of continuing the investigation on the desirability of establishing a "Close Time," for the preservation of indigenous animals, report as follows :—

Believing the time had come for advantageously urging the Legislature to take further action whereby the object for which your Committee was appointed might be promoted, your Committee, after due consideration, prepared a bill, intituled an Act for the Protection of Wild Fowl, which being entrusted to the care of Mr. Andrew Johnston, M.P., was by him, Colonel Tomline, M.P., and Mr. Brown, M.P., brought into the House of Commons on February 15, and read a first time.

This bill was based on the "Sea-Birds Preservation Act of 1869," and *mutatis mutandis* only, strictly followed the provisions of this Act, which experience has shown to have fully effected the object for which it was passed, and to have given very general satisfaction to the country at large.

On the motion for the second reading of the bill in the House of Commons, June 12, the Hon. Auberon Herbert, M.P., proposed as an amendment that it was "desirable to provide for the protection of all wild birds during the breeding season;" but this amendment, which would have been fatal to the bill, was withdrawn, the bill was read a second time and ordered to be committed, June 21.

In the debate in the House of Commons on the notice for going into Committee, Mr. Herbert moved, according to notice, "That it be an instruction to the Committee that they have power to extend the protection, given under the bill to Wild fowl during the breeding season, to other wild birds." The House divided: Ayes 20, Noes 15; and thereupon Mr. Herbert moved a number of other amendments of which he had given notice, and these being accepted by the House, the bill, instead of being the moderate measure contemplated by your Committee, became one of general and indefinite scope.

By this means the fate of the bill, which had hitherto met with no serious opposition, was rendered very uncertain; and notice was given of a motion to throw it out; but on the report being taken, the bill on Mr. Johnston's proposal, was referred to a Select Committee, by whom it was still further modified; the objections urged against its sweeping clauses being overcome by limiting its effects to certain kinds of birds named in a Schedule, while the penalties for its infringement were diminished. In this form it went back to the House of Commons, and with a few other alterations finally passed that House, and was sent to the House of Lords.

In the Upper House, charge of the bill was taken by the Earl of Malmesbury, and, some fault being found with it, its provisions were further altered in committee, a person convicted of a first offence being rendered liable to a reprimand and the payment of costs and summons only. Thus modified it was returned to the House of Commons, and has since received Her Majesty's assent.

Your Committee cannot look with unmixed favour on this measure. It appears to them to attempt to do too much, and not to provide effectual means of doing it. In their former Reports they have hinted at, if not expressed, the difficulty or mpossibility of passing any general measure, which without being oppressive to any class of persons, should be adequate to the purpose. Further consideration has strengthened their opinion on this point. They fear the New Act, though far from a general measure, will be a very inefficient check to the destruction of those birds, which, from their yearly decreasing numbers, most require protection, its restraining power having been weakened for the sake of protecting a number of birds which do not require protection at all. Your Committee have never succeeded in obtaining any satisfactory evidence, much less any convincing proof, that the numbers of small birds are generally decreasing in this country. On the contrary they believe that from various causes, many if not most species of small birds are actually on the increase. They are therefore of opinion that an Act of Parliament proposing to promote their preservation is a piece of mistaken legislation, and is mischievous in its effect, since it diverts public attention from those species which through neglect, indifference, custom, cupidity, or prejudice, are suffering a persecution that will in a few years ensure their complete extermination. At the same time your Committee are glad to state that such protection as is afforded by the new Act will be extended to the particular group of birds which in former Reports they have shown to require it most—all the wild fowl named in the bill prepared by your Committee, having being included in the schedule of the Act. It is also gratifying to your Committee to find that the principle of a "Close Time" for all birds has been admitted by the House of Commons, though the application of that principle may at present be inexpedient. Your Committee therefore trust that the Act will not be otherwise than beneficial in its results, and though greatly indebted to many noblemen and gentlemen for the assistance they have rendered, your Committee cannot refrain from especially thanking Mr. Andrew Johnston, for the skill and patience he has shown in the conduct of the bill introduced.

Your Committee respectfully suggest that they may be reappointed.

Fourth Report on the Fauna of South Devon, by C. Spence Bate.

Attention had been principally directed to the development and habits of animals which had fallen under observation. This had been facilitated by the establishment at Plymouth of a marine pond as store for the Crystal Palace Aquarium. The observations had already proved interesting, and would become more so as the conditions of the pond became better adapted to Deep Sea species. It is formed out of a deep gulley in the limestone, partly extending back into a cave. At the entrance it is 11 ft. wide, and in other parts more than double; when the water is highest, its length is upwards of eighty feet. With the replacement of the original *Fucus* by green algæ, the water has become pellucid and clear. A list was given of the fish taken on the coast since the last report. Most of these have done well in the pond, the exceptions being fish of erratic habits, such as the mackerel. These, after restlessly roaming in search of an outlet, succumbed and died. Other fish thrive apparently unconscious of their confinement. The Blue Wrasse (*Labrus mixtus*) had exhibited marked sexual selection, a fact which had also been observed by Mr. Lloyd at Hamburgh. During the breeding time the male selects one out of many females, and afterwards regularly accompanies her. It had also been ascertained that the Blue Wrasse and the Spotted Wrasse were the same species. The male in confinement at Plymouth appears to be losing his fine colouration and approximating to that of the female; it seems, therefore, probable that the blue colour is more or less assumed at the breeding season.

With regard to the Crustacea, there are two subjects of interest. The first is the perceptible decrease in the numbers of the edible species, the decrease being more perceptible in the littoral than in the deep sea species. This arises from the custom of destroying the females as well as the males at all seasons of the year, and also from the preference given to the lobster for culinary purposes when laden with spawn. In the case of the crab (*Cancer pagurus*) there is not even this excuse. The marketable value of the female is at least one fifth that of the male. This arises from the smaller size, especially of the claws. Captured in greater numbers, they are wantonly destroyed, being hawked about the streets for a few pence. The capture of the lobster, he thought, should be interdicted from February until May, and that of the female crab altogether. To the assertion that the lobster and crab are so prolific as to render the destruction unimportant, there was the obvious reply, that in all those forms of life where the ova are most abundant, the development of the individuals is least quantitatively. In the case of the lobster, no one has ever seen that stage in its life which unites the animal as we know it with that which we have seen when it quits the egg, and, except the common littoral crab (*Carcinus mænas*), this is true of all the higher crustacea. Mr. Lloyd, of Hamburgh, has noticed that the male or soldier crab (*Pagurus*) in the spring takes hold of the shell containing the female, and carries it about for weeks together, and does not intercept its food as it would if a male were contained inside. He had found that crustacea might be preserved in a very superior way by keeping them in glycerine, and then drying them. Specimens preserved in this way two or three years ago were as flexible as if fresh. The soft parts should, if possible, be removed. He hoped to preserve fish in the same way. (Mr. Spence Bate subsequently remarked that after five or six years the structure of specimens preserved in glycerine appeared to become rotten. He suggested, therefore, the previous admixture with the glycerine of one-eighth of spirit of wine.)

Among the molluscs many species of *Aledone* had been captured. This was generally supposed to be a rare species, but

Octopus vulgaris proves to be the more difficult to obtain. Two specimens of *Sepia officinalis* were placed in the pond on the 8th of June, 1871. On the 12th July the female died, and was found to contain a large quantity of ova. Steps have been taken to have constructed in the cave behind the pond a case with a glass front for watching the habits of animals. The temperature of the water in the pond is several degrees below that in the tanks at the Crystal Palace.

The Mollusca of Europe compared with those of Eastern North America, by J. Gwyn Jeffreys, F.R.S.

After mentioning that he had dredged last autumn on the coast of New England in a steamer provided by the Government of the United States, and that he had inspected all the principal collections of Mollusca made in Eastern North America, the author compared the Mollusca of Europe with those of Massachusetts. He estimated the former to contain about 1000 species (viz. 200 land and fresh water, and 800 marine), and the latter to contain about 400 species (viz. 110 land and freshwater, and 290 marine); and he took Mr. Binney's edition of the late Professor Gould's Reporton the Mollusca of Massachusetts as the standard of comparisons. That work gives 407 species, of which Mr. Jeffreys considered 40 to be varieties, leaving 367 apparently distinct species. About thirty species may be added to this number in consequence of the recent researches of Prof. Verrill and Mr. Whiteaves on the coast of New England and the Gulf of St. Lawrence. He identified 173 out of the 367 Massachusetts species as European, viz. land and freshwater 39 (out of 110), and marine 134 (out of 257), the proportion in the former case being 28 per cent. and in the latter 52 per cent.; and he produced tabulated lists of the species in support of his statement. He proposed to account for the distribution of the North American Mollusca thus identified by showing that the land and freshwater species had probably emigrated from Europe to Canada through northern Asia, and that most of the marine species must have been transported from the arctic seas by Davis's Strait current southward to Cape Cod, and the remainder from the Mediterranean and western coasts of the Atlantic, by the Gulf Stream in a northerly direction.

Dr. Sclater said that it had always been an interesting problem how the similarity of the Fauna of North Europe and North America had been brought about. It was formerly supposed that a continuous land area existed between the two continents in the neighbourhood of Greenland. He was quite disposed to agree, however, that the communication had been brought about through the northern parts of Asia. In fact the fauna of Western America and of Eastern Asia had greater points of similarity than those of Northern Europe and Eastern America. For example, *Ursus horribilis* of Western America was intrinsically connected with *U. Arctos* if not merely a form of it. There were also some peculiar mammals which were identical; for example, an Insectivore *Urotrichus* was common to Japan and North Western America. With regard to birds several European types have turned up also in North Western America, a true Bullfinch for example.

Prof. Allman said that the distribution of Hydroids hardly accorded with that of Molluscs. Amongst recently collected *Tubularida* which he had examined, and all of which were new, two species only were common to both sides of the Atlantic. Our own islands, the coasts of Norway, Iceland, and Greenland, and the northern shores of the Atlantic down to Southern Nova Scotia belonged to one large province. At Florida all Eastern forms die out. Amongst the West Indian islands not a single species was common to both sides of the Atlantic. Looking at the facilities for distribution afforded by the locomotive buds of these organisms, these facts were not easy to understand.

Prof. Thiselton Dyer said that plant distribution quite supported the theory of communication between Asia and America. Prof. Asa Gray had shown that the Flora of Japan had a strong affinity to the North West American. Grisebach had endeavoured to invalidate this, but as Mr. Bentham said in his recent address, with little success. It was remarkable to find in a case like this an accordance between the facts of animal and plant distribution, because in the case of the Malayan Archipelago plants of the Indo-Malayan type extended far to the east of the limits Mr. Wallace found to exist in the case of animals.

Mr. M'Lachlan as confirming Dr. Sclater's remarks concerning the similarity of the fauna of Siberia and Eastern Asia with North America, stated that several genera of Insects are common to the two districts, though absent in Europe. He instanced especially the neuropterous genus Pteronarcys which formed the subject of a well-known memoir by Newport on the occurrence of external breathing filaments in the perfect kind of insect.

Mr. Jeffreys in reply, instanced some cases of marine shells which are common to the western or Pacific, and eastern or Atlantic coasts of North America; one of these is *Verticordia acutecostata*, which was at first known only as a tertiary fossil, but has lately been found living not only in the European seas, but also in the Gulf of Mexico, Japan, and probably Davis's Straits.

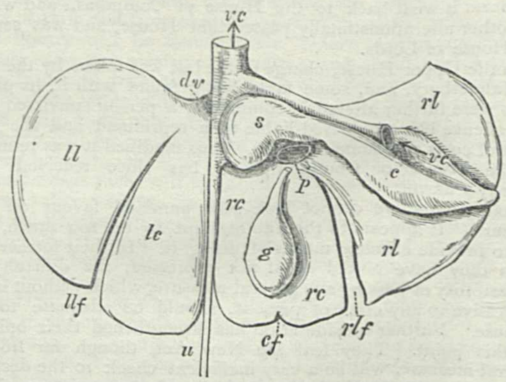
M. de Macklay had ascertained the existence of a species of sponge both in Japanese and Norwegian waters.

Department of Anatomy and Physiology

On the Arrangement and Nomenclature of the Lobes of the Liver in Mammalia, by Prof. W. H. Flower, F.R.S.

The description of the livers of various animals to be met with in treatises or memoirs on comparative anatomy are generally very difficult to understand for want of a uniform system of nomenclature. The present communication, which endeavours to supply such a system (and was illustrated at the meeting by a large series of coloured diagrams), is based upon an examination of the condition of the organ in examples of every important sub-division of the class. The difficulty usually met with arises from the circumstance of the liver being divided sometimes, as in man, ruminants, and the cetacea, into two main lobes, which have always been called respectively right and left; and in other cases, as the lower monkeys, carnivora, rodentia, &c., into a larger number of lobes. Among the latter, the primary division usually appears at first sight to be tripartite, the whole organ consisting of a middle, called "cystic," or "suspensory," lobe, and two lateral lobes, called respectively right and left lobes. This introduces confusion in describing livers by the same terms throughout the whole series of mammals, as the right and left lobes of the monkey, or dog, for instance, do not correspond with the parts designated by the same names in man and the sheep. There are, moreover, conditions in which neither the bipartite nor the tripartite system of nomenclature will answer, which we should have considerable difficulty in describing, without some more general system.

It appears desirable to consider all livers as primarily divided by the umbilical vein into two segments, right and left. This corresponds with its development, and with the condition characteristic of the organ in the inferior classes of vertebrates.



DESCRIPTION OF FIGURE.

Diagrammatic plan of the inferior surface of a multilobed liver of a mammal extended transversely. The posterior or attached border is uppermost. *u*, umbilical vein of the fœtus, represented by the round ligament in the adult, lying in the umbilical fissure; *d v*, the ductus venosus; *v c*, the inferior vena cava; *p*, the vena portæ entering the transverse fissure; *l l f*, the left lateral fissure; *r l f*, the right lateral fissure; *c f*, the cystic fissure; *l l*, the left lateral lobe; *l c*, the left central lobe; *r c*, the right central lobe; *r l*, the right lateral lobe; *s*, the Spigelian lobe; *c*, the caudate lobe; *g*, the gall bladder.

The position of this division can almost always be recognised in adult animals by the persistence of some traces of the umbilical vein in the form of the round ligament, and by the position of the suspensory ligament.

When the two main parts into which the liver is thus divided are entire, they may be spoken of as the right and left lobes;

when fissured as the right and left segments of the liver, reserving the term lobe for the subdivisions. This will involve no ambiguity, for the terms right and left lobes will no longer be used for divisions of the more complex form of liver.

In the large majority of mammals each segment is further divided by a fissure more or less deep, extending from the free towards the attached border, which I propose to call *right* and *left lateral* fissures (see Fig., *rlf*, and *llf*). When these are more deeply cut than the umbilical fissure, the organ has that tripartite or trefoil-like form just spoken of, the part between them being he so-called middle, cystic, or suspensory lobe. These terms I should propose to discontinue, and to institute *right central* (*r c*) and *left central* (*l c*) for the two regions included between the umbilical and the two lateral fissures, and to use *right lateral* (*r l*) and *left lateral* (*l l*) for the regions beyond the lateral fissures. The essentially bipartite character of the organ, and the uniformity of its construction throughout the class, is thus not lost sight of, even in the most complex forms.

The left segment of the liver is rarely complicated to any further extent, except in some cases by minor or secondary fissures marking off small lobules, generally inconstant and irregular, and never worthy of any special designation. The principal differences to be noted depend on the degree of completeness of the lateral fissure (which sometimes extends quite across the hepatic tissue completely severing the left lateral lobe), and the relative size of the two lobes.

On the other hand, the right segment is usually more complex. The right lateral fissure when fully developed passes into the right extremity of the portal fissure. The right central lobe, therefore, on its under surface does not reach to the attached border of the liver; but is always bounded in that direction by the portal fissure. Moreover, the gall-bladder when present is always in relation to its under surface. The position of this receptacle with respect to the lobe may vary—sometimes it is merely applied to its surface, loosely connected by connective tissue; in other cases it is deeply embedded in a fossa. Very often it is placed near the middle of the lobe—sometimes close to one or the other of its lateral boundaries. In many cases the fossa in which the gall-bladder is sunk is continued to the free margin of the liver as an indent, or even a tolerably deep fissure. This is called the cystic fissure (*c f*); but in consequence of its irregularity of position and frequent absence it is not of the same importance as the other fissures I have named, and does not mark off any distinct divisions of hepatic substance.

The right lateral lobe always has the great vena cava (*v c*) either grooving its surface or tunnelling through its substance near the inner or left end of its attached border, and a prolongation to the left, between the vein and the portal fissure, has long been known under the name of the *Spigelian lobe* (*s*). This is always a distinct hepatic region, sometimes a mere narrow, flat track, but more often a prominent tongue-shaped process. Whatever may be its form, it is bounded in front, or towards the free surface of the liver, by the portal fissure; on the left by the fissure of the ductus venosus (unless the vessel is bridged over by hepatic substance); posteriorly and partially on the right by the vena cava, but between this vessel and the right end of the portal fissure it is continued onwards into the adjoining part of the right lateral lobe.

The main body of the right lateral lobe is most commonly divided into two parts, not by a cleft, such as the lateral fissures, passing from the upper to the lower surface of the liver, but by one which severs a part off from the under surface. This is the *caudate lobe*, and the fissure which separates it from the right lateral lobe may be called the "fissure of the caudate lobe." In man it is almost obsolete, but in most Mammals it is of very considerable magnitude, and has very constant and characteristic relations. It is connected by an isthmus at the left (narrowest or attached end) to the spigelian lobe, behind which isthmus the vena cava is always in relation to it, channelling through or grooving its surface. It generally has a pointed apex, and is deeply hollowed to receive the right kidney, to the upper and inner side of which it is applied.

For ready comparison I have found it convenient to tint the diagrams of different livers with the following colours:—The left central lobe, dark blue; the left lateral, light blue. Where the left lateral fissure is not present, as in man, the ruminants, and cetacea, the colours will shade into each other, or the whole segment may be made of a medium shade. The right central lobe, dark red; the right lateral, light red; the spigelian, yellow; and the caudate brown. By this method the homologous parts of every liver, and the essential similarity of their construction, however diverse in appearance, may be seen at a glance.*

SECTION F—Economic Science and Statistics

Report of the Committee appointed on Uniformity of Weights, Measures, and Coins.

The Metric Committee of the British Association has much pleasure in reporting that another great stride has been made towards the uniformity in the weights, measures, and coins of all countries, by the passing of a law in Austria in June 1871, rendering the use of metric weights and measures permissive from January 1, 1873, and compulsory from January 1, 1876. The metric system is gradually diffusing itself all over Europe. At this moment fully two-thirds of that continent measured by population have adopted the metric system of weights and measures, and the other one-third has manifested sufficient interest in the question to justify the expectation of its early adhesion to the general agreement. But in this one-third there are comprised Russia and England, two countries which, by their population and commerce, exercise an enormous influence in the whole world.

The state of the question in Russia appears to be as follows:—In 1859 a Committee of the Imperial Academy of Russia, issued a report on the subject, which approved of the decimal division already incorporated in the Russian money system, and expressed an opinion in favour of extending such decimal divisions to weights and measures. In discussing, however, the possibility of even this moderate reform, the Academicians saw that such a considerable change would be required that they felt it would be far better for Russia at once to introduce the metric system, and this was the conclusion of their recommendations. Since the publication of the report, the Imperial Academy of Russia has taken an active part in advance of the system all over the world. In 1867 Mr. Jacobi was a member of the International Committee on weights, measures, and coins in connection with the Paris International Exhibition, and wrote the report which was agreed to by the representation of the nations who took part in the conference on the subject. And later still, in 1870, owing to the representations of the Imperial Academy of Russia to the French Government and to the scientific bodies of other nations of the need of preparing more accurate and metric standards for the use of countries which might adopt the metric system, an International Committee was appointed to prepare such standards. This Committee met in Paris, in June 1870, and will resume its labours in September next.

In the United Kingdom considerable progress has been made towards the introduction of the metric system, though much certainly remains to be done. In 1862 a Committee of the House of Commons was appointed to consider the practicability of adopting a simple and uniform system of weights and measures, with a view not only to the benefit of internal trade, but to facilitate our trade and intercourse with foreign countries. In discussing the question of the possible decimalisation of the existing system, the Committee of the British House of Commons, in the same manner as the Committee of the Imperial Academy of Russia, reported that it would involve almost as much difficulty to create a special decimal system of our own as simply to adopt the metric decimal system in common with other nations. And under the circumstances the Committee came to a unanimous recommendation in favour of the introduction of the metric system.

Nearly 200,000,000 of people in Europe have already recognised the metric system as the international system of weights and measures, 160,000,000 of whom have already adopted it in a compulsory manner. If once, therefore, Russia and England should finally place their legislation on the same footing, the other smaller states will certainly follow, and Europe will have attained perfect unity as regards weights and measures. But in other parts of the world also considerable progress has been made. In Asia the whole of India may be said to have adopted the weights and measures of capacity of the metric system, though some time may elapse before the Act passed by the Indian Government can be carried into operation.

In America the United States have introduced it permissively;

* The principal modifications from this common plan are described in "Lectures on the Organs of Digestion in the Mammalia," in course of publication in the *Medical Times and Gazette*.

whilst Brazil, Chili, Mexico, Grenada, and other American Republics have adopted the metric system absolutely.

Nor has there been less done as regards the coinage. If we compare the coins now in use all over the world with those in use some twenty years ago it will be seen what advance we have already made everywhere towards unity. Some countries, such as France, Italy, Switzerland, Belgium, Greece, and Roumania, have already an identical system of coinage secured to them by the Coinage Convention of December 23, 1865. The Austro-Hungarian Empire issues gold pieces marked 20 florins and 8 florins, equal to 25fr. and 10fr. respectively. Spain issues gold pieces of 25 pecates, equal to the 25fr. pieces, and Sweden the Caroline, equal to 10fr.

The Committee much regret that the German Empire, which had recently a most favourable opportunity for extending the desired uniformity, an object to which she has shown her adherence by the adoption of the metric system, has issued a new gold coinage, having nothing in common either with the money of the Convention of France, Switzerland, Italy, and Belgium, or with the monetary systems of England or the United States.

During the last year the Committee have had communications with the Indian Government on the question of introducing the metric system of weights and measures into India, the original Act by which all the weights and measures of the system were introduced having been vetoed by the Home Government, and another, limited to the weights and measures of capacity, having been passed in its stead.

The ramification of the weights, measures, and coins all over the world will be fraught with immense benefit to science, commerce, and civilisation; and scientific and philosophical bodies of all nations have given their adhesion to it; the commercial classes look for it as an essential element in the economy of time and the performance of international work, and travellers all over the world regard it as the greatest boon that could be conferred. Towards the attainment of this important object the Metric Committee of the British Association for the Advancement of Science have exercised an important influence.

SECTION G—MECHANICAL SCIENCE

OPENING ADDRESS BY THE PRESIDENT, FREDERICK J. BRAMWELL, C.E.

THE point which I have to determine is what shall my one subject be—on what shall I address you? I have thought over many subjects connected with mechanical science, but I cannot discover anything more practically important than "Coal." Very few matters are of greater real interest at all times to the nation at large, and very few are more prominently before the minds of the public at the present time, and certainly no subject can be more appropriate for a mechanical engineer, if for no other reason than this, that the steam engine is still the very crowning glory of mechanical engineering, and that coal is the staff of life, and, so to speak, the breath of the nostrils of the steam engine. The raisings of coal, which in 1855 were only 64 millions of tons in Great Britain, rose to 80 millions in 1860, and to 108 millions in 1869; and I will also advert to the fact that the price of all kinds of coal has in the colliery districts risen, speaking in round numbers, about 100 per cent. within the last twelve months, and is still rising. Let us now see how we do deal with coal in those cases where coal must be used; how we might deal with it in such cases; and how we might in certain instances substitute other sources of power for the coal which we now consume. And let us first of all consider this question of finding sources other than coal for our motive power. Before the steam engine was so extensively used as it now is, the wind, the force of the streams, and the force of the tide were all employed to give motive power. With respect to the power of the wind, it is to be feared it is too irregular to enable any manufacturer to rely upon it in competition with the steam engine. With respect to the power of our streams, the altered condition of the soil due to increased drainage and cultivation has so materially interfered with the regularity of their flow, that their efficiency as sources of constant power is seriously diminished, while competition with them by steam has become much greater than it was when the water mills themselves were better off. This state of things, however, might be cured, and, in fact, has been cured in certain districts, by the union of a large number of mill proprietors to form storage reservoirs, from which the water can be delivered with regularity so as to give an uniform supply to the mills. But the third source of water power, the tide mill, which at one time was used to a considerable extent, is almost wholly discontinued. The causes of this discontinuance are sufficiently obvious. The tide mill as formerly constructed could work for only a limited period in each ebb, and to obtain the full effect it had to utilise both the night and the day tides. But while the tide mills laboured under these disadvantages, they possessed the great merit that their power, such as it was, was one that could be depended on, and one which, although it fluctuated, fluctuated regularly and within known and definite limits. I would suggest that, in those cases where there are large manufacturing districts within a few miles of the sea, and where there is a rise and fall of the tide, coupled, in the outset at all events, with natural indentations of the coast which might be comparatively readily dammed up for the storage of the water, there such storage should be made that the water should be set to work turbines of the best kind (turbines which will work with very nearly the same per-centage of the total power given out by the water at any particular moment, whether they are immersed or whether they are not); that these turbines should be employed in pumping water at a high pressure into Armstrong accumulators; and that pipes should be laid on from those accumulators to the neighbouring manufacturing town, and should there deliver their power to the consumers requiring it, to be used by them in water-pressure engines. Suppose a beginning were made with the city of Bristol, which is no doubt a very favourable instance for the application of this suggestion. Here the rise and fall of the tide might safely be taken at 24 ft. Half a square mile of water enclosed would, after the most lavish deductions for loss, yield, in Bristol at least, 5,000 horse-power, probably sufficient to replace the whole of the power of the stationary engines now at work in Bristol. I will now consider the question how coal is wasted in its use, but before doing so I will say a few words upon the loss that occurs in the coal mine itself. Happily, this loss has for some years past been greatly reduced. More economic systems of working have prevailed, plans of dealing with small coal by washing away its impurities, so as to render it fit for cokeing, have been largely adopted, and thus a great deal of that coal which a few years since would have remained buried in the mine, as not justifying the expense of raising it to the surface and of paying royalty upon it, is now brought to light and is utilised. Nevertheless we know that at ordinary prices of coal it is to the advantage of the colliery proprietor in many instances to leave a considerable per-centage of the seams that are worked rather than to endeavour to lessen that per-centage by the use of a more expensive system of artificial support for the roof, and further that it also pays him to leave altogether unworked very thin seams of coal. Hereafter, when coal becomes scarce, there can be no question that the inhabitants of these islands would be glad to make use of the now despised unworked seams, and also to recover the buried coal of the worked seams; but such seams and such savings, although they can be worked and made at present, when the mines are open, if not at profit, yet with little loss, will then only be capable of being reached by a reopening and pumping out of abandoned mines, a process so expensive that great indeed must be the need of our successors if they are compelled to resort to it. I now come to the question of the way in which waste occurs in the use of the coals that are brought to the surface. This use may be divided into two great branches—the domestic and the manufacturing. I will consider first the domestic use. This is a highly important branch of the subject. It is believed that out of the total of ninety-eight or ninety-nine millions of tons of coal which in 1869 were retained for home use, eighteen and a-half millions of tons, about one-fifth of that quantity, were consumed for domestic purposes (about ten millions being exported). We all of us know intimately the way in which coals are burnt for domestic purposes. The other way in which we use coal is for purposes of manufacture, and this, again, may be divided into two branches at least—namely, the coal that is employed for obtaining power, and the coal that is employed in metallurgical and other operations not immediately connected with the production of power. To treat of those latter cases first, they are far too numerous to be dealt with in detail, and, therefore, only a few of the principal must be considered. Take the subject of coke making. How much coal is heated in clamps and in kilns to be converted into coke, and in how few instances is any use made of the whole of the heat residing in the gaseous parts of the coal which are driven off. This heat frequently amounts to 30 per cent. of the whole of that which is in the coal. We come next to the smelting of iron. Take the preliminary process of calcining the ore. In those cases where the ore is "black band," the ore so common in Scotland, the calcining is done by the combustion of the carbonaceous matter mixed with the ore. Far more than the quantity of fuel requisite for the calcination is associated with this ore, but the whole of it is burnt off, and no effort whatever is made to utilise the surplus heat. Then with regard to the blast furnaces for smelting iron. Here, still almost universally in Scotland, that large seat of the iron manufacture, and to a considerable extent in England, the waste gases are suffered to issue from the furnace top, illuminating the country for miles round, and bearing testimony to the indifference of the owner of the furnaces to a waste of our store of fuel. Upwards of sixty years ago—viz., in 1811—the utilisation of these gases was suggested in France, but not much was done for thirty years. About 1840, however, their use became not infrequent in that country, and French manufacturers and chemists taught us that the gas thus recklessly wasted might be collected and utilised, and made to replace the fuel expended in heating the hot blast stoves and in raising steam for the blowing engines. But, for the cause which has been and will be alluded to, the adoption of this plan was very slow indeed in England. It has now been in use, however, for many years in our best conducted works, but as a proof of the slowness of its introduction, the furnaces of Scotland, as I have already said, are even to this day almost universally worked upon the wickedly wasteful principle of allowing these gases to burn idly away. Take again the melting of steel in crucibles where the heat issues from the furnace, of necessity hotter than the heat of the melted steel (for were it not so it would cool it), and of this issuing heat, as a rule, no use whatever is made. Take again the heating furnace and puddling furnace of our iron works, very commonly from these heat at a greater temperature than that of welding iron escapes up the chimneys, disregarded as though it had cost nothing for its generation.

Next let us consider how we are dealing with coal when we use it for obtaining motive power in our steam engines. Steam engines may be divided into the four great heads of marine, locomotive, portable, and fixed. Including within the term steam engine the boiler as well as the engine, the waste may arise in a steam engine in two ways, in either one of them, or in both combined. It may arise from an imperfect utilisation of fuel in the production of steam—that is, a waste due to the boiler and to the firing; or it may arise in an improper use by the engine of the steam provided for it by the boiler. There can be no question that the boiler waste is, as a rule, very large indeed. I am perfectly certain there is hardly any subject more worthy the attention of the engineer than the replacing the stoker by some mechanical arrangement which shall afford absolute uniformity of firing, and therefore absolute uniformity of the conditions of the fire, and this is a subject not only worthy of attention on account of the saving of coal, but also on the ground of putting an end to a most laborious, exhausting, and, it is to be feared, unhealthy occupation, viz., that of the steamboat fireman, more particularly when he is working in a hot climate. If perfect combustion were obtained in the fire, I do not think there would be much difficulty in properly utilising by the boiler the heat evolved.

I have now laid before you some of the points in which the boilers and engines of the present day are below the standard to which engineering science has already reached, and in which, therefore, there is known opportunity for immediate improvement. There is a perpetual bugbear in the way of improvements, and that bugbear is the so-called "practical man," and he was in my mind when, in previous parts of this address, I have hinted at the existence of an obstacle to the adoption of improvement. I do not wish the section for one moment to suppose that I, brought up as an apprentice in a workshop, and who all my life have practised my profession, intend to say one word against the practical man. On the contrary, he is the man, of all others, that I admire, and by whom I would wish persons to be guided; because the truly practical man is one who knows the reason of that which he practises, who can give an account of the faith that is in him, and who, while he possesses the readiness of mind and the dexterity of action which arise from the long-continued and daily intercourse with the subject of his profession, possesses also that necessary amount of theoretical and scientific knowledge which justifies him in pursuing any process he adopts, which in many cases enables him to devise new processes, or which, at all events, if he be not of an inventive quality of mind, will enable him to appreciate and value the new processes devised by others. This is the truly practical man, about whom I have nothing to say except that which is most laudatory. But the practical man, as commonly understood, means the man who knows the practice of his trade, and knows nothing else concerning it; the man whose wisdom consists in standing by seeing, but not investigating, the new discoveries which are taking place around him, in decrying those discoveries, in applying to those who invent improvements, even the very greatest, the epithet of "schemers," and then when he finds that beyond all dispute some new matter is good and has come into general practice, taking to it grumblingly, but still taking to it, because if he did not he could not compete with his co-manufacturers. The aim and object of such a man, indeed, is to ensure that he should never make a mistake by embarking his capital or his time in that which has not been proved by men of large hearts and large intelligence. It is such a practical man as this who delays all improvement. For years he delayed the development in England of the utilisation of the waste gases of blast furnaces, and he has done it so successfully that, as I have already had occasion to remark, this utilisation is by no means universal in this kingdom. It was such men as these who kept back surface condensation for twenty years. It is such a man as this who, when semaphores were invented, would have said, "Don't suggest such a mode to me of transmitting messages; I am a practical man, sir, and I believe that the way to transmit a message is to write it on paper, deliver it to a messenger, and put him on horseback." In the next generation his successor would be a believer in semaphores, and when the electrical telegraphist came to him and said, "Do you know that I can transmit movement by an invisible electrical power, through a wire however long, and it seems to me that if one were to make a code out of this movement, I could speak to you at Portsmouth at one end of the wire, while I was in London at the other," what would have been the answer of this practical man? "Sir, I don't believe in transmitting messages by an invisible agency; I am a practical man, and I believe in semaphores, which I can see working." In like manner, when the Siemens' regenerative gas furnace was introduced, what said the practical man: "Turn your coals into gas, and burn the gas, and then talk of regeneration. I don't know what you mean by regeneration, except in a spiritual sense. I am a practical man, and if I want heat out of coals I put coals on to a fire and burn them," and for fifteen years the practical man has been the bar to this most enormous improvement in metallurgical operations. The practical man is beginning slowly to yield with respect to these furnaces, because he finds, as I have already said, that men of greater intelligence have now in sufficiently large numbers adopted the invention to make it a formidable competition with the persons who stolidly refuse to be improved. The same practical man for years stood in the way of the development of Bessemer steel; now he has been compelled to become a convert. It may be said that employers and the heads of manufactories are, as a rule, in these days, educated gentlemen, and that, therefore, it is wrong to impute to them the narrow mindedness of the practical man. I agree that in numerous instances this would be wrong; but the fact is that in many cases, I think I may say in most cases, the head of the establishment, the moneyed man, the man who by his commercial ability (that most necessary element in all establishments) keeps the concern going by finding lucrative orders, is not intimately acquainted with the practice of the business carried on by his firm. He relies upon some manager or foreman who too commonly is not the real but the so-called practical man. It is to such men as those who simply practise that which they have seen, without knowing why they practise it, that the title of practical man has most improperly been attributed, and it is on the advice of such men that the true heads of the firm too commonly regulate their conduct as to the management of their business, and as to the necessary changes to be made in the way of improvement. As I have said, the practical man derides those who bring forward new inventions and calls them schemers. No doubt whatever they do scheme, and well it is for the country that there are men who do so. It also may be true that the majority of schemes prove abortive; but it must be recollected that the whole progress of art and manufacture has depended, and will depend, upon successful discoveries, which in their inception were and will be schemes, just as much as were those discoveries that have been and will be unfruitful

But the successful discoveries, because they are successful, are taken out of the category of schemes when years of untiring application on the part of the inventors have, so to speak, thrust them down the throat of the unwilling practical man. Take the instance of Mr. Bessemer, who was beset for years by difficulties of detail in his great scheme of improvement in the manufacture of steel. As long as he was so beset, the practical men chorused, "He is a schemer; he is one of the schemers; it is a scheme." Supposing that these practical difficulties had beaten Mr. Bessemer, and that they had not been overcome to this day, the practical man would have derided him still as a schemer, although the theory and groundwork of his invention would have been as true under these circumstances as it now is. Fortunately for the world, and happily for him, he was able to overcome these most vexatious hindrances and make his invention that which it is. No one now dares to apply the term "schemer" to Mr. Bessemer or "scheme" to his invention; but it is as true now that he is a "schemer," and his invention a "scheme," as it would have been had he failed up to the present to conquer the minor difficulties. It is a species of profanation to suggest, but I must suggest it, for it is true, that Watt, Stephenson, Faraday, and almost every other name among the honoured dead, to whose inventive genius we owe the development that has taken place within the last century in all the luxuries, the comforts, and even the bare necessities of our daily existence, would, in their day, and while struggling for success, have been spoken of as schemers even in respect of those very inventions of which we are now enjoying the fruits. But I feel I need not labour this point further at a meeting of the Mechanical Section of the British Association—an Association established for the advancement of science. I know I shall be accused of decrying the practical man, and of upholding the schemers. I say most emphatically that I do not decry the practical man. I plead guilty to the charge of decrying the miscalled practical man, and I glory in my guilt; while I readily accept that which I consider the praise of upholding "schemers," and I do so for this simple reason that if there were no schemers there would be no improvement. I think it becomes a scientific body like the British Association to laud the generous effort of the unsuccessful inventor rather than to encourage the cold selfishness of the man who stands by and sees others endeavour to raise the structure of improvement without lending a hand to help, and even sneers at the builders, but when the structure is fully raised and solidly established, claims to come in to inhabit, and being in probably essays, cuckoo like, to oust the builders, and to take possession for his own benefit. One word in conclusion. Can we not devise some means by which consumers of coal may be instructed in, shamed into, or tempted to the economical use of that most valuable material? The Royal Agricultural Society of England, by its judicious efforts for many years past by the institution of trials and the giving of prizes for the best engines, has brought the consumption of coal down from 10 lbs. per horse-power to a little over a quarter of that quantity. Could we not institute a Society which should devote itself to the recording and the rewarding of the performances of steamboats and of fixed engines for land purposes? I am aware it is supposed that there is a difficulty in these cases which does not obtain in the case of portable engines that can be brought for trial upon a dynamometer, and that is, that the power exerted by marine engines varies during the voyage, and is not that which is developed at the measured mile, while in a manufactory it varies according to the conditions of the trade, and to the extent to which the British workman condescends to attend to his work. But there are implements which record the horse-power exerted from moment to moment, and register it on indices as readable as those of an ordinary counter of an engine, or as those of a gas meter. I believe that one of the very greatest incentives to economical working which the owners of steamboats could offer to their engine builders and engineers would be the application of such implements as these. Were they employed, the shipowner would know at the end of the voyage so much horse-power had been exerted as a whole, and that so much coal had been burnt, and that the result, therefore, was a consumption of so many pounds per horse-power per hour. All excuses of head-winds, and all the aid of canvas to the engine-power, would be eliminated from the calculation. The continual indicator would register truly the work the engine had to do, whether that work was made excessive by contending with head winds, or was rendered light by favourable breezes and the assistance of canvas. In the same way the proprietor of the engine for manufacturing purposes, the cotton mill, the woollen mill, the corn mill, and even the highly irregularly working rolling mills and saw mills, would be able at the end of the quarter to say: "Notwithstanding all the variations of my trade and rate of manufacture, I know that my engines have exerted so much power, I know that I have burnt so much coal, and that therefore such and such have been the economic results." Assuming that steamboat proprietors and the owners of fixed land engines would go to the expense of applying such continuous recording implements as these to their engines, and would become members of an association for the purpose of visiting and inspecting and of reporting upon their machinery, and of giving prizes to the men in charge for careful attention; prizes to the manufacturers for original good design and workmanship of the engines; and prizes to the proprietors for their public spirit in having bought that which was good instead of that which was bad and cheap, and for having employed intelligent and careful workmen instead of ignorant and careless ones,—I believe within a few years as great an improvement might be seen among the marine and manufacturing class of engines as has been effected by the laudable exertions of the Royal Agricultural Society of England among the portable ones. I think the initiation of some such society as this would be a practically useful result from the meeting of Section G.

SOCIETIES AND ACADEMIES

PARIS

Academy of Sciences, July 29.—Mr. Cayley presented the continuation of his memoir on the condition enabling a family of given surfaces to form part of an orthogonal system.—M. de Saint-Venant communicated a note by M. J. Boussinesq on a simple mode of determining experimentally the maximum resistance to sliding in a ductile, homogeneous, and isotropic solid.—M. Yvon Villarceau presented a note on a new theorem in general mechanics.—M. W. de Fonvielle read a notice of the results of observations on recent thunderstorms.—A note from M. P. Volpicelli on the theory of Nicholson's duplicates was read.—M. E. Becquerel presented a note by M. A. Cazin on the quantity of magnetism of electro-magnets.—M. C. Sainte-Claire Deville communicated a note by M. de Tastes on the fall of an aërolite in the commune of Lancé (Loir-et-Cher) on July 23. This fall took place about half-past 5 P.M., with a clear sky and bright sun; it was accompanied by a violent explosion heard over a great extent of country. The course of the meteor was from S.W. to N.E., and it appeared to be double, or to consist of two meteors following a parallel course. A large portion fell and buried itself in the ground to the depth of 1·50 metre.—M. Boussingault read a memoir in continuation of his researches upon the presence of iron in the organism; it related to the distribution of iron in the materials of the blood. The greatest portion is contained in the globules.—M. Daubrée presented an investigation of the meteorites of Ovifak, with regard to the amount of carbon and of soluble salts which they contain.—M. Berthelot presented a note on the constitution of acid salts in solution; M. J. A. Le Bel a note on the pyrogenated carburets of Pechelbroun; and MM. Girard and De Laire a note on the colouring matters derived from aniline, in reply to a recent communication by M. Lauth.—M. C. Sainte-Claire Deville presented a note of an examination by M. Gorceix of the gaseous emanations of Santorin during the close of the eruption of 1866.

CONTENTS

ERRATA.—Vol. vi., p. 266, 1st col., line 19 from bottom, for "bulk" read "bulb;" line 9 from bottom, for "plane" read "pane:" 2nd col., line 16 from bottom, for "behind" read "between;" p. 267, 1st col., line 20, for "pressures" read "temperatures."