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## *THE SCIENCE COMMISSION REPORT ON THE ADVANCEMENT OF SCIENCE*

IN our last issue we published the substance of the Eighth and final Report of the Royal Commission on Science, presided over by the Duke of Devonshire, which includes the measures deemed by that body necessary for the advancement of science in England.

We now propose to lay before our readers a summary of the evidence on the above branch of the investigation undertaken by the Commission. It must be borne in mind that the evidence given on this topic fills a Blue Book of more than 400 closely printed pages, and the extracts from it with which the Commissioners fortify the Report now under notice fill some forty pages. These extracts] have been selected with obvious impartiality. The further compression which it must undergo in order to fit it for our columns must necessarily weaken the force of the testimony borne by a cloud of able witnesses. All we can hope to do, within our limits, is to give an idea of some of the salient points established, and of the general tendency of the whole.

Adhering to the subdivision, adopted by the Commission, under four principal heads, we proceed to

### I.—*The Scientific Work carried on by Departments of the Government.*

The following enumeration of State Scientific Institutions now existing, together with that of the various Departments responsible for them, is given on the authority of the Royal Commission :—

Topographical Survey [Treasury (Office of Works)].
Hydrographical Survey [Admiralty].
Geological Survey [Privy Council].
Astronomical Observations :—
Greenwich and the Cape of Good Hope [Admiralty].
Edinburgh [Treasury (Office of Works)].
Meteorological Observations :—
Greenwich [Admiralty].
Edinburgh [Treasury (Office of Works)].
The Meteorological Office.
[The Meteorological Office is not administered by any Public Department, but is directed by a Committee, which, although appointed by the Royal Society, is independent of that body.]
Botany.—Royal Gardens, Kew ; Botanic Garden, Edinburgh ; Botanic Gardens, Dublin [Treasury (Office of Works)].
The Chemical Department of the War Office.
The Standards Department of the Board of Trade.
Analogous work is carried on in some of the colonies and foreign possessions by departments of their respective Governments.

In one case, that of the Royal Observatory, Greenwich, the work is examined into and reported on to the Admiralty by a Board of Visitors composed of men of science.

This extraordinary list is substantially that with which Col. Strange opened his evidence as the foundation on which the present demands for reform must be based. It establishes conclusively three most important points. (1) That the State does, and therefore should, actively aid scientific research. (2) That it does so partially, many essential branches being without aid. (3) That a divided administration such as this list of six or seven departments concerned with science indicates, cannot possibly secure harmony, systematic efficiency, or the extension which, as knowledge and the wants of the nation advance, may be requisite.



The Commissioners then add the following statement, showing the annual charges borne by imperial funds, at the present time, to defray the expenses of such of these various investigations as appear separately in the Estimates for the year 1874-75 :—

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| Topographical Survey (excluding military pay of men employed) ... ... | £132,000 |
| Hydrographical Survey ... ... ... | 121,055 |
| Geological Survey ... ... ... ... | 22,920 |
| Astronomy ... ... ... ... ... ... | 9,703 |
| Meteorology ... ... ... ... ... ... | 12,082 |
| Botany, including the maintenance of Botanical Gardens as places of public recreation ... ... ... ... | 21,470 |
| Standards Department of the Board of Trade ... ... ... ... ... ... | 2,063 |

In addition to these recurring charges, sums are voted from time to time for various expeditions and for experiments incidental to the services of the various departments, such as the investigations concerning the causes and processes of disease carried on under the direction of the Lords of the Privy Council, and the various experimental researches carried on for the army and navy.

Even if no questions of completeness or extension were raised, the fact of an expenditure, reaching probably about half a million annually, without any pretence of a system to regulate it, is one in itself deserving very serious consideration.

As to the insufficiency of our present administrative arrangements, we have valuable evidence from several Government officials and gentlemen engaged in national works.

Sir Henry Rawlinson, a member of the Indian Council, states that in that Council they perpetually have references before them which they are unable to deal with. He adds :—

" We have, for instance, Sir William Baker upon the Council, and General Strachey and Colonel Strange, both attached to the office ; yet, notwithstanding their valuable aid, there are many subjects referred to us with which we are quite incompetent to deal."

He then refers to the following subjects among others : —The Manufacture of Iron and Steel in India ; the Efflorescence of Soda on Irrigated Land ; the Fermentation of Beer, " which may involve a loss of 200,000*l*. or 300,000*l*. a year to the British Government ;" the question of Drought arising from the Destruction of Forests ; the Construction of Harbours and of other Hydraulic Works ; the Founding of Brass Guns ; Tidal Observations ; the Publication of Works on the Flora and Fauna of India ; Geological and Trigonometrical Surveys ; Sea Dredging ; and Observatories.

He points out that many of these questions are practical and economical, but that still there is a scientific element in almost all of them, and he adds :—

" References on all these subjects are constantly coming home, and we have no means of answering them in our own body, while it is very unsatisfactory to be obliged to send out for gratuitous information. We do sometimes, it is true, apply to individuals and sometimes to societies, but in very many cases, I am afraid, the questions are shelved, because there is no competent and authoritative body to refer to."

Capt. Douglas Galton, of the Office of Works and Public Buildings, thinks that, as a rule—

" Our statesmen do not appreciate properly the value of scientific advice or scientific inquiry, and that they are very much fonder of experiments made upon a large scale with no defined system, than they are of experiments which have been brought out as the result of a carefully studied previous inquiry. I think that an enormous amount of money was wasted in the case of the inquiry into armour plates, both for ships and forts. In that case the Government appointed a partly scientific committee, but it was mixed up with other persons who were not scientific; and instead of commencing a series of experiments upon a small and clearly defined scale, from which they could have drawn conclusions for making their larger experiments, they began by firing at any plates that were offered to them which had no relation one to another, either in their relations to the guns or to the form of backing, or in any other way, and consequently it was difficult to draw useful calculations from them."

Mr. Froude, who was a prominent member of the late Committee on Naval Designs, and who is now devoting his whole time without remuneration to the investigation of the proper forms of ships of war, states that if, at an earlier time, a laboratory had existed, and proper experiments had been made, enormous sums would have been saved which have been expended in the actual construction of ships, or, as he terms it, in "experiments on the scale of twelve inches to a foot;" and that definite results would have been arrived at with less loss of time.

It will be seen from the evidence of General Strachey that he also disapproves of the mode in which Government is at present advised on questions of science, especially on the ground of the absence of scientific training in the political and official classes of this country.

Sir Wm. Thomson has given the following evidence :—

" With a vast amount of mechanical work which is necessarily undertaken by the Government, and which is continually in hand, questions involving scientific difficulties of a novel character frequently occur; questions requiring accurate knowledge of scientific truth hitherto undeveloped are occurring every day. In both respects the Government is at present insufficiently advised, and the result is undoubtedly that mechanical works are sometimes not done as well as they might be done, that great mistakes are sometimes made; and again, a very serious and perhaps even a more serious evil of the present system, in which there is not sufficient scientific advice for the Government, is the undertaking of works which ought never to be undertaken."

" Are you able to point out any instances which you have in your mind of mistakes which you think have occurred from the want of good advice on the part of the Government?—One great mistake undoubtedly was the construction of the *Captain*, and I believe that a permanent scientific council advising the Government would have made it impossible to commit such a mistake. They would, in the very beginning, have relieved the Government from all that pressure of ignorant public opinion which the Government could not possibly, in the present state of things, withstand."

The present system of Special Committees is objected to by Sir William Thomson, and by other competent witnesses.

Sir William Thomson thinks "that a single body would be better than a number of small committees for advising the Government on the great variety of questions which from time to time would be likely to arise."

Admiral Richards, late hydrographer of the Admiralty, is of opinion that—

" The members of such committees must be selected more or less to fulfil certain political conditions, and that, as a rule, they would come new to the subject that they were going to consider, and I do not believe that the Commission which sat on the Naval Designs the other day was a very successful one. I do not know that any great advantages have arisen or are likely to arise from it."

Mr. Froude, in reply to the remark, "You do not consider committees of that kind to be a very satisfactory way of proceeding?" thus states his objection to the present system :—

" I do not think so, because they have to find out the dream and the interpretation both, which is always a difficulty. They have to feel their way to a *locus standi*, which would already be possessed by a Council habitually operating with reference to the subject."

Additional examples of these defects are given, not only by these witnesses, but also by others, whom we shall quote when dealing with the proposed remedies.

Evidence was taken by the Commission as to the insufficiency of the present appliances for investigation.

The attention of the Commission was especially directed to the want of laboratories for the use of the officials charged with scientific investigations urgently required for the economical management of the public departments.

Mr. Anderson, the superintendent of machinery at Woolwich, who has been responsible for the expenditure of "very nearly 3,000,000*l*. of public money," points out that there are no means at the disposal of State servants to enable them to investigate questions on which large expenditure depends. With special regard to his own department he states :—

" There is a very great deal which I should like to see taken in hand systematically. There is much that we are in the dark about; we are groping in the dark in almost everything at present."

" . Although we know a very great deal with regard to iron, cast, wrought, and in the condition of steel, there is yet very much which we do not know, and I am persuaded that if we could with certainty treat ordinary cast iron in the way that we sometimes do, nearly by chance, we would do away with three-fourths, or a very large proportion of the wrought iron which is now used in this country, and we should use cast iron."

He next refers to another question of great importance to almost all the public departments :—

" There is another very important subject which I might mention to the Commission. Some twenty years ago we were using ten or twelve pounds of coal per horse-power per hour, and the majority of engines still require six pounds, but by the improvements that have taken place we are now down to two pounds. There is a little engine at work now in the London district which is working at 1¾ pounds. There is a great gulf yet between getting steam-engines that will work at 1¾ pounds per horse-power per hour, and the point where we are now; I mean getting that done practically: but I believe that if the right man, or two men, were told off to thoroughly investigate this subject, and not to stop working until they had brought it to a practical shape, we could in ten years from this time get down to one pound per horse-power per hour. I see that there are very many leakages or loss in steam-engines in the very best way that we make them at present. The knowledge that was gained by Joule's experiments a few years ago seems to me to have been of immense value. Those experiments that he carried out for himself were the sort of thing which I think the Government should have done for the sake of the country. He did more to make engineers thoroughly dissatisfied with their present knowledge with regard to what they can do with steam than anything which had been done before. I believe that what Mr. Joule did will do more for this country than even what James Watt did. The part that James Watt took was very great, and the world gives him full credit for it, but the world is scarcely willing to give credit to Joule for what he will do; but he has made all engineers dissatisfied. They know that the best steam-engine is not doing one-sixth of the work which it ought to do and can do. That is a sad state of matters to be in when we know that we are so far wrong, but yet no one will go to the trouble of going to the end of the question so as to improve the steam-engine as it might be done; in fact, it will cost a great deal of trouble and a great deal of expense, I have no doubt."

With regard to the question whether it is "desirable that the Government should establish any laboratories for carrying on those investigations," he thus stated his opinion :—

"I should like to see a grand laboratory fitted with everything that would go towards the investigation of such matters, and at the same time a testing apparatus for getting at the physical facts as well. To get up the proper plant would be very expensive, but still I should like the nation to have it, so that any public department could go to this same laboratory and ask them for assistance to investigate any doubtful point."

Mr. Anderson's evidence finds a parallel in that given by Mr. E. J. Reed, M.P., late Chief Constructor of the Navy. He says :—

"I think that there are many branches of science remaining undeveloped at present, the development of which would be of great advantage to the country. I base that opinion partly upon the experience which I acquired at the Admiralty, in which I continually found that great and important questions were undeveloped for the want of organisation and of the means of developing them."

". . . A second illustration which I should like to give is this: the present condition of the marine steam-engine and boiler is very unsatisfactory. It is unsatisfactory to such an extent that I believe if the manufacture of iron and steel were improved with reference to its use in the construction of engines and boilers, and if improved material were applied by improved methods, a saving of one-half of the present weight would be attained; and when I say one-half, I know that I am speaking greatly within the limits which some persons who have thought very much about this question would be prepared to express. Of course, if that be so, if we are carrying about in our mercantile and other steamships twice the weight which is essential for the production of the power, that is so much taken off either from the further power and speed which might be obtained, or from the freightage and commercial value of the vessel.

"I may mention that in the manufacture of shafts, for instance, of the marine engine and of stern posts, and other large forgings for ships, the method of production is comparatively rude, and it very much needs development. . . . So much has the subject been neglected, that at this moment I have the responsibility of seeing some very large forgings indeed made for certain ships, and the most effectual manner in which I can give effect to my responsibility is that of selecting the very best working smith that I can find, and putting him into the manufactory where those things are being made, for him to do the best that his experience enables him to do, in order to see them properly constructed. I believe that if a regular independent scientific investigation were applied to a manufacture of that nature, enormous advantage would at once result."

The Standards Department of the Board of Trade is another department requiring advice in varied scientific subjects. The Warden of the Standards (Mr. Chisholm) states that there is no scientific authority to which he is entitled to appeal.

Sir William Thomson, in reference to the subject of standards, says :

"The conservancy of weights and measures is a subject involving questions of the most extreme scientific nicety. Faraday made statements showing how completely unknown at present are the properties of matter upon which we depend for a permanent standard of length. One of the very first objects that should be undertaken in connection with the conservancy of the standards of weight and length is secular experiments, on the dimensions of metals and solids of other classes under various conditions of stress, temperature, and atmosphere. Those would involve scientific experiments of an extremely difficult character, and also operations extending from year to year. There ought to be just now a set of experimental specimens of solids laid up which should be examined every year, or every ten years, or every fifty years, or every hundred years, the times when observations are to be made from age to age being regulated by the experience of the previous observations. This would not be a very difficult or expensive thing to institute in such a way as eventually to obtain good results, but it would be an operation of a secular character, which could only be carried out by the Government."

Dr. Frankland thus refers to the various requirements of Government involving chemical investigations :—

". . . The State requires many important investigations to be carried on. Such investigations are being continually conducted in buildings often very ill-adapted for the purpose, and which are fitted up for the purpose at a great cost. The laboratory of the Rivers Commission, for instance, which we have occupied for four years, was constructed in a house in Victoria Street; a rent of 200*l.* a year is paid for it, and it is literally nothing more than a moderate sized room, and two smaller ones, very ill-adapted for the purpose. Consequently, this laboratory is not so efficient as a building erected for the express purpose of conducting such investigations would be."

We pass now to

II.—*The Assistance given by the State towards the Promotion of Scientific Research.*

It may be convenient to consider the assistance given by the State towards scientific research as being either permanent or occasional.

Our museums of natural history are examples of the first. These afford to the students of those branches of science aid analogous to that afforded to students of literature and art by our national libraries and galleries.

No similar facilities are provided for the student of the physical sciences—such collections of instruments as exist being wholly inadequate both as to character and completeness. Moreover, as the Commissioners remark, "a mere collection of instruments, however complete, without working laboratories, is of little use to the student of the experimental sciences, and as there are no public laboratories available for the researches of private investigators, it may be said that in many branches of experimental science the State affords no permanent material aid to such investigators."

Assistance of a permanent description is also afforded to learned societies, by providing them with apartments free of rent, or with annual grants of money in lieu of such accommodation: the sum of 500*l.* granted annually to the Royal Geographical Society under certain conditions is an instance of such a grant.

We may regard as a permanent aid to science the grant of 1,000*l.* for researches carried on by private individuals, which is annually voted by Parliament, and administered by a Committee of the Royal Society.

The first proposal for such a grant was contained in a letter (dated October 24th, 1849) from Earl Russell then (Lord John Russell) to the then President of the Royal Society (the Earl of Rosse), and was to the following effect:—

"As there are from time to time scientific discoveries and researches which cost money and assistance the students of science can often but ill afford, I am induced to consult your lordship, as President of the Royal Society, on the following suggestion:—

"I propose that at the close of the year the President and Council should point out to the First Lord of the Treasury a limited number of persons to whom the grant of a reward, or of a sum to defray the cost of experiments, might be of essential service. The whole sum which I could recommend the Crown to grant in the present year is 1,000*l.*, nor can I be certain that my successor would follow the same course; but I should wish to learn whether, in your lordship's opinion and that of your colleagues, the cause of science would be promoted by such grants."

Lord Rosse, in reply to the proposal made by Lord J. Russell, expressed his personal opinion that the judicious employment of grants in the way proposed "would very materially promote the advancement of science;" and of the two alternatives, namely, expending the 1,000*l.* in rewards, or appropriating it to the payment of the expenses of experiments, he preferred the latter, indicating his reasons as follows:—

"There are often details to be worked out before it is possible to employ usefully newly discovered principles. In many of the sciences reductions are required before observations can be made use of. Both in science and art, facts technically called constants are the materials of discovery; to determine them accurately is of great importance. Now in all these cases, and in many others, the work to be done is laborious and expensive, and as it adds but little comparatively to the fame of the individual, it especially requires encouragement."

With regard to this "Government grant" Sir Edward Sabine in his evidence says: "I suppose that the 1,000*l.* in one year was designed as an experiment to try the matter in the first instance. I always understood that Lord Russell contemplated that the sum would be augmented if the plan were found to work well."

No change however has been made either in the amount of the grant or in its mode of distribution since its first establishment.

As examples of the second—occasional—kind of aid, expeditions for special researches, outfits of ships, and apparatus and grants of money for such researches, are mentioned. Great as is the value of these contributions, the Commissioners pointedly remark that "they do not appear to be granted or refused on any sufficiently well-defined principle."

The lesson, indeed, which crops up throughout the invaluable investigations of this Commission, is that there is a total want of system in almost all that we do, as a nation, towards advancing scientific research.

(*To be continued.*)

## THE ENCYCLOPÆDIA BRITANNICA

*The Encyclopædia Britannica; a Dictionary of Arts, Sciences, and General Literature.* Ninth Edition. Vol. II., ANA to ATH. (Edinburgh: Adam and Charles Black, 1875.)

IN reviewing the first volume of this new edition of the "Encyclopædia" (NATURE, vol. xi. p. 343), we were obliged, by want of space, to omit more than the briefest possible remarks upon the general plan of the work. The conspicuous and increasing success of the work is apparently a sufficient answer to those who would find fault with the form of arrangement peculiar to this "Encyclopædia." Among the considerable number of Cyclopædias which have been produced in Great Britain during the last hundred years, this one, almost alone, has been reproduced in a number of successive editions, growing in excellence and reputation, and many people might take this fact to be a sufficient proof that it is well designed to meet a general want. But this success must surely be due in great degree to the eminence of the contributors, to the skill of the editors, or to any circumstance rather than the scheme of the work.

We have always been unable to comprehend the exact *raison d'être* of a cyclopædia which is neither strictly alphabetical nor strictly systematic. The "Britannica" may be compared to a solid body of pudding with plums in the form of excellent treatises disposed here and there. Now we entirely fail to perceive any convenience in this mode of construction. That it is not very suitable for the purpose of simple reference seems to be proved by the need of a full index to the whole of the volumes. Nor, if a person wishes to use one of the articles for careful continuous study in the manner of a text-book, is it convenient to have it embedded in a very heavy quarto volume, one of a large and costly series. Many valuable and highly useful treatises are in fact buried in this "Encyclopædia," and are hardly available for purposes of general reading. That this is so has been confessed by the separate publication of some of the principal treatises in former editions; those, for instance, by Sir John Herschel on "Physical Geography," and on "Meteorology."

Cyclopædias have varied in form from the purely alphabetical ones, best represented now in "Chambers' Cyclopædia," which approximates to the character of a dictionary, to "Lardner's Cyclopædia," in which each subject was treated in a distinct and handy volume. Coleridge tried to combine the two principles in the "Encyclopædia Metropolitana," in which all sciences and branches of knowledge were to be expounded in a series of elaborate treatises, arranged according to logical method, while an alphabetical dictionary of reference was added as a complement. The treatises contributed to this work by Herschel, Airy, De Morgan, Peacock, Whately, Senior, and others, are some of the most profound works in English scientific literature, and maintain their scientific value after the lapse of forty years or more. It was the weight of these too-valuable treatises which damned the commercial success of the whole scheme.

The "Encyclopædia Britannica" has effected a compromise between the systematic and alphabetic methods in another way, altogether inferior in a logical point of view, but far more successful as actually carried into effect. In this volume we have forty-four important articles, almost every one of which is written by a master of the subject, if not in every case by its most eminent representative. The longest of these except one is that on *Astronomy*, by Mr. R. A. Proctor. It occupies eighty quarto pages, in addition to four large plates of engravings, and might be easily made to fill a good-sized octavo volume of 400 or 500 pages. This article is on the whole a satisfactory compendium of the science, but it is matter of regret that Mr. Proctor cannot avoid exhibitions of bad taste. He has no right to insinuate in the second column of p. 786 that two of the joint authors of an important scientific paper are the *assistants* of the one first named. The accuracy of some of Mr. Proctor's statements as to the history of recent discoveries in solar astronomy would have to be seriously called in question, were it possible in an article of this kind to enter upon a subject involving many details.

One of the most profound and at the same time interesting articles is that of Dr. E. B. Tylor on *Anthropology*, occupying about sixteen pages. As we should expect from the principal founder of the new science, it contains a luminous abstract of the evidence concerning the antiquity, descent, and development of the human race, mainly brought to notice since the last edition of the "Encyclopædia" was published. Taken in connection with Prof. Daniel Wilson's article on *Prehistoric Archæology*, and Prof. St. George Mivart's elaborate account of the *Ape Family*, filling twenty-one pages, we have in this single volume of the work a full supply of information relating to the origin and affinities of the human species. It is curious to compare the views discussed in these articles with those propounded in earlier editions of the "Encyclopædia" under the title "Creation."

Probably the longest article in the volume is that, the joint production of Prof. T. Hayter Lewis and Mr. G. E. Street, upon *Architecture*, which, taken together with a very useful glossary of architectural terms, extends over ninety-four pages. If reprinted in a separate volume it would form a convenient and much-needed text-book of the science. As treated by Mr. Ferguson, the history of architecture forms in fact one of the most instructive branches of the new science of Sociology, and no subject of study is better calculated to produce correct views of the origin and development of civilisation. We are unable to understand why the work of Mr. Ferguson is referred to in the Bibliography of the subject (p. 457) only under the head of Chinese Architecture.

It will be a matter of regret to many that Professor Huxley's article on the *Classification of the Animal Kingdom* is restricted to six pages, but it is surprising how many profound remarks he has managed to compress into this narrow compass. The article, however, is only suited for the reading of experts. The article, again, on the word *Aryan*, by Prof. Max. Müller, is another one of which the brevity must be lamented, unless it be supplemented by other articles on closely allied topics, to which there is no reference.

In spite of the fulness and excellent quality of some of the articles relating to physical or natural science, we entertain some fear that the weakest side of the "Encyclopædia" will lie in this direction. The method of arrangement prevents us from speaking with confidence, because it is impossible to say how far subjects which are weakly treated or altogether omitted in their alphabetical place, will be introduced into later systematic articles. There are indications, however, that Prof. Spencer Baynes is not as ably supported in chemical, mathematical, or general physical subjects as he should be. The brief account of *Antimony*, for instance, is a very perfunctory production, and, if the other elements are to be treated in like manner, we should prefer to find them omitted altogether. If Mr. Baynes can spare barely more than one column for an element of considerable importance, he need not have told us that the paint said in the Holy Scriptures to have been used by Jezebel was made of stibnite containing antimony. Nor need a sentence have been wasted in repeating a tradition to the effect that the metal was called antimony because a preparation of it proved fatal to monks (hence *antimonachos*), a tradition, it is added, which will hardly bear investigation. If so, why give the tradition when there is so much else of importance omitted.

The article on *Assaying*, though not positively bad, is not up to the proper mark, and is not sufficiently precise to be of any technical value. The subject should either have been omitted or more developed, and placed in the hands of Mr. Chandler Roberts, the chemist and assayer of the Royal Mint, who would have been in every way the most fit writer to treat it.

We hope that the column given to *Anthracite* is not a specimen of the way in which so important a subject as Coal is to be dismissed. Yet it contains no reference to Coal, Fuel, or other articles on related topics. Moreover, we are unable to comprehend why, if there is to be a satisfactory systematic article on Coal, as surely there must be, this brief separate account of anthracite should be given. As the article remarks, "No sharply defined line of demarcation can be drawn between anthracite and the bituminous varieties of coal, as the one series merges by imperceptible degrees into the other." If so, why allow the mere name to give rise to a separate article, when the alphabetic system is not observed in other cases?

Every now and then the mixture of systems gives rise to a waste of space by useless repetitions. Thus, under *Asteroids*, we find an article of seventeen lines, ending with a reference to p. 806 in the article on *Astronomy*. Turning to this page, we find a pretty full account of the asteroids, filling four columns, and containing a complete and useful table of the whole of the minor planets, which were 143 in number when the table was drawn up, although two or three new additions have since been made. It is obvious that a mere reference under the name *Asteroid* would have been sufficient. The editor avoids the introduction of the copious references which are to be found in the "Penny Cyclopædia," "Rees' Cyclopædia," and many other ones, but he does not do this consistently and completely. In other cases subjects of considerable importance are treated with the brevity of a dictionary, and yet no references are added. Take, for instance, the account of the word *Anodyne* given in seven lines, and containing merely the meaning and etymology of the name, and a list of six substances used as anodynes. There is no reference to anæsthetics or any other article where the subject might be fully studied.

Perhaps the worst article allowed to stand in this volume is that under the word *Angle*, which tells us in twenty-seven lines, and by aid of a figure, what an angle is, what a right angle is, how the whole circumference is divided into 360°, and so on, concluding by a reference to geometry and trigonometry. Such a puerile description of the word would not be tolerated in "Chambers' Information for the People" or Cassell's Popular Educational works. There is only a single sentence in this article which could in all probability give new information to any person likely to consult such a work as the "Encyclopædia Britannica."

It is not our duty, of course, to form any judgment upon the larger part of this volume, which treats of literary or artistic subjects. The many articles treating of classical, biographical, geographical, and other information are probably on the whole superior to the parts devoted to physical and mathematical science. The scarcest and perhaps the weakest articles altogether are those on mathematical topics. There are, indeed, in this volume only two articles of any length which can be called mathematical. That on *Annuities* is a fair one, especially as supplemented by other articles to which reference is made. That upon *Arithmetic*, however, is a very dry, perfunctory production, chiefly consisting of a mere compendium of the ordinary rules. We do not recognise the name of the author by his initials, and the name is not made public in the list of principal contributors. It is obvious that the "Encyclopædia Britannica" will not compare in the mathematical department with the "Penny" or the "English" Cyclopædias, which contain a splendid series of articles by De Morgan of permanent interest and value. While, therefore, we can entertain no doubt that, taken as a whole, the "Encyclopædia Britannica," as now republishing, is excellently edited, we think that Prof. Baynes is inclined to sacrifice in some degree the less for the more popular branches of knowledge.

We are driven to this conclusion when we compare the number and length of the articles given to the more severe scientific subjects with those upon more popular topics, such as *Architecture* and *Archæology*. The treatise on *Army*, again, taken in connection with that upon *Arms and Armour*, takes up a very large amount of space. No doubt it is requisite that War, which occupies unfortunately so large a part of the attention of Europe at the present time, should be fairly noticed in an "Encyclopædia" intended for the use of all. It is a matter of opinion and a question of degree and of proportion in which it is hopeless for Prof. Baynes to please all parties. But it may be well to remind Prof. Baynes that the more popular articles are those which will soon lose their value. Such an article as that on *Army* rapidly becomes antiquated by the progress of political and social changes and of mechanical invention, whereas good mathematical essays like those of De Morgan or Peacock retain their value for hundreds of years. Almost the only volume of "Lardner's Cyclopædia" now sought after is that by De Morgan on the Doctrine of Probabilities.

Although the "Encyclopædia Britannica" seems a very costly work to purchase, it must really be considered, in proportion to its contents, very cheap. We find that this second volume contains at least 1,100,000 words, in addition to thirty large and expensive engraved plates. Now, the same quantity of matter purchased in the form of detached treatises would probably cost from two to four times as much. It is true that when we select our own library we generally purchase works which we intend to read more or less completely, whereas the persons who would read an encyclopædia through would be truly exceptional characters, though we have heard it reported that such persons do exist. A cyclopædia is published on the principle which auctioneers seem to adopt in selling books, of mixing up what a purchaser does not want with what he does want; so that he has to buy all the more. Those, however who do want a library selected for them cannot do better than confide in the work of Prof. Baynes and his predecessors.

## OUR BOOK SHELF

*Annual Record of Science and Industry for* 1874. Edited by S. F Baird. (New York: Harper and Brothers, 1875.)

*The Year-book of Facts in Science and the Arts for* 1874. Edited by C. W. Vincent, Assistant in the Library of the Royal Institution of Great Britain. (London: Ward, Lock, and Tyler, 1875.)

THE American "Annual Record of Science," is a work that each year grows in interest and value. It now consists of two distinctive parts (1), an historical summary of the progress of various branches of science and industry during the past year; and (2), classified groups of paragraphs, giving a succinct report of noteworthy occurrences or special scientific investigations. At the end of the volume is a catalogue of scientific books published during the year, and also a capital index to the whole work. The summary of progress has grown from sixteen pages in 1871, when this Annual first appeared, to 200 pages in the present volume. Each department of science is separately treated, and in the preparation of the different parts the editor has had the co-operation of numerous eminent men of science. Evidently no pains have been spared to make the Record as complete as possible, and so far as we are competent to judge, it is as accurate as it is comprehensive.

In his modest preface to the volume, the editor tells us he has been urged by some to make the abstract of papers more detailed; we think, however, Mr. Baird has exercised a wise discretion in his present arrangement, and at the same time we are glad to learn that he intends publishing a series of annual reports on special branches of science similar to what already exists, to some extent, in Germany. In England we have nothing corresponding either to the general record of science or to the special reports, and the want of such works is increasingly felt. We hope that before long some one of our leading publishers will see their way to issuing a really good digest of the annual progress of natural knowledge in all its various branches.

Why could not the record before us be published in England as well as in America? This seems a very feasible plan, and would doubtless add to the usefulness of the work, inasmuch as English collaborateurs might be added.

Very different from the American annual is the English year-book, yet it is, we believe, the only "year-book of science" of which we can boast. Outside it resembles a shilling railway novel; inside it is a pleasant gossipping account of odds and ends of science picked up at the Royal Institution. An altogether disproportionate amount of space is devoted to extracts from the papers and addresses of Prof. Tyndall, and the woodcuts on the title-page are taken from the same source. We are glad, however, that the "Year-book of Facts" still remains, notwithstanding the death of its former indefatigable compiler. Mr. Vincent tells us he undertook at short notice to continue the work of the late Mr. Timbs. To compile a year-book under such circumstances can be no light duty, and hence we must be lenient to its shortcomings. So far as the book goes, Mr. Vincent has done his work well, and gives a bill of fare that no doubt will be relished by the *dilettante* scientific public. But it should be clearly understood that the volume is merely a *scrap-book* of popular science, and not in any sense an annual register, such as we hope may soon be issued.

## LETTERS TO THE EDITOR

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

### Systems of Consanguinity

IN Sir John Lubbock's *vindication* of his original charge that I seem to have two theories of the facts in my work on Consanguinity (NATURE, vol. xii. p. 124), he fails to show that the classificatory system was interpreted by me as "arbitrary, artificial, and intentional." This is one of the theories, and in fact the principal one, which he ascribes to me, and which I repudiate. The other theory, that which I did advocate, is presented both in his address before the Anthropological Institute and in this vindication (stated partially and imperfectly), as something that I "admit." "Mr. Morgan admits that systems of relationship have undergone a gradual development, following that of the social system." (Address, p. 4, NATURE, vol. xii. p. 125.)

It would require too free a use of your columns to explain at length how, by quotations severed from their connections, and by a use of their phraseology not in accordance with my design, a defence of an unwarranted statement has been put together.

I beg leave to re-state the propositions in my work on Consanguinity, which contain the substance of the views I have advocated, and to which I stand committed; and to request those who may be interested in the subject to read the last chapter in the light of these statements.

In that chapter, entitled "General Results," the facts are discussed under seven propositions, in substance the following:—

Proposition I. That the systems of consanguinity given in the tables may be resolved into two, which are radically distinct, one of which is called *descriptive* and the other *classificatory*. The first is that of the Aryan, Semitic and Uralian families, and the second that of the Malayan, Turanian, and Ganowánian families.

Proposition II. That these systems are to be ranked as domestic institutions.

Proposition III. (in full). "Can the origin of the descriptive system be accounted for and explained, from the nature of descents and upon the principle of natural suggestion, on the assumption of the antecedent existence of marriage between single pairs?" (Con. p. 472.)

The affirmative of this proposition is maintained. "It is the institution of marriage between single pairs which teaches the descriptive system; whilst this form of marriage has been taught by nature through the slow growth of the experience of the ages." (Con. p. 469.)

Proposition IV. (in full). "Can the origin of the classificatory system be accounted for and explained, from the nature of descents, upon the assumption of the existence of a series of customs and institutions antecedent to a state of marriage between single pairs, of which the Hawaiian custom is one?" (Ib. p. 474.)

The affirmative of this proposition is likewise maintained. Under it the solution of the origin of the Malayan system is given, and also of the Turanian, together with the customs and institutions, fifteen in number, arranged in a sequence, which stand connected with the birth and growth of these systems. Assuming, for example, the intermarriage of brothers and sisters in a group, every relationship in the Malayan system is found to be that which would actually exist; wherefore, the system itself proves the antecedent existence of this form of marriage. The same line of argument and of inference is then applied to the Turanian system. In Propositions III. and IV I speak of both forms as *natural* in contradistinction to *artificial*, although they are radically different. They are natural in the sense that they are in accordance with descents as they actually existed when each system respectively was formed. This is the main proposition in that chapter, occupying in its discussion nineteen of its forty-three pages. It presents the theory of the author; it is the only place where the origin of the classificatory system is discussed.

Proposition V. This proposition maintains the unity of origin of such tribes of the American aborigines as are found to possess an identical system of consanguinity.

Proposition VI. (in full). "Where two or more families, constituted independently on the basis of such a system of relationship, are found in disconnected areas or upon different continents, can their genealogical connection be legitimately inferred from their joint possession of the same system?" (Ib. p. 498.)

After showing that the people of South India who speak the Tamil, Telugu, and Canarese dialects have a system of consanguinity identical with that of the Seneca-Iroquois of New York, in upwards of 200 relationships, the question is raised, "How shall this identity be explained?" It was my discussion of this question that confounded my distinguished adversary, which he misunderstood at first, and is not sure that he "quite comprehends even now." How his difficulty could have arisen I confess puzzles me. Under Proposition III. the origin of the descriptive system had been discussed, and under Proposition IV. that of the classificatory; but under this (VI.) the question was whether any evidence of the Asiatic origin of the Ganowánian family could be found in this identity of systems. The four hypotheses quoted by him (vol. xii. p. 124) are produced and discussed here. "Spontaneous growth" was referred to and of course rejected as an adequate explanation of this identity of systems.

Proposition VII. relates to inferences that may be drawn from partial identity of systems.

These several propositions show very plainly, I submit, that these systems are not explained in that volume as "arbitrary, artificial, and intentional," and equally plainly that they are explained as growths or results of certain customs and institutions.

Turning now to Sir John Lubbock's vindication, his first principal quotation is taken from the discussion of my first proposition, where "natural and spontaneous" is used in opposition to resulting growths from customs and institutions, the cause being unknown in the first case, and known in the second. His second quotation is from the discussion of my sixth proposition, where "spontaneous growth" is used, and in the same sense.

The discussion of the mass of materials accumulated in that volume was confined to forty-three out of five hundred and eighty-three pages. It was a new subject, in which it was necessary to invent, to some extent, a new terminology. I am aware of its great defects, but I deny that two theories of the facts are to be found therein, or that I have explained the classificatory system as "arbitrary, artificial, and intentional," which is the point from which this discussion started.

Rochester, New York, July 20 LEWIS H. MORGAN

### Weather on the Atlantic

I HAVE reluctantly come to the conclusion that attempts to forecast the weather on the North Atlantic frequently result in disappointment. A recent passage from New York to this country has enabled me to gather some remarkable data on this subject, so remarkable, indeed, that any one crossing for the first time might reasonably question the action of the barometer. If I had had only one on board, I should certainly have doubted its accuracy, but having three, the readings of them cannot be questioned by the most sceptical.

We left Sandy Hook on the forenoon of April 10, with a light north-west wind and pleasant weather. Temperature of the air 46, barometer 29·82. From that date to the 16th the ship steamed 2,210 miles, and the mercury, with the exception of a slight fluctuation which never exceeded $\frac{5}{100}$ of an inch, fell steadily until it reached 29·14 on the latter day. Throughout this period the wind veered and backed between N.N.W. and E.N.E., never exceeding in force a whole sail breeze, and frequently light or calm for hours together. The sky was generally overcast until the meridian of 32° W. was passed; light rain fell once, but no snow or sleet. Temperature of the air ranging between 34° and 57°

Until the ship was to the eastward of Cape Race (passing 300 miles south of it), as no gale blew I expected a heavy fall of snow; but as it did not come, I assumed that the snow-covered ice on the Grand Bank of Newfoundland caused this unusual depression of the mercury. Great was my surprise, therefore, to see it falling lower as the distance increased from the supposed cause of the depression, while the wind gradually died away, the clouds opened out and assumed softer forms, the horizon cleared, and the long northerly swell subsided. The latter is always a sign of fair weather on this troubled sea. If a storm be advancing towards a ship, the swell usually comes before the wind, so quickly is the motion of the water translated.

While on the subject of waves, I may state that I have been investigating the cause of the greater height of the waves raised by a north-west wind above those raised by a south wind. The observations were made while crossing several offshoots of the Gulf Stream, and I found that in every instance the sea was smoother in the warm water than in the cold. If this view be correct, then the waves in tropical seas should be inferior in height to those of the temperate zone. The question is, Are they so?

Snow has an extraordinary effect on the barometer, but its action is most mysterious, as in this case the ship was several hundred miles from any locality where snow could have fallen.

In March 1872 I witnessed a similar instance of great depression in the barometer, with no wind and a clear sky. On reaching the land it was found to be covered with snow. In that instance there was scarcely a cloud visible during the last 400 miles, and not a single flake fell on the ship. I believe the remarks of an old seaman on the weather of the Atlantic are very true, viz., "The longer one sails on it the less one knows about it."

The presence of heavy field-ice in the month of April, so far south as 41° 40′ N., only fifty miles north of the latitude of Naples, has excited considerable astonishment amongst Atlantic navigators, since many steamers were entangled in it as early as the 24th of January.

The Admiralty Chart of 1873 indicates March as the first month of its arrival, and further gives lat. 42° 13′ N. as the extreme southern limit of its existence, whereas it has already been met with twenty-seven miles south of that parallel, forming a dangerous barrier to ships on the great highway to America: and the commanders of those vessels, relying implicitly on the correctness of a survey which should be above suspicion, have seriously injured their vessels, thereby jeopardising many lives and valuable property in a locality where every feature of it should be as well known as the waters of the Serpentine or the Thames above bridge. It is, moreover, notorious that this is not the only defect in the chart of 1873. The northern limit of the Gulf Stream is laid down from 100 to 150 miles south of its true position; and the existence of another important current (the Labrador), which plays no mean part in the economy of the globe, is entirely ignored, although its line of demarcation from the adjacent waters is as well defined as that of its great neighbour.

It is stated by the old residents of Canada that such a severe winter as this has not occurred in the Dominion for forty years. During the months of January and February at Montreal the wind only blew from the south for six hours. Not only was the thermometer low, but the northerly gales were incessant, rendering outdoor exercise almost an impossibility. These storms broke the ice of Newfoundland and Labrador from its moorings before the summer sun could soften it, and hence the reason of its floating down south. Being almost as hard as granite, and with the sea water at 30° it will not readily decompose.

The recent severe winter must affect the fortunes of the polar expedition for good or for evil. Channels into which ice has drifted will become inaccessible until late in the season, but, on the other hand, the pack-ice will be less inconvenient from its solidity and compactness. It is not probable that many large bergs will reach the Atlantic this season.

*Celtic* W. W. KIDDLE, R.N.

### The late W. J. Henwood, F.R.S.

MR. G. T. BETTANY is no doubt very nearly, if not quite, correct in saying of Mr. Henwood (NATURE, vol. xii. p. 293), "I believe that scarcely one of his cherished objects in this respect [the arrangement of his stores of facts and observations] remains unfulfilled."

In a letter to me, dated July 31, 1875, Mr. Henwood remarked: "I believe all I have done since [I wrote you last] has been to make some preliminary calculations regarding the corrections for temperature of the results of my observations on magnetic intensity, made on the surface and near the bottom of Dolcoath Mine in 1832. I think they hold out promise of something if I have only strength to put them in order." On the fifth day after writing this he died. M. Y.

### Zoology of the "Erebus" and "Terror"

*Palmam qui meruit ferat.* Referring to the article on this subject (NATURE, vol. xii. p. 289), allow us, as the publishers of the botanical portion, to say that the indefatigable labours of Dr. Hooker, aided by the Government grant, resulted in *six* vols. 4to.; not *two*, as stated by the reviewer. This was published in three divisions, viz.: 1. Flora Antarctica, 2 vols.; 2. Flora Novæ Zealandæ, 2 vols.; 3. Flora Tasmaniæ, 2 vols.; the whole comprising nearly 600 coloured plates.

L. REEVE AND CO.

5, Henrietta Street, Covent Garden, Aug. 14

### The Rocks at Ilfracombe

COULD any of your readers state in your columns the nature of a curious appearance in the rock near Ilfracombe (North Devon), on the way to Coombe Martin, just where the road begins to descend to the latter place? Here on the right-hand side the bank is considerably excavated, and through the scaly and friable strata, whose cut surface is perpendicular to the road, rock of a harder kind seems to have been pushed, presenting a rounded surface, which gives the appearance of trees laid in the bank and partly uncovered; indeed, I first heard of them as "petrified trees," and from the road they look very much like the trunks of silver birches. Our Ilfracombe driver told me that a great many people came to look at them, some saying they were trees, others that they were not.

There are several of them, and various lengths are visible, from about a yard to twenty feet, I should think.

WILLIAM S. TUKE

## *OUR ASTRONOMICAL COLUMN*

BINARY STARS.—(1) $\eta$ CASSIOPEÆ.—Dr. Duner, of the Observatory of Lund, Sweden, has calculated elements of this binary from measures 1782-1874; the orbit is as follows:—

| | | |
|---|---|---|
| Peri-astron passage, 1748·413 | | |
| Angle between the lines of nodes and apsides | 245°·91 | Meridian of 1850 |
| Node | 50 ·83 | |
| " Inclination | 68 ·46 | |
| Angle of excentricity ($= \sin^{-1} e$) | 38 ·812 | |
| Mean annual motion | + 2 ·04112 | |
| Semi-axis major | 10″·681 | |
| Period of revolution | 176·374 years. | |

The comparison with measures used by Dr. Duner in his calculation shows very small residual errors, but the elements here transferred from Leverrier's "Bulletin International" of the 12th inst., though representing the angles of Struve, Dawes, Jacobs, and Dembowski, with small negative errors give the distances measured since 1827, very sensibly in defect of the observations. Thus for Dembowski's measures we have—

| | | | | |
|---|---|---|---|---|
| 1863·26 | Error in position | − 0°·72 | Error in distance | − 0″·69 |
| 1867·16 | " " | − 0 ·71 | " " | − 0 ·63 |
| 1871·05 | " " | − 0 ·18 | " " | − 0 ·46 |

For a normal founded upon measures by Jacobs, Dawes, and Dembowski, for 1854·20, the error in position is, – 2°·4, and in distance, – 0″·74. The elements above are perhaps affected by error of copy, but as they stand they will admit of some improvement.

With Dr. Duner's semi-axis and period, and Mr. Otto Struve's first approximation to the annual parallax, the mass of this system would be upwards of ten times the solar mass.

It will be remarked that the angles in the above orbit are expressed by Dr. Duner in decimals of degrees, and we may take this opportunity of directing attention to a very useful table of five-figure logarithms adapted to decimals of the degree published at Berlin in 1872 by Dr. C. Bremiker, which will be found available not only in double-star computations, but very generally for five-figure work. The figures closely resemble those in De Morgan's well-known tables (which are now apparently out of print), and consequently are exceedingly clear and readable, and the price nominal (one shilling). Several miscellaneous tables and various useful constants are appended. The work will be sent over in paper cover, and in binding this or any other set of tables for frequent use, we would recommend the strong gilding of all the edges as materially facilitating their working. When shall we have a table of *four-figure* logarithms to the same extent as tables for five figures are usually printed? Such a work would be by no means without its value.

(2) $\gamma$ Leonis.—Dr. Doberck, of Col. Cooper's Observatory, Markree, has calculated elements for this star, though the arc described is at present less than 30°, under which condition orbits widely different may be obtained. Peri-astron passage, 1741·11; period of revolution, 402·6 years; node, 111° 50′; $\lambda$, 194° 22′; $\gamma$, 43° 49′; excentricity, 0·7390; semi-axis major, 2″·00.

There are several of the revolving double-stars of which much better orbits than have yet been published might now be found; as, for instance, $\omega$ Leonis and $\lambda$ Ophiuchi. Of the fairly determined orbits, the shortest period appears to be that of 42 Comæ Beren—25·5 years, according to Mr. Otto Struve; and the longest that of Castor, 997 years, according to the very complete investigation of Herr Thiele.

The Minor Planets.—M. Leverrier, in his "Bulletin International" of the 8th inst., announces the discovery of No. 148 at Paris, by M. Prosper Henry, on the same morning. The planet is of 10·7 mag., and was found a little west of 70 Aquarii.—Circular No. 31 of the "Berliner Jahrbuch" contains new elements of Lachesis (120); the period of revolution at the next opposition in November is 2,028 days. In No. 30 appeared new, though still uncertain, elements of Austria (136); period 1,261 days.

The August Meteors.—The extensive systematic plan of observation at the principal meteor epochs which has been for some time organised by the Scientific Association of France, at the instance of M. Leverrier, has again been attended with success, on the occasion of the Perseid shower. At Rouen on August 9, between 11h. and 15h., 200 meteors were noted, of which 180 came from the Perseus-radiant; at Rochefort, on the same night, 258 meteors were observed, nearly the whole conformable; and on the 11th, at the same place, 260, many with the same radiant.—About August 5th, in the neighbourhood of London, an unusual number of meteors, more than one as bright as stars of the first magnitude, diverged from Omicron in Andromeda.

Prof. Oppölzer's *definitive* elements of Comet 1862 (III.), with which the August meteor-stream is associated, are here subjoined:—

Perihelion passage, 1862, August 22·91192 G.M.T.

| | | |
|---|---|---|
| Longitude of perihelion ... | 344° 41′ 32″ | M. Eq. 1862·0 |
| ,, Ascending node ... | 137 27 10 | M. Eq. 1862·0 |
| Inclination to ecliptic ... | 66 25 48 | |
| Eccentricity ... ... ... | 0·9607588 | |
| Semi-axis major ... ... | 24·53142 | |
| Period of revolution ... ... | 121·502 years. | |

The point of nearest approach to the earth's orbit at the descending node is passed 19·357 days after perihelion; if in 1862 the comet had arrived at perihelion July 21·557, a little before noon on the 10th of August, it would have been distant from the earth less than twice the distance of the moon. It might not be without interest to determine the effect of so close an approach to our globe, upon the orbit of the comet; but in such an unusual computation it appears almost necessary that earth and moon should be treated as distinct disturbing agents; perhaps the ordinary methods might apply, if the intervals were taken sufficiently short and the elements changed with sufficient frequency.

## THE SEPARATION OF THE ARAL AND THE CASPIAN

In a note on the Hyrcanian Sea (vide Nature, vol. xii., p. 51), it was stated that the waters of Aral, whose surface is now about 159 feet above sea level, formerly overflowed at their S.W. corner, when the lake possessed a depth of 50 feet more than at present. It is certain that the spur of Ust Urt, which formed a waste weir at the point in question, has been lowered by the action of escaping water; and the level at which the overflow took place, in the first instance, was probably some few feet higher than the figure of 209 which has been given. The greatest height ever reached by the water contained in the basin of Lake Aral may therefore be said with tolerable accuracy to be about 220 feet above the sea.

On the N.W., near the head of the Tchagan stream, where Aral must have overflowed to flood the country round the limits of Ust Urt, the barometrical height of a point situated in latitude 47° 7′ 27″, and longitude (east from Greenwich) 58° 17′ 41″, is 257 feet (*a*). This height approximates sufficiently to that which has been indicated for the overflow at S.W., to suggest that future levelling operations will find a point somewhere in this neighbourhood situated at less than 220 feet above the sea. There is, in addition, in latitude 43° 15′, a cleft in the eastern cliff of Ust Urt, by which, and probably by other similar clefts yet to be discovered, the waters of Lake Aral may have overflowed to the west; and in such a case they would, as they travelled down to the lower level of the Caspian Sea, have submerged many extensive, depressed tracts, which occur on the surface of the intervening country. The separation of the two seas, which has afforded subject for much discussion, seems thus actually to have been due to the cessation of the overflow of the basin upon the higher level. Nor is, perhaps, that separation so entirely complete as has generally been thought, for Lake Aral could possibly be filled and made to overflow again; and under such restored conditions, the physical aspects of the country lying between the two seas would very nearly resemble those which are possessed at the present time by the country on the lower courses of the Amú Darya, and are caused by the annual flooding from that river. In such a drowned condition, the Aralo-Caspian region was naturally included in the water-spread of the Hyrcanian Sea by all the classical historians and geographers who have described it; and though, perhaps, no possible overflow from Lake Aral could now exactly reproduce the physical aspects of 2,000 years ago, such difference as would be observable is susceptible of explanation by considerations to be presently entered upon.

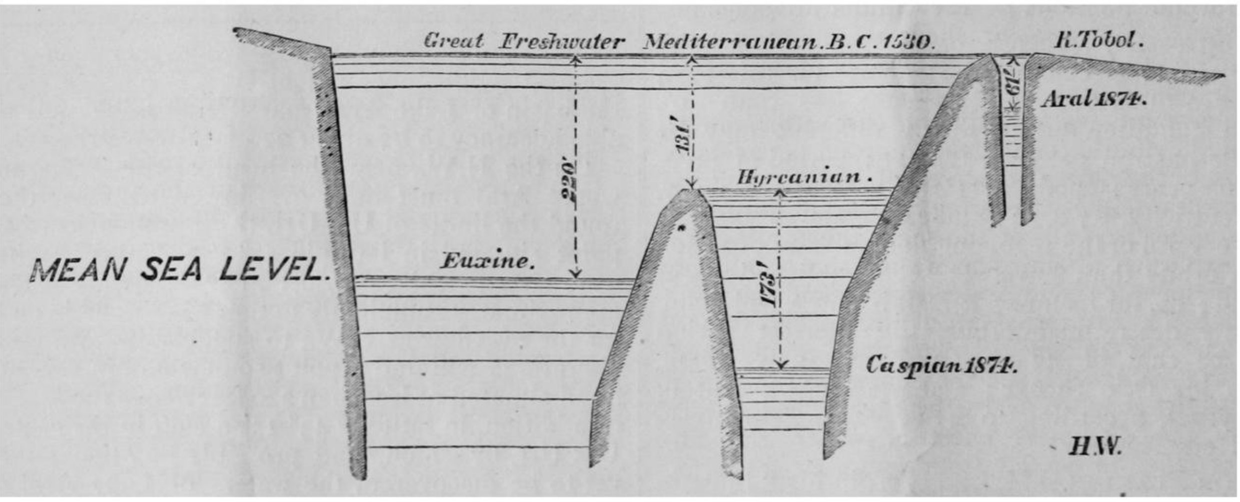
Since the accidental circumstance of more or less water having existed in several depressions upon the surface of the Aralo-Caspian region is the only known variation which has attached to its physical aspects from the earliest historical times, there is a strong presumption that no phenomena of upheaval have occurred, and that over-

(*a*) These figures are taken from the Catalogue of Trigonometrical and Astronomical points in the Russian Empire. Edited by the Director of the Geodesical Department of the Military Topographical Staff.

flow could still take place in a northerly direction also from Lake Aral. Some sixteenth century maps show the river Obi flowing out of the lake of Kitay, which is one of the names of Aral; and by such an overflow may be explained that supposed irruption of Ocean into Asia which the most ancient Greek and Latin authorities have recorded. Nor would the demonstration of the possibility of this overflow in any way affect the reputation either of Herodotus or of Aristotle, who both maintained the isolation of the Hyrcanian from the ocean; for the overflow from Aral might or might not have taken place during a series of years, depending as it did upon the magnitudes of the annual floods of the rivers which supplied it, at the epoch when the winter broke up, on the highlands of Central Asia.

It was estimated in the note on the Hyrcanian Sea that when the Oxus discharged directly westwards, the waterspread of Lake Aral and the lands drowned by its overflow might have added about 70,000 square miles to the area of 140,000 square miles, which is possessed by the Caspian of to-day. If 30,000 square miles be added besides, for the volume which Oxus, Ochus, and Arius probably supplied, the total area of the Hyrcanian Sea would have been about 250,000 square miles, which would have formed a waterspread almost reaching up to the ridge which divides the Caspian from the Black Sea, *t.e.* the level of the largest possible Hyrcanian Sea may have been 89 feet above mean sea-level, in the lowest of the two basins which formed it. The observations of Pallas have, however, placed beyond doubt that the ancient limits of the Caspian were situated at a much higher level than this; and since these limits, which are delineated in a map illustrating his works, did not owe their existence to the overflow from Aral, in conjunction with the volumes of water delivered by the rivers of the Caspian basin, they must have been formed by water flowing out of the Euxine basin. And this latter could not consequently have had at such a time a communication with the Mediterranean Sea.

We know that at the present day a very much larger volume than is required to compensate its surface evaporation is contributed by the various rivers supplying the Black Sea, and passes thence through the Bosphorus into the Sea of Marmora. Before this escape existed, the level of the Euxine would have been higher, and the surplus waters would have overflowed to the east by the channel of the Manytsch into the basin of the Caspian, whose level would, in turn, have been raised. The united waterspread of the two basins would have continued to rise, until the surface evaporation equalled the supply of water




it received; or until it found an escape into a lower level, and this latter circumstance was the one which almost certainly occurred, and in a northern direction.

The part of the ancient shore of the Caspian, which Pallas has delineated, and which is situated at a point called Cholon Komyr, in latitude 45° 30′ 25″, and longitude (east from Greenwich) 44° 51′ 34″, has a height of 221 feet above the sea (*b*). In other words, the great inland sea of fresh water, which extended from the western shores of the Black Sea to the eastern shore of Lake Aral, had its surface precisely on the level at which, it has been stated, there is a strong presumption that Lake Aral could overflow to the north and form a junction with the Frozen Ocean by the drainage lines of the Tobol and of the Obi. Under all the circumstances it is scarcely hazardous to say that this presumption becomes all but a certainty; and that the height of the low ridge, which divides the drainage on the north of Lake Aral, will eventually be found to be 220 feet or less, at its lowest point, above sea-level.

The actual original separation of the Aral and the Caspian may thus be referred to the rupture of the Bosphorus, and to that consequent rush of waters from the Euxine into the Mediterranean, which is known as the Deluge of Deucalion. The immediate result of this cataclysm would have been a fall in the level of the Caspian from 220 to 89 feet above the sea; and though actually isolated from Lake Aral, it would have appeared connected with it by marshes, alimented by the overflow of the latter basin. Though the Caspian level still continued to fall, from surface evaporation, the aqueous character of the intervening bed of the drained-off waters would thus have been preserved for a long time, and such a condition will explain the probable difference in physical aspect which would distinguish the long since desiccated Aralo-Caspian region if it were subjected once more to an overflow of Lake Aral. The cessation of this overflow would have, in the first instance, hastened the drying up of the higher levels of the intervening country, and accentuated to the Orientals upon the shores of the higher sea that isolation of the two basins which the Europeans upon those of the lower were not, and in fact could not be, acquainted with until very long afterwards.

HERBERT WOOD

(*b*) See note (*a*).

## *GUN-COTTON WATER-SHELLS*

IN the published accounts of Field Artillery Experiments which are just now being carried on at Okehampton, in Devonshire, considerable prominence has been given to the formidable nature of the so-called water shells, with which practice has been carried on against rows of targets, in the form of "dummy" soldiers, representing columns of infantry, shrapnel shells and common shells, filled with gunpowder, having been fired in comparison with them.

The term *water-shell* denotes not a shell of special form or construction, but simply a new system of bursting shells of ordinary construction, elaborated by Prof. Abel nearly three years ago, by which the breaking up of cast iron shells into a large number of fragments and their dispersion with considerable violence is accomplished by filling the shell with water instead of with an explosive agent.

In a memoir communicated by Mr. Abel to the Royal Society in 1873,* it was pointed out that detonation was transmitted from a mass of dry compressed gun-cotton to distinct masses of the material saturated with water and separated from each other and from the detonating (or "initiative") charge by small spaces filled with water, the whole being enclosed in a case of stout wrought iron; and Mr. Abel stated that the suddenness and completeness with which detonation was transmitted through small water-spaces had suggested to him the possibility of applying water as a vehicle for the breaking up of cast iron shells into numerous and comparatively uniform fragments, through the agency of force suddenly developed in the perfectly closed shell, completely filled with water, by the detonation of a small quantity of gun-cotton or other similarly violent explosive substance, immersed in the water. Mr. Abel considered that if such a result were obtained, a shell or hollow projectile of the most simple construction could be made readily to fulfil the functions of the comparatively complicated *shrapnel* and *segment* shells which have been specially designed to furnish a large number of dangerous missiles when burst during their flight.

A few experiments with ordinary cast iron shells, spherical and cylindro-conoidal, afforded conclusive demonstration of the power possessed by water, in virtue of its slight compressibility, to bring to bear uniformly in all directions upon the walls of the shell, the force developed by an explosion which is made to occur suddenly in the completely confined water-space, and showed, moreover, that the disruptive effect was proportionate not merely to the amount of explosive agent used, but also to the suddenness of the concussion imparted to the completely confined water by the explosion. In illustration of the disruptive effect of water, the following results may be quoted from a number given by Mr. Abel in his memoir. A 16-pounder (cylindro-conoidal) shell, filled with 16 ounces of gunpowder, was broken by the explosion of this charge into 29 fragments. The detonation of a quarter of an ounce of gun-cotton confined in a shell of precisely the same construction and weight, the chamber being filled up with water and tightly closed, burst the shell into 121 fragments, which were violently dispersed. A corresponding charge of gun-cotton, confined in a third similar shell, the chamber being filled with air, did not burst the shell when detonated; the resulting gases found vent through a minute perforation in the plug or screw-stopper of the shell. One ounce of gun-cotton confined in a similar shell, filled up with water, broke it up into 300 fragments, but in addition there were 2 lb. 1 oz. of the shell almost pulverised by the force of the explosion brought to bear upon the metal through the agency of the confined water.

The manner in which Mr. Abel has applied this system of bursting shells is very simple. The fuse which is used in field-artillery service for bursting shrapnel-shells or the common shell (when the latter is filled with gunpowder and used as a mine or an incendiary projectile), has fitted to it a small metal cylinder closed at one end, into which is tightly packed from a quarter to one-half ounce of dry compressed gun-cotton. The open end of the cylinder is closed with a screw plug containing a small chamber filled with fulminate of mercury, the upper side of which is in close contact with the fuse when the cylinder has been attached to the latter. To employ common shells as *water-shells* it is now only necessary to fill them completely with water, and then to insert and screw down firmly the fuse with its little detonating cylinder attached, when the detonating charge is fired by the action of the fuse, the shell is instantaneously burst into a large number of fragments by the concussion transmitted by the water.

Mr. Abel's prediction that this plan of bursting shells would be found most effective, is amply borne out by the magnificent practice made by the field-guns at Okehampton. Of the two batteries of Royal Artillery which have carried on the experiments during the past week, one has done more mischief with the "water-shells" than with the delicately constructed shrapnel, with the nature of which the gunners are intimately acquainted; while with the other battery of heavier field-guns the practice made was but little inferior. A little better acquaintance on the part of artillerymen with the new system of using shells will, it is anticipated, still further increase the deadly effect of these terrible weapons. Moreover, the water-shell has hitherto only been used in conjunction with a percussion fuse, while it is with the time-fuse that the shrapnel-shell is found the most effective. With the percussion-fuse the two shells are about on an equality, while the water-shell has the advantage of greater simplicity.

* Contributions to the History of Explosive Agents, Second Memoir, by F. A. Abel, F.R.S.—Phil. Trans. 1874, p. 373.

## NOTES FROM THE "CHALLENGER"

THE following extracts from a letter dated Yeddo, June 9, 1875, addressed to me by Prof. Wyville Thomson, will, I think, interest the readers of NATURE:—

"In a note lately published in the proceedings of the Royal Society on the nature of our soundings in the Southern Sea, I stated that up to that time we had never seen any trace of the pseudopodia of Globigerina. I have now to tell a different tale, for we have seen them very many times, and their condition and the entire appearance and behaviour of the sarcode are, in a high degree, characteristic and peculiar. When the living Globigerina is examined under very favourable circumstances; that is to say, when it can at once be transferred from the tow-net and placed under a tolerably high power in fresh, still sea-water, the sarcodic contents of the chambers may be seen to exude gradually through the pores of the shell and spread out until they form a gelatinous fringe or border round the shell, filling up the spaces among the roots of the spines and rising up a little way along their length. This external coating of sarcode is rendered very visible by the oil-globules, which are oval and of considerable size, and filled with intensely coloured secondary globules; they are drawn along by the sarcode, and may be observed, with a little care, following its spreading or contracting movements. At the same time, an infinitely delicate sheath of sarcode containing minute transparent granules, but no oil-globules, rises on each of the spines to its extremity, and may be seen creeping up one side and down the other of the spine, with the peculiar flowing movement with which we are so familiar in the pseudopodia of Gromia, and of the Radiolarians. If the cell in which the Globigerina is floating receive a sudden shock, or if a drop of some irritating liquid be added to the water, the whole mass of protoplasm retreats into the shell with great rapidity, drawing the oil-globules along with it, and the outline of the surface of the shell and of the hair-like spines is left as sharp as before the exodus of the sarcode. We are getting sketches carefully prepared of the details of this process, and either Mr. Murray or I will shortly describe it more in full.

"Our soundings in the Atlantic certainly gave us the impression that the siliceous bodies, including the spicules of Sponges, the spicules and tests of Radiolarians, and the Pustules of Diatoms which occur in appreciable proportions in Globigerina ooze diminish in number, and that the more delicate of them disappear, in the transition from the calcareous ooze to the 'red clay;' and it is only by this light of later observations that we are now aware that this is by no means necessarily the case. On the 23rd of March, 1875, in the Pacific, in lat. 11° 24′ N., long. 143° 16′ E., between the Carolines and the Ladrones, we sounded in 4,574 fathoms. The bottom was what might naturally have been marked on the chart 'red clay;' it was a fine deposit, reddish brown in colour, and it contained scarcely a trace of lime. It was different, however, from the ordinary 'red clay,'—more gritty—and the lower part of the contents of the sounding tube seemed to have been compacted into a somewhat coherent cake, as if already a stage towards hardening into stone. When placed under the microscope, it was found to contain so large a proportion of the tests of Radiolarians, that Murray proposes for it the name 'Radiolarian ooze.' This observation led to the reconsideration of the deposits from the deepest soundings, and Murray thinks that he has every reason to believe (and in this I entirely agree with him) that, shortly after the 'red clay' has assumed its most characteristic form, by the removal of the calcareous matter of the shells of the Foraminifera, at a depth of say 3,000 fathoms, the deposit begins gradually to alter again by the increasing proportion of the tests of Radiolarians, until, at such extreme depths as that of the sounding of the 23rd of March, it has once more assumed the character of an almost purely organic formation, the shells of which it is mainly composed being however in this case siliceous, while in the former they were calcareous. The 'Radiolarian ooze,' although consisting chiefly of the tests of Radiolarians, contains, even in its present condition, a very considerable proportion of red clay. I believe that the explanation of this change, which was suggested by Murray, and was indeed almost a necessary sequence to his investigations, is the true one. We have every reason to believe, from a series of observations, as yet very incomplete, which have been made with the tow-net at different depths, that Radiolarians exist at all depths in the water of the ocean, while Foraminifera are confined to a comparatively superficial belt. At the surface and a little below it, the tow-net yields certain species; when sunk to greater depths, additional species are constantly found, and, in the deposits at the bottom, new forms occur, which are met with neither at the surface nor at intermediate depths. It would seem also that the species increase in number, and that the individuals are of larger size as the depth becomes greater; but many more observations are required before this can be stated with certainty. Now, if the belt of Foraminifera which, by their decomposition, according to our view, yield the 'red clay,' be restricted and constant in thickness, and if the Radiolaria live from the surface to the bottom, it is clear that, if the depth be enormously increased, the accumulation of the Radiolarian tests must gain upon that of the 'red clay,' and finally swamp and mask it."

Prof. Wyville Thomson further informs me that the best efforts of the *Challenger's* staff have failed to discover *Bathybius* in a fresh state, and that it is seriously suspected that the thing to which I gave that name is little more than sulphate of lime, precipitated in a flocculent state from the sea-water by the strong alcohol in which the specimens of the deep-sea soundings which I examined were preserved.

"The strange thing is, that this inorganic precipitated is scarcely to be distinguished from precipitated albumen, and it resembles, perhaps even more closely, the proligerous pellicle on the surface of a putrescent infusion (except in the absence of all moving particles), colouring irregularly but very fully with carmine, running into patches with defined edges, and in every way comporting itself like an organic thing."

Prof. Thomson speaks very guardedly, and does not consider the fate of *Bathybius* to be as yet absolutely decided. But since I am mainly responsible for the mistake, if it be one, of introducing this singular substance into the list of living things, I think I shall err on the right side in attaching even greater weight than he does to the view which he suggests.

T. H. HUXLEY

## THE INTERNATIONAL CONGRESS AND EXHIBITION OF GEOGRAPHY

At the distribution of prizes the Ordnance Survey obtained a letter of distinction, although it was not an exhibitor. It is the only instance in which such an honour was awarded. M. Quatrefages, in the name of the governing body of the society, awarded two exceptional prizes, one to MM. Payer and Weyprecht for the discovery of Francis-Joseph Land, and the other to M. Delaporte for the foundation of the Cambodian Museum at Compiègne. Admiral la Roncière, le Nourry closed the meeting by a very impressive address reviewing the characteristics of the Congress.

The success of the Exhibition is so great that it will be kept open up to the 19th of September. The number of visitors is greater than ever now that the Congress is over, and many fresh attractions have been added to several sections. M. Buys Ballot, the director of the Utrecht Meteorological Institution, has sent a board used by him for better indicating the direction of winds and distribution of pressure. Small holes are perforated in a map at the places occupied by the several stations. In these holes are placed small needles whose height indicates the barometrical height, and whose head is an arrow showing the actual direction of the wind.

In the French annexe has been exhibited a drawing of a machine for manufacturing relief maps out of a block of plaster. The knife is movable by a kind of pantograph, and can be conducted alongside the several *lines of level* (lignes de niveau) of a map which is seen by reflection in a plate of glass placed in a suitable position.

Peter the Great having been appointed a member of the Academy of Paris in 1717, ordered a map of the Caspian Sea to be drawn, which he sent to his fellow-members of the Academy as a proof of his zeal for the progress of science, and to justify the honour which had been conferred upon him. This map was lodged in the archives of the Academy, engraved and published in the volume of 1721, with a report written by Dellile the astronomer. It happens that the same map is exhibited at the Russian annexe, and the circumstances connected with it having become generally known, it has given rise to the report that the Grand Duke Constantine will be elected a member of the Academy, like his ancestor and the Emperor of Brazil. It is something more than an idle rumour.

A banquet was given by the Section of Commercial Geography, and some resolutions were adopted *inter poculas*. The most notable is in reference to the establishment of a *fonda* in the centre of the Sahara for the use of all civilised nations. But although adopted unanimously, the motion is not likely to be carried into execution very speedily.

## SCIENCE IN GERMANY

(*From German Correspondents.*)

It was the phenomenon of the motion of glaciers which caused most of the scientific men, that studied its details, to make experiments on the behaviour of snow and ice under pressure. The brothers Von Schlagintweit and Prof. Tyndall were the first who made such experiments with regard to glacial phenomena. Later on Helmholtz described a series of investigations, which proved amongst other things that snow is changed into ice by high pressure, that ice broken into little pieces can again be pressed into a homogeneous ice cylinder, that such a cylinder can be pressed through openings of smaller diameter, &c. It was thus shown that under a strong pressure ice can be formed into any desired shape, that it behaves plastically even on a small scale, in the same way as the gigantic ice-rivers of glaciers do on a large one, adapting themselves to the narrower or wider parts of the valleys through which they flow. The phenomenon discovered by Faraday in the year 1850, which was afterwards widely discussed, and which was called regelation, formed the key for the explanation of this behaviour. Not one, however, of the men of science mentioned has tried to determine the exact pressure under which ice changes its form; all of them have worked with very high pressure, which in fact is necessary to obtain results that are visible in a short time. Only Moseley has made several series of experiments, to ascertain at what pressure or draught ice tears, is crushed, or when its plasticity becomes perceptible, *i.e.* at what pressure a dislocation of the ice-particles takes place. He found, that to tear an ice-cylinder apart, for each square inch of its base a weight of from 70 to 116 lbs. was necessary according to the higher or lower temperature (representing a pressure of $5\frac{1}{2}$ to 9 atmospheres). To break an ice cylinder by pressure, 101·8 lbs. were necessary for each square inch; and to cause a dislocation of the ice-particles, from 97·89 lbs. to 118 lbs. were required ($7\frac{1}{2}$ to 9 atmospheres).

Herr Pfaff, of Erlangen, has lately made a series of experiments in order to obtain some more exact numerical values for the degrees of pressure which change the form of ice to any apparent extent; it is particularly interesting to know with reference to the glacier motion, what is the *minimum* of pressure at which ice still remains plastic, *i.e.* yields to pressure. It was found that even the *smallest* pressure was sufficient to dislocate ice-particles *if it acted continuously, and if the temperature of the ice and its surroundings was near the melting-point.* At a pressure of two atmospheres ice showed itself so yielding, that for instance a hollow iron cylinder of 11·5 mm. diameter and 1·7 mm. thickness of side entered 3 mm. deep into the ice within two hours, and at a temperature of between $-1°$ and $+0·5°$. The following will show the influence of temperature. The same iron cylinder under the same pressure entered 1·25 mm. deep into the ice in twelve hours at a temperature of between $-1°$ and $-4°$; while at a temperature varying between $-6°$ and $-12°$ it only entered 1 mm. deep in five days, at a pressure of five atmospheres, or only 0·1 mm. in twelve hours. If the temperature of the surroundings rises beyond the melting-point the ice becomes so soft that in one hour the same iron cylinder under the same low pressure entered 3 cm. deep into the ice, although it was completely surrounded by snow in order to prevent the temperature of the cylinder itself rising beyond 0°. In all these experiments a one-armed lever was used to regulate the pressure; it consisted of a steel rod of 86 cm. length, which had a boring at its end and was fastened to a steel plug round which it could easily be turned. By this simple contrivance any desired pressure could be maintained for any length of time. These and other experiments (which were made with a pressure of only $\frac{1}{3}$ atmosphere) show that the plasticity of ice at a temperature near its melting-point is very great even at the lowest degrees of pressure. Herr Pfaff is of opinion that at this temperature the plasticity of the ice only becomes *nil* when the pressure itself is *nil*, but that it decreases very quickly as the temperature gets lower.

The opinion is still widely spread, based upon some experiments of Tyndall, that ice is not in the least flexible or ductile, although lately several observations have been made which force us to ascribe some flexibility to that substance. Kane observed, for instance, that a large slab of ice resting with its edges on two other blocks, bent itself under its own weight after a lapse of several months. Herr Pfaff experimented with a parallelopiped of ice of 52 cm. length, 2·5 cm. breadth, and 1·3 cm. thickness. It was placed with its two ends on wooden supports, so that on each side 5 mm. were resting on wood. From Feb. 8th to Feb. 15th, when the temperature remained between $-12°$ and $-3·5°$, the middle sunk very little, on the average 2 or 3 mm. in twenty-four hours, so that on Feb. 15th the total bend amounted to 11·5 mm. Then the temperature rose but still remained under 0°; yet this rise caused a great increase in the bending, as it reached the value of 9 mm. in twenty-four hours (therefore 20·5 in all). Nowhere could any crack or tear in the ice be seen; the lower surface was examined with particular care, and did not show the trace of a crack!

Herr Pfaff has also succeeded in proving the expansion of ice by draught. It appears therefore that near its melting-point ice, like other bodies, yields to pressure and to draught, and must be looked upon, particularly with reference to the former, as an eminently plastic substance. This behaviour of ice towards pressure at different temperatures throws a new light upon the fact that the velocity in the motion of glaciers increases with temperature. As the glacier ice and the air over it possess a temperature, in the summer months at least, which lies very near the freezing point, it is evident that a very small pressure suffices to cause the glaciers to move. S. W.

At present a question is being discussed by morphologists, which seriously affects in more than one direction some traditional maxims of experience which were apparently confirmed long ago. It treats of the way and means by which cells, the foundation-stones as it were of the animal organism, are formed during the first process of the development of the ovum, viz., during its continually progressing division. The views of Remak, Kölliker, and others were generally adopted and often repeated until lately, namely, that the ripe and fertilised ovum, when it lost its former nucleus, the "germ bubble," received a new one, and that the division of this new nucleus caused that of the ovum itself; the further divisions were represented by the simple idea of a division of cells. Although Goette already, in the year 1870 ("Centralblatt für die medicinischen Wissenschaften," No. 38), and later, Bütschli ("Beiträge zur Kenntniss der freilebenden Nematoden," in "Nova acta der Leop. Carol. Deutschen Akademie der Naturforscher," 1873), and Fol ("Die erste Entwickelung des Geryonidencies; Jenaische Zeitschrift für Medicin und Naturwissenschaft," 1873) had opposed these views on the basis of new observations, yet general attention was only obtained by Auerbach in his work, "Organologische Studien" (1874), as the question at stake was treated in a more detailed manner. Auerbach examined the same animals which Bütschli had observed, viz., that order of Entozoa known as Nematoidea; he found that in their fertilised ovum, after the germ bubble has disappeared, two new nuclei are formed at two opposite poles of the ovum, which then approach each other towards the middle of the ovum and unite into *one*; this, however, soon disappears again, and a less sharply defined clear substance takes its place; this then extends longitudinally and takes a star-shaped form at each end, so that the two stars are connected by a thin stem. Now the division of the ovum begins to take place through the middle of that stem, while in each half of the same, by the confluence of little bubbles, a nucleus forms, which initiates the same phenomena for the further divisions as those which precede and accompany the first one. The result, therefore, would be as follows:—1. In the division of the ova of Nematoidea the nuclei disappear before each stage of the division, and form anew after each stage. 2. This formation takes place through the confluence of two or more bubble-shaped or nucleus-like new forms. 3. The disappearance of the nuclei is accompanied by a peculiar star-shaped formation, which Auerbach deduces from the flowing apart of the nucleus matter. Bütschli has lately published new observations on the same subject ("Siebold's und Kölliker's Zeitschrift für wissenschaftliche Zoologie," 1875), from which it must be specially pointed out that even the first nucleus of the fertilised ovum of some Nematoidea, and of the fresh-water mollusc, Limnæus, results from the confluence of several little bubbles. Flemming has found Auerbach's observations confirmed with the fresh-water shell, Anodonta ("Archiv für mikroskopische Anatomie," band x., and "Sitzungsberichte der Akademie der Wissenschaften zu Wien III. Abtheilung," 1875"); he only differs so far from Auerbach in the interpretation of what he saw, that he does not deduce the "carpolytical figures" of the latter from the nucleus matter which radiates from the centre of the nucleus, but from a peculiar structure in the surrounding yolk-protoplasm, which he considers to be in connection with each division of the yolk and the new formation of the nuclei. But he does not interpret the process of this new formation. Flemming, in his second paper, describes the observations on a radiated arrangement of the yolk, which had previously been made occasionally with several other animals, without the observers being able to explain these phenomena or trying to investigate them further. We must, however, remark here that Goette, in the work we mentioned in our last report, has not only completely described the interior process of the division of the ovum of *Reptilia*, but has also attempted a uniform explanation of the same. According to his experience no nuclei at all are formed for some time in the division parts of the yolk, but only nuclei-shaped interior transformation products of the yolk, which are only apparently separated from their surroundings, but are in reality in continuous connection with them. These interior formations originate as collecting points of a radiated and universal protoplasm current in the yolk, which in turn results from the reciprocal action of the ovum and the surrounding medium. The difference in the currents is said to cause (in a manner described in detail) the division of these interior formations, and, as a consequence, the division of the surrounding yolk material. The radiated arrangement of the latter round the brighter centres is only imperfectly visible in *Batrachia*; but Goette has observed it in the ova of *Ascidia*, and interpreted it in the way just described. The definite nuclei of embryo cells, which result immediately from the division of the yolk, Goette supposes to be formed within those centres from a number of grains, which are at first greatly augmented, and then finally unite completely. But these origins of the nuclei do not disappear during the divisions of the yolk. If now we compare all the observations mentioned, we first of all find them all agreeing *that the division of the yolk is no simple cell division*, such as is elsewhere found in the tissues of developed organisms; for the remainder, the observations do not agree. While Goette supposes a gradual and continual progress of the formation of cells beginning from the first division, the other observers incline to the belief that at each division an interruption and a consequent re-beginning of the formation of cells takes place, as the once formed nuclei are said to disappear continually and new ones are said to form.

## NOTES

THE U.S. Government have just shown in a handsome manner their appreciation of the services rendered by Dr. Henry Draper in connection with the U.S. observation of the recent Transit of Venus, by presenting him with a gold medal made at the U.S. Mint at Philadelphia. On the obverse is the motto, from Virgil, "Famam extendere factis hoc virtutis opus est," and in the centre a figure of the heliostat which was used by Dr. Draper in training the photographers. On the reverse is the inscription, "Veneris in sole spectandæ curatores, R. P. F. S. Henrico Draper, M.D., Dec. viii. MDCCCLXXIV." The phrase around the edge of the reverse, "Decori decus addit avito," conveys a tribute of praise to the literary and scientific attainments of Dr. Draper, sen. The Transit Commission have also sent Dr. Draper a handsomely bound set of resolutions illuminated in mediæval style, with a telescope, camera, &c. We are sure all scientific men will join in congratulating Dr. Draper on his well-deserved honour, and at the same time the U.S. Government on their enlightenment in thus acknowledging the glory which the triumphs of pure science have shed upon a nation; they have set a striking example to our own and other European Governments.

THE fifth session of the French Association for the Advancement of Science, as we intimated in our last number, will be opened to-day at Nantes. The principal attraction will be the excursions; one of them will last for more than three days, a war-steamer having been placed at the service of the Association by the Minister of Marine. The excursionists will visit Vannes and its prehistorical museums, the megalithic monuments of Locmariaques, the celebrated remains at Carnac, the sland of Belle-ile, and Lorient. No doubt there will be a great rush for the excursion. The list of papers to be read is a very long one. In the Mathematical Section a large number of the papers are on engineering subjects, and in the Natural Science Section a large proportion are on medical subjects, besides a good many on prehistoric archæology. Among the latter class are the following:—Dr. Broca, On the anthropology of Brittany; The Dolmens of the Lozère, by Dr. Prunières; On the funeral rites of prehistoric times in Scandinavia, by M. Waldemar-Schmidt. Other papers in this section are: On a new elementary theory of botany, by Dr. Ecorchard; On the meaning which it is proper to attach to the word "Mollusc" as a taxonomic term, and On the organisation of Rhizomes, by Dr. Gulland; On the Fauna of the Lake of Tiberias, by Dr. Lortet; On the pressure and rate of the blood in the arteries, by M. Marey. In the Section of Physical and Chemical Sciences we note the following:—On Microzymes in their relation to fermentation and physiology, On two new principles of wine, and On the origin of Bacteria, by Prof. Béchamp; Experiments on the rate of light between the Paris Observatory and Montlhéry, by M. A. Cornu; On the use of the spectroscope in the manufacture of Bessemer steel, by M. V. Deshayes; The meteorology and physics of the Polar Regions, by the Abbé Durand; On molecular combinations, by M. C. Friedel; On the limits of permanent snow and ice on the surface of the globe, On a magneto-dynamic galvanoscope, and On the chemical constitution of albuminoid matters, by M. P. Schützenberger; On a polymer of the oxide of ethylene, and on the dissociation of the salts of aniline, by M. A. Wurtz. There will be two public lectures—one by Prof. Bureau, of the Paris Museum, On the Natural Sciences at Nantes, and the other, On Acoustics—the *timbre* of sounds, by Dr. Gavarret.

THE above Association is not the only French institution which was created after the model of the British Association. M. de Caumont, who died four years ago, instituted another annual scientific congress, which will hold its forty-first session at Perigueux, in the department of Dordogne. Every year this association meets in a provincial town during summer, and at Paris during the recess of Easter. The members are mostly Legitimists and Roman Catholics.

THE forty-eighth meeting of the German Scientific and Medical Association will commence this year on the 17th of September at Graz (Austria). The two branches will be presided over by Drs. Rollet and von Tebal of that University, who have issued the following programme: Sept. 17, 8 P.M.—Preliminary Meeting. Sept. 18, 10 A.M.—First General Meeting; 1 P.M.—Sectional Meetings; 8 P.M.—Reunion; Sept. 19.—Excursion to the Castle, Sectional Meetings, Evening Concert at the Theatre. Sept. 20.—Sectional Meetings and Excursions. Sept. 21.—Second General Meeting, Sectional Meetings, Festive Performance in two Theatres. Sept. 22.—Excursions. Sept. 23.—Sectional Meetings, Banquet. Sept. 24.—Third and Concluding General Meeting, Ball. The Sections will be divided as follows: (1) Mathematics and Astronomy. (2) Natural Philosophy and Meteorology. (3) Chemistry. (4) Mineralogy, Geology, and Palæontology. (5) Botany. (6) Zoology. (7) Anatomy and Physiology. (8) Medicine. (9) Surgery. (10) Ophthalmology and Otiatry. (11) Midwifery. (12) Psychiatry. (13) Public Health. (14) Military Surgery. (15) General Pathology. (16) The Teaching of Science. (17) Agriculture.

A CONGRESS has been held at Nancy on the history, archæology, and languages of the American continent. The city was illuminated, and a banquet was given by the municipality to the foreign members of the Congress. A most interesting exhibition took place, principally of American stone implements, Peruvian mummies, Columbian idols, and skulls of a number of the aborigines. The Congress discussed the questions relating to the discovery of America before Columbus, by Norwegians, Phœnicians, and Buddhists, and did not appear inclined to believe in the reality of any of the traditions. There were also discussed at some length the relations of Esquimaux tribes with those of Northern Asia, traditions as to white men, the monuments of the Mississippi Valley, and the rock inscriptions, without coming to any definite conclusions.

THE observation of meteors has been organised in France by the Association Scientifique under M. Leverrier; this organisation numbers more than 6,000 members, but has no annual meeting. About forty stations keep watch on critical nights. The results of the observations during the time of the August shower have been unusually good. At Rochefort and Rouen alone more than 160 tracks were mapped during the nights of the 9th and 10th of August, mostly connected with the Perseus radiant.

THE preparations for the Scientific and Agricultural Congress at Palermo on the 29th inst. are proceeding with unabated activity. Many *savants*, particularly from Germany, have intimated their intention to assist at the proceedings. Father Secchi will preside in the department of Astronomy.

FROM observations made upon the Manatee living in the Zoological Gardens, Regent's Park, the Society's Prosector has had the opportunity of presenting a paper to be read during the next session of the Scientific Committee of the Society, on the peculiar prehensile power of the upper lip of that animal, by which it seizes its food between the two lateral bristle-covered pads with which that organ is provided, and which it can move laterally.

THE *Journal of Anatomy and Physiology*, which till now has done much service to biologists under the able editorship of Prof. Humphry, of Cambridge, and Prof. Turner, of Edinburgh, is to be further strengthened in the Physiological Section by the extra editorial assistance of Dr. Michael Foster, of Cambridge, and Prof. Rutherford, of Edinburgh. The journal is also to appear quarterly, not half-yearly, as heretofore.

THE Transactions of the Zoological Society, vol. ix. Part iv., just issued, comprises a memoir, by Mr. Sclater, F.R.S., "On the Curassows now or lately living in the Society's Gardens." It is illustrated with thirteen coloured quarto plates from the pencil of Mr. Smit, and forms a complete monograph of all the known species of true curassows.

M. E. MULSANT, Conservator of the Library of the City of Lyons, is on a visit to this country for the purpose of examining Messrs. Salvin and Godman's, as well as other collections of birds, in order to render more complete his "Histoire Naturelle des Oiseaux-Mouches," now in course of publication.

CAPT. BURTON and party have just returned from Iceland. The immediate object of the visit was to examine the extensive sulphur mines which were worked in the north-eastern part of the island about the beginning of the present century, and for the reopening of which a company has recently been formed. The result of the visit seems in this respect to have been satisfactory. Mr. W. L. Watts met Capt. Burton's party, just after he had performed the remarkable feat of crossing the Vatna Jokul, an immense snowy table-land in the S.E. corner of the island. Mr. Watts has been the first to accomplish this feat.

IN the note concerning a shower of hay in Denbighshire in last week's NATURE, p. 298, we omitted to say that the year in which the occurrence took place was 1857.

THIS year's meeting of the British Archæological Association was opened at Evesham on Monday by the President, the Marquis of Hertford, who reviewed the several points of interest which the Association intended to visit in Warwickshire and Worcestershire.

THE most important paper in the July number of the *Bulletin* of the French Geographical Society is on the geography of the Athabasca-Mackenzie region, by the Abbé E. Petitot, who has spent twelve years as a missionary in that inhospitable portion of North America, making many journeys to all parts of the district indicated, lying between the Coppermine River and the Rocky Mountains, and the Great Slave Lake and the Arctic Ocean. The Abbé gives a brief *résumé* of discovery in this region, and a short sketch of the various journeys he himself made, to be followed by further details. An excellent map accompanies the narrative, and although the explorer's instruments were rather scanty, it is evident that he has added largely to our knowledge of the geography of the district of country referred to.

ANOTHER interesting paper in the same number is on the Lyssous of Lin-tze-Kiang, by another missionary, the Abbé Dubernard. It is notable how large a number of French explorers have been missionaries.

A RETURN has been presented to Parliament giving a statement of all the weather telegrams issued by the Meteorological Office, and also of all the storms experienced on the coasts of the British Islands during 1874, from which it appears that of the warnings issued, 78·2 per cent. were justified by subsequent gales or strong winds, and that 16·4 per cent. were not justified by the subsequent weather. This percentage of success in the warnings issued, which is slightly in excess of the last two years' of Fitzroy's management, considerably in excess of 1870 and 1871, and about equal to the results for 1872 and 1873, is perhaps as good as may reasonably be expected until the system be further extended and developed.

WE have received a circular calling attention to the success attending the working of Dr. Herman Sprengel's improvement in the manufacture of sulphuric acid. The process was patented in 1873, and consists in injecting water in the form of spray into the chambers instead of steam. To effect this a jet of steam escapes from a platinum nozzle at a pressure of about two pounds, and blows through the centre of a flowing jet of water by means of an apparatus similar in principle to Herapath's blow-pipe. These jets are let into the side of the chamber at distances of 40 feet. The advantages gained are economy of fuel, nitric acid, and pyrites. The method has been in use at the works of the "Lawes Chemical Manure Company" at Barking, and the returns show that a saving of coal to the amount of ⅞ of the quantity formerly burned has been effected—the total saving in steam, nitric acid, and labour during three months, amounting to five shillings per ton of acid of sp. gr. 1·6 made from pyrites. The patentee just points out that a saving of even one shilling per ton means in this country an annual gain of 50,000*l.*

THE Rev. N. M. Ferrers, of Cambridge, author of "A Treatise on Trilinear Co-ordinates," is preparing for the press a work on Spherical Harmonics. The plan adopted in this work will be first to discuss thoroughly the properties of the Zonal Harmonic, for which various expressions will be given, and general formulæ investigated, by which any rational integral function of one independent variable may be expressed in a series of Zonal Harmonics. The properties of Tesseral and Sectorial Harmonics will then be deduced from these. The expression of a discontinuous function by means of Spherical Harmonics will be discussed; and various examples will be given of the use of Spherical Harmonics in their applications to the theories of attraction, and of electricity and magnetism. The book will be published by Messrs. Macmillan and Co.

"PYTHAGOREAN Triangles" is the title of a paper which was read by W. Allen Whitworth, M.A., before the Literary and Philosophical Society of Liverpool in February of the present year. A Pythagorean triangle is a right-angled triangle having all its sides commensurable. The most familiar instance is that triangle whose sides are in the ratio of the numbers 3, 4, 5. The author shows that one of the sides must be even (a multiple of 4), one a multiple of 3, and that either a side or the hypotenuse must be divisible by 5. Making use of a discovery of Fermat's, he further shows that every prime number of the form $4N + 1$ is the hypotenuse of such a triangle. The most general results obtained are "the product of $n$ prime hypotenuses, all different, will be itself the hypotenuse of $2^{n-1}$ Pythagorean triangles;" this result is modified if $m$ only are different, to $2^{m-1}$ Pythagorean triangles. With the aid of these results he presents, in a tabulated form, 395 such triangles, with hypotenuses less than 2,500. We may mention that in Tebay's Mensuration a table of some 200 of these triangles is given, but with no indication as to how they are obtained. A great deal of information on the subject of these triangles is given in vol. xx. of "Mathematics from the *Educational Times*," at pp. 20, 54, 75, 76, 87, 97–100, to which we refer such of our readers as may be interested in the matter.

THE West Riding Consolidated Naturalists' Society have published the first number of a new monthly journal, the *Naturalist*. A journal with a similar title was published in the same district during the years 1865-6-7; we hope the present one will have a much longer life. Its principal object is to afford a means of communication among all Natural History Societies, either within or outside the county of York.

FROM the fourth Annual Report of the Chester Society of Natural Science, we are glad to see that the Society is prosperous and in good working order. The members now number 541, and during the past year several excursions have been made, several general meetings held for lectures, and the regular work of the sections carried on. Altogether this Society seems in a hopeful condition. The same Report contains a brief report of the Wrexham Society of Natural Science, which seems to some extent to be under the fostering care of its more prosperous Chester sister. It seems to be, on the whole, doing well.

MAJOR WOOD has sent us a reprint of two papers, with a map, on the Aralo-Caspian region; they originally appeared in the *Globe*, the journal of the Geographical Society of Geneva. Ramboz and Schuchardt, of Geneva, are the publishers.

THE additions to the Zoological Society's Gardens during the past week include a Red Deer (*Cervus elaphus*), European, presented by Mr. Samuel Carter; a Malabar Squirrel (*Sciurus maximus*) from S. India, presented by the Chevalier Blondin; two Purple Cow Birds (*Molothrus purpureus*) from Peru, presented by Prof. W. Nation; a Yellow-fronted Amazon (*Chrysotis ochrocephala*) from Guiana, presented by Mrs. Bolton; a Crested Peacock Pheasant (*Polyplectron chinquis*) from Malacca, purchased; three Hoffmann's Sloths (*Cholopus hoffmanni*) from Panama; three Spotted Cavies (*Cœlogenys paca*), a Coypu (*Myopotamus coypus*) from S. America, an Argus Pheasant (*Argus giganteus*) from Malacca, deposited.

## *ON THE ACTION OF URARI ON THE CENTRAL NERVOUS SYSTEM*

SINCE the introduction of urari twenty years back it has become more and more employed as an anæsthetic for physiological experiments. Its effects on the peripheral portions of the nervous system have been carefully studied, and are most distinct and peculiar, so much so that they seem to have diverted attention from its action on the central organs. Its effect, briefly, when injected subcutaneously, is to produce a paralysis of the motor nerves by attacking their ultimate branches. Dr. Foster, at whose suggestion these experiments were undertaken, and to whom I am indebted for much assistance, in the "Handbook for the Physiological Laboratory" establishes the following propositions:—1. "The effect of urari is to destroy or suspend the irritability of nerves, but not of muscles." 2. "With moderate doses of urari the small branches appear to be poisoned and to have lost their irritability, while the trunks are still intact." He also points out that "in order to bring these results out well, the dose of poison must not be more than sufficient to poison the motor nerves. Subsequent or stronger action of the poison affects the central nervous system as well." Now it is perfectly clear that the poison produces no appreciable effect on the sensory nerves, and in consequence rash conclusions have been drawn that it also has no effect on the sensorium, and is, in fact, not an anæsthetic at all.

The method of investigation employed was to take two frogs, as nearly as possible alike in size and vigour, and to pass a ligature round the whole abdomen (on Bernard's plan), taking care to exclude from the ligature the sciatic plexus and to include the blood-vessels. To one of the frogs a dose of urari was then administered, and the two placed under similar conditions and watched. The ligature in the poisoned frog of course prevented the urari from gaining access to the hinder limbs, while it could act fully on the nerve centres; and the behaviour of this frog could be compared with one which had merely undergone the operation, and was clearly possessed of consciousness and volition. We will call the two frogs A and B, B being the one which has the dose of urari. Now as soon as the poison took effect, movements of respiration of course ceased, and the frog lost control over its fore-limbs. On placing them side by side in an unconstrained position, A constantly moved, executing large and small movements with precision; its actions seemed in no way different from those of an uninjured frog. During this time the frog B never moved, and although quite capable of using its hind limbs, never did so; at rare intervals (perhaps half an hour), however, a movement was executed, but of a very distinct kind, a mere kick, such as a frog gives after the removal of its brain, in virtue of pure reflex action; now the innervation of the hind limbs was quite intact; the animal, if possessed of any wish to move them, was quite able to do so, so far as its structural arrangements were concerned. Indeed, the frog bore a striking resemblance to one which had had its brain removed; it behaved in almost every respect in the same manner.

If the two frogs be now laid on their face, a most convincing experiment can now be tried. If the leg of A be forcibly extended and let go, it is drawn up; if it be extended and held for a short time, it is again drawn up. Now if the leg of B be extended and at once released, it is also drawn up; but if it be held for a second against the efforts of the animal to withdraw it, these efforts cease and the limb retains its position for an almost indefinite period. Now there can be only one explanation of the behaviour of the frog B, namely, that the urari destroys consciousness and volition at an early period; that on extending the hind limb the mere act of extension is sufficient stimulus to call forth a definite amount of response which takes the form of a simple contraction, but that if the limb be held until this reflex act has passed off there is no consciousness on the part of the brain that the limb is in an unusual position, and consequently no volition is exerted to remove it.

It cannot be objected to this experiment that the stoppage of the circulation in the hind limbs has diminished their irritability because the frog A has perfect control over his; and, moreover, the vigour with which the reflex acts are executed in B precludes this idea. Again, it might be said that the stoppage of the respiration by the urari, and consequent supply of ill-aërated blood to the brain has injured the volition of the animal; to meet this, two counter experiments have been tried: in one a frog was gagged so as to keep its mouth open for some hours, and in the other a frog was kept under well-aërated water for two hours (a period equal to the duration of the chief experiment), and in neither case did the frogs seem to suffer any inconvenience whatever, least of all did they lose their volition.

In order to investigate the action of urari on the spinal cord, two similar frogs were taken as before; but previously to being ligatured they were pithed and had their brains destroyed; they were then suspended, and the state of the cord, as manifested by reflex action, tested; dilute sulphuric acid was used as stimulus; the numbers represent quarter seconds.

| | h, m. | A* | B |
|---|---|---|---|
| α | 3 30 | 9 | 8 |
| | 3 35 | 7 | 6 |
| | 3 40 | 8 | 6 |
| | | A* Lost blood. | |
| β | 3 40 | Urari was given to B. | |
| | 4 15 | 8 | 5 |
| | 4 20 | 8 | 7 |
| | 4 25 | 8 | 6 |
| | 4 30 | 8 | 8 |
| | 4 35 | 9 | 9 |
| γ | 4 35 | A second dose to B. | |
| | 4 40 | 7 | 14 |
| | 4 45 | 8 | 26 |
| | 4 50 | 9 | 22 |
| | 4 55 | 7 | 27 Not strong. |
| | 5 0 | 9 | 60 Weak. |
| | 5 5 | 8 | No action after 220. |
| | 5 10 | ... | ... |

From this it would appear that the first effect of urari is to make the action of the cord uncertain, then to delay the reflex action, and finally to destroy it entirely. The table has been divided into three parts, α, β, and γ, which seem to represent in a tolerably typical manner the three stages into which the phenomena are always divisible; sometimes the animal recovered after the stage γ.

This short account of the above experiments is intended as a preliminary notice. I am continuing investigations on mammals, and purpose hereafter to publish a more complete account of my results.

C. YULE

Physiological Laboratory, Cambridge

P.S.—Since writing the above my attention has been called to a paper by Dr. J. Steiner, in *Reichart's und Du Bois-Raymond's Archiv* for July. He investigates the action of urari on Invertebrates and fishes, and finds that among the latter its effect is to destroy volition before the peripheral motor fibres are attacked.

## WEATHER AND EPIDEMICS OF SCARLET FEVER IN LONDON DURING THE PAST THIRTY-FIVE YEARS*

THIS paper gives the results of an investigation, the purpose of which was to determine whether the seasonal influence of weather on deaths from scarlet fever, as shown by the curve constructed from the figures of thirty years, would present itself if the period were broken up and curves constructed for the several smaller periods embraced in the long one. In other words, the object was to determine whether, in the case of a disease which is strongly epidemic, the obedience to seasonal influences, would exhibit a steadiness and uniformity of character, such as is presented in the case of pulmonary diseases. In London there have been six epidemics of scarlet fever during the last thirty-five years, reaching their maxima in 1844, 1848, 1854, 1859, 1863, and 1870. Curves were constructed representing the average weekly deaths from scarlet fever for each of the six periods embracing these epidemics. These curves were then compared with the curve for the thirty years, 1845–74, the leading features of which are that it is above the average from the beginning of September to the end of the year, and below the average during the rest of the year; and that the period of highest death-rate is from the beginning of October to the end of November, when it rises to about 60 per cent. above the average, and the period of lowest death-rate in March, April, and May, when it is about 33 per cent. below the average.

On comparing the curves for the six short portions of the thirty-five years, each dealing only with four, five, or six years, with the general curve for the long period of thirty years, a remarkable similarity is found to occur. They are all substantially the same curve. The description of the general curve given above applies almost literally to every one of the six curves for short periods, and indeed so close is the correspondence that they all cross their mean almost in the same week of the year. In every case the maximum occurs in October and November, and the only point of difference among them is that while the general curve rises at the maximum period to 60 per cent. above the average, during the first epidemic it rose only to 40 per cent., and in one or two of the others it rose to 80 per cent. above the average. The steady obedience to climatic influences in the fatality from a disease so decidedly epidemic as scarlet fever is very remarkable, and the more so inasmuch as no other disease, with the single exception of typhoid fever, attains to its maximum fatality in London under the conditions of weather peculiar to October and November.

* Abstract of a paper read by Dr. Arthur Mitchell at the general meeting of the Scottish Meteorological Society, July 13.

## PHYSICAL PROPERTIES OF MATTER IN THE LIQUID AND GASEOUS STATES*

### II.

*Law of Gay-Lussac.*—That the law of Gay-Lussac in the case of the so-called permanent gases, or in general terms of gases greatly above their critical points, holds good at least at ordinary pressures, within the limits of experimental error, is highly probable from the experiments of Regnault; but the results I have obtained with carbonic acid will show that this law, like that of Boyle, is true only in certain limiting conditions of gaseous matter, and that it wholly fails in others. It will be shown that not only does the coefficient of expansion change rapidly with the pressure, but that, *the pressure or volume remaining constant, the coefficient changes with the temperature.* The latter result was first obtained from a set of preliminary experiments, in which the expansion of carbonic acid under a pressure of seventeen atmospheres was observed at 4°, 20°, and 54°; and it has since been fully confirmed by a large number of experiments made at different pressures and well-defined temperatures. These experiments were conducted by the two methods commonly known as the method of constant pressure and the method of constant volume. The two methods, except in the limiting conditions, do not give the same values for the coefficient of expansion; but they agree in this respect, that at high pressures the value of that coefficient changes with the temperature. While I have confined this statement to the actual results of experiment, I have no doubt that future observations will discover, in the case, at least, of such gases as carbonic acid, a similar but smaller change in the value of the co-efficient for heat at low pressures. The numerous experiments I have made on this subject will shortly be communicated in detail to the Society; and for the present I will only give the following results:—

Expansion of Heat of Carbonic Acid Gas under high pressures.

| Pressure. at. | Vol. $CO_2$ at 0° and 760 millims. = 1. | Vol. $CO_2$ at 6°·05 and 22·26 at. = 1. | Temperature. | |
|---|---|---|---|---|
| 22·26 | 0·03934 | 1·0000 | 6·05 | ...(A) |
| 22·26 | 0·05183 | 1·3175 | 63·79 | |
| 22·26 | 0·05909 | 1·5020 | 100·10 | |

* "Preliminary Notice of further Researches on the Physical Properties of Matter in the Liquid and Gaseous States under varied conditions of Pressure and Temperature." Paper read before the Royal Society by Dr. Andrews, F.R.S., Vice-President of Queen's College, Belfast. Continued from p. 301.

| Pressure. at. | Vol. $CO_2$ at 0° & 760 millims. = 1. | Vol. $CO_2$ at 6°·62 and 31·06 at. = 1. | Temperature. | |
|---|---|---|---|---|
| 31·06 | 0·02589 | 1·0000 | 6°·62 | ... (B) |
| 31·06 | 0·03600 | 1·3905 | 63·83 | |
| 31·06 | 0·04160 | 1·6068 | 100·64 | |

| Pressure. at. | Vol. $CO_2$ at 0° and 760 millims. = 1. | Vol. $CO_2$ at 6°·01 and 40·06 at. = 1. | Temperature. | |
|---|---|---|---|---|
| 40·06 | 0·01744 | 1·0000 | 6°·01 | ... (C) |
| 40·06 | 0·02697 | 1·5464 | 63·64 | |
| 40·06 | 0·03161 | 1·8123 | 100·60 | |

Taking as unit 1 vol. of carbonic acid at 6°·05 and 22·26 atmospheres, we obtain from series A the following values for the coefficient of heat for different ranges of temperature :—

$$\alpha = 0·005499 \text{ from } 6°·05 \text{ to } 63°·79$$
$$\alpha = 0·005081 \text{ from } 63°·79 \text{ to } 100°·1$$

From series B, with the corresponding unit volume at 6°·62 and 31°·06 atmospheres, we find :—

$$\alpha = 0·006826 \text{ from } 6°·62 \text{ to } 63°·83$$
$$\alpha = 0·005876 \text{ from } 63°·83 \text{ to } 100°·64$$

And in like manner from series C with the unit volume at 6°·01 and 40·06 atmospheres :—

$$\alpha = 0·009481 \text{ from } 6°·01 \text{ to } 63°·64$$
$$\alpha = 0·007194 \text{ from } 63°·64 \text{ to } 100°·60$$

The co-efficient of carbonic acid under one atmosphere referred to a unit volume at 6° is

$$\alpha = 0·003629$$

From these experiments it appears that the co-efficient of expansion increases rapidly with the pressure. Between the temperatures of 6° and 64° it is once and a half as great under 22 atmospheres, and more than two and a half times as great under 40 atmospheres, as at the pressure of 1 atmosphere. Still more important is the change in the value of the co-efficient at different parts of the thermometric scale, the pressure remaining the same. An inspection of the figures will also show that this change of value at different temperatures increases with the pressure.

Another interesting question, and one of great importance in reference to the laws of molecular action, is the relation between the elastic forces of a gas at different temperatures while the volume remains constant. The experiments which I have made in this part of the inquiry are only preliminary, and were performed not with pure carbonic acid, but with a mixture of about 11 volumes of carbonic acid and 1 volume of air. It will be convenient, for the sake of comparison, to calculate, as is usually done, the values of $\alpha$ from these experiments; but it must be remembered that $\alpha$ here represents no longer a coefficient of volume, but a coefficient of elastic force.

Elastic force of a mixture of 11 vol. $CO_2$ and 1 vol. air heated under a constant volume to different temperatures.

| Vol. $CO_2$. | Temperature. | Elastic Force. at. | |
|---|---|---|---|
| 366·1 | 13°·70 | 22·90 | ... (A) |
| 366·2 | 40·63 | 25·74 | |
| 366·2 | 99·73 | 31·65 | |
| 256·8 | 13·70 | 31·18 | ... (B) |
| 256·8 | 40·66 | 35·44 | |
| 256·8 | 99·75 | 44·29 | |

From series A we deduce for a unit at 13°·70 and 22°·90 atmospheres :—

$$\alpha = 0·004604 \text{ from } 13°·70 \text{ to } 40°·63$$
$$\alpha = 0·004367 \text{ from } 40°·63 \text{ to } 99°·73$$

And from series B :—

$$\alpha = 0·005067 \text{ from } 13°·70 \text{ to } 40°·66$$
$$\alpha = 0·004804 \text{ from } 40°·66 \text{ to } 99°·75$$

The coefficient at 13°·70 and 1 atmosphere is

$$\alpha = 0·003513$$

It is clear that the changes in the values of $\alpha$, calculated from the elastic forces under a constant volume, are in the same direction as those already deduced from the expansion of the gas under a constant pressure. The value of $\alpha$ increases with the pressure, and it is greater at lower than at higher temperatures. But a remarkable relation exists between the coefficients in the present case which does not exist between the coefficients obtained from the expansion of the gas. The values of $\alpha$, deduced for the same range of temperature from the elastic forces at different pressures, are directly proportional to one another. We have, in short—

$$\frac{0·004367}{0.004604} = 0·9485, \qquad \frac{0·04804}{0·05067} = 0·9481.$$

How far this relation will be found to exist under other conditions of temperature and pressure will appear when experiments now in progress are brought to a conclusion.

*Law of Dalton.*—This law, as originally enunciated by its author, is, that the particles of one gas possess no repulsive or attractive power with regard to the particles of another. "Oxygen gas," he states, "azotic gas, hydrogenous gas, carbonic acid gas, aqueous vapour, and probably several other elastic fluids may exist in company under any pressure and at any temperature without any regard to their specific gravities, and without any pressure upon one another." The experiments which I have made on mixtures of carbonic acid and nitrogen have occupied a larger portion of time than all I have yet referred to. They have been carried to the great pressure of 283·9 atmospheres, as measured in glass tubes by a hydrogen manometer, at which pressure a mixture of three volumes carbonic acid and four volumes nitrogen was reduced at 7°·6 to $\frac{1}{378}$ of its volume without liquefaction of the carbonic acid. As this note has already extended to an unusual length, I will not now attempt to give an analysis of these experiments, but shall briefly state their general results. The most important of these results is *the lowering of the critical point by admixture with a non-condensable gas.* Thus in the mixture mentioned above of carbonic acid and nitrogen, no liquid was formed at any pressure till the temperature was reduced below − 20° C. Even the addition of only $\frac{1}{10}$ of its volume of air or nitrogen to carbonic acid gas will lower the critical point several degrees. Finally, these experiments leave no doubt that the law of Dalton entirely fails under high pressures, where one of the gases is at a temperature not greatly above its critical point. The anomalies observed in the tension of the vapour of water, when alone and when mixed with air, find their real explanation in the fact that the law of Dalton is only approximately true in the case of mixtures of air and aqueous vapour at the ordinary pressure and temperature of the atmosphere, and do not depend, as has been alleged, on any disturbing influence produced by a hygroscopic action of the sides of the containing vessel. The law of Dalton, in short, like the laws of Boyle and Gay-Lussac, only holds good in the case of gaseous bodies which are at feeble pressures and at temperatures greatly above their critical points. Under other conditions these laws are interfered with; and in certain conditions (such as some of those described in this note) the interfering causes become so powerful as practically to efface them.

## SCIENTIFIC SERIALS

*Poggendorff's Annalen der Physik und Chemie*, Nos. 5 and 6. —These parts contain the following papers:—No. 5: On the variations in the phases of light when reflected from glass, by P. Glan; account of experiments made in the physical laboratory of Berlin University, under the direction of Prof. Helmholtz. —On some remarkable growths of quartz crystals on calcareous spar from Schneeberg in Saxony, by Aug. Frenzel of Freiberg, and G. vom Rath of Bonn.—Mineralogical researches, by G. vom Rath. This paper treats of pseudomorphous monticellite from Pesmeda, on the Monzoni Mountain in Tyrol, of rhombic sulphur, of calcareous spar from Ahren (Tyrol), and of a peculiar specimen of quartz from Japan.—On a method to determine extra currents electroscopically, by Dr. F. Fuchs.—On the electric conduction resistance of air, by A. Oberbeck.—On the absorption and refraction of light in metallic opaque bodies, by W. Werniche.—On the changes which take place in temperature at the passage of an electric current from one metal to another, by Dr. Heinr. Buff.—On the isodynamical planes round a vertical magnetic rod, and their application in an investigation of iron ore deposits, based upon magnetic measurements, by Rob. Thalén.—A paper on the same subject, by Th. Dang. Both these papers are from the *Kongl. Vetenskaps Förhandlingar*.—Spectroscopic Notes, by J. Norman Lockyer: On the evidence of variation in molecular structure, and On the molecular structure of vapours in connection with their densities. These Notes are translated from the Proceedings of the Royal Society, June 11, 1874.—On the distribution of heat in the normal spectrum, by G. Lundquist.—On the time of attraction and repulsion of electro-magnets, by Dr. Schneebeli.—On the mathematical determination of the places of deviation in telegraph lines, by Fr. Schaak.—Experiments on the plasticity of ice, by Prof. F. Pfaff. These experiments have been minutely described under our heading "Science in Germany."—On the behaviour of certain fluorescent bodies towards oleum ricini, by Ch. Horner.—On a new source of magnetism, by Donato Tommasi.—No. 6: On the temporary course of the polarisation current, by Prof. J. Bernstein.—On the objections raised against Weber's law by Tait, Thomson, and Helmholtz, by C. Neumann.—Researches in spectrum analysis, by R. Bunsen. This paper will also appear in detailed extract under our heading "Science in Germany."—On the evidence of alternation of electricity by means of flames, by F. Fuchs.—On the variations in the phases of light when reflected from glass, by P. Glan (second paper).—On the theory of laying and examining submarine telegraph lines, by W. Siemens.—Researches on the magnetism of steel rods, by C. Fromme.—On the permanently magnetic moments of magnetic rods and Häcker's formula: $T = \rho \sqrt[3]{Q} \times \sqrt[4]{l}$, by L. Külp.—On the influence of the texture of iron on its magnetism, by the same.—On the passage of gases through thin layers of liquids, by F. Exner.

THE *Naturforscher*, June.—From this part we note the following papers:—On some phenomena of interference in circular nets, by M. Soret.—On the simultaneous formation of two microscopic minerals, by H. Fischer.—On the distortion of the images reflected from the surface of water, with reference to some phenomena observed on Lake Leman, by Ch. Dufour.—On the power of diffusion in the soil of fields, by M. Grandeau.—On the tenor of carbonic acid in the soil-gases of Klausenburg, by J. von Fodor.—On the formation of the "terra rossa" from the shells of Globigerina, by M. Neumayr.—On a strange dimorphism among walnut trees (*Juglans regia*), by F. Delpino.—On the exhalation of carbonic acid by different animals, by Rud. Pott.—On a new source of magnetism, by Donato Tommasi.—On some physical properties of collodion films, by E. Gripon.—On the influence of oxygen upon life; experiments made with frogs which were placed in an atmosphere of nitrogen for some time, by E. Pflüger.—On the action of coloured light upon the assimilation of the mineral matter in plants, by Rud. Weber.—On the principle of the dispersion of energy, by A. Fick.—Light and electro-magnetism, by Ludw. Boltzmann.—On the nitro compounds of the fatty series, by Victor Meyer (a long paper taken from Liebig's *Annalen der Chemie*).—On hearing with two ears, by F. P. le Roux.—On the adaption-power of fresh-water molluscs breathing by lungs, by Th. von Siebold.

*Journal of the Franklin Institute*, June.—The following are the principal original articles in this number:—"The Centennial Exhibition," with three plates.—"Account of some Experiments made for the purpose of comparing the indication of Cassella's Air Metres," by C. B. Richards, M.E.; these experiments were adverse to the trustworthiness of the metres.—"Sympathetic Vibration," by H. A. Rowland, C.E.—"A new Vertical-Lantern Galvanometer," by Prof. G. F. Barker.—"The rapid Corrosion of Iron in Railway Bridges," by W. Kent.—"Molecular Changes in Metals," by Prof. R. H. Thurston.

*Proceedings of the Bristol Naturalists' Society*. New edition, vol. i. Part 2.—The first thing that strikes one on opening this part of the Bristol Society's *Proceedings* is the number of *errata*, there being a list of about eighty mistakes which have been allowed to slip into this and the previous number; this is very bad. The following are the titles of the papers contained in this part:—"On Fish Remains in the Bristol Old Red Sandstone," by S. Martyn, M.D.; "On *Ceratodus Forsteri*," by W. W. Stoddart, F.G.S.; "On the Physical Theory of Under-currents and of Oceanic Circulation," by W. Lant Carpenter, B.A., B.Sc.; "Bristol Rotifers: their Haunts and Habits," by C. Hudson, LL.D.; "Notes on Trias Dykes," by E. B. Tawney, F.G.S.; "Notes on the Radstock Lias," by E. B. Tawney, F.G.S.; "On the Geological Distribution of some of the Bristol Mosses," by W. W. Stoddart, F.G.S.; "A Contribution to the Theory of the Microscope and of Microscopic Vision. After Dr. E. Abbe, Professor in Jena," by H. E. Fripp, M.D.; "The Geology of the Bristol Coal-field (Part II.)," by W. W. Stoddart, F.G.S.; "The Land and Fresh-water Mollusca of the Bristol District," by A. Leipner; "Notes on Bristol Fungi," by C. E. Broome, F.L.S.; "The Rainfall in Bristol during 1874," by G. F. Burder, M.D.

THE numbers of the *Nuovo Giornale Botanico Italiano* for January—July 1875 give evidence of the impulse given to the study of lichens by the recent theory as to their compound and parasitic nature. We have in these numbers two elaborate papers on this subject, based on careful elaborate research, and both well illustrated, but coming to opposite conclusions. A. Borzi adopts the theory of Schwendener and Sachs that the gonidia of lichens have no genetic affinity with the hyphæ, but that the latter are of the nature of ascomycetous fungi parasitic on the former. G. Arcangeli, on the other hand, inclines to the views of Nylander and Tulasne that many algæ belonging to the families Protococcaceæ, Nostocaceæ, and Rivularieæ, are nothing but special forms of the gonidia of lichens; but that the gonidia are true lichen-organs. Prof. Caruel has a short note on the so-called viviparous leaves of *Begonia*, in which he shows that the adventitious buds are in reality metamorphosed hairs. Prof. Beccari has some remarks on the Rafflesiaceæ, supplementary to Dr. Hooker's monograph of the order in De Candolle's "Prodromus." He makes five species of *Rafflesia*—*R. Arnoldii*, *R. Titan*, *R. Patma*, *R. Rochussenii*, and *R. Cumingii*, besides a doubtful one, *R. Horsfieldii*; four of *Hydnora*, viz., *H. africana*, *H. abysinica*, *H. bogociensis*, *H. triceps*; and one *Prosopanche*—*P. Burmeisterii* (*Hydnora americana*). These three numbers contain, in addition, many other useful and important papers.

*Zeitschrift der Oesterreichischen Gesellschaft für Meteorologie*, July 15.—This number contains an article on the calculation of the arithmetical mean of constant quantities, by Herr Wilczek, and another on the ventilation of the St. Gothard Tunnel.

*Bulletin of the Essex Institute*, 1874 (Salem, U.S.)—A notable incident in the history of this excellent American Society during 1874, was a visit from the late Rev. C. Kingsley, who delivered a lecture on Westminster Abbey, and in whose honour a reception was afterwards held. The following are the principal scientific papers in the *Bulletin*:—Mr. F. W. Putnam, one of the most active members of the Society, contributes the following:—"Rare Fishes taken in Salem, Beverly, and Marblehead Harbours;" "On Black Fish taken in Salem Harbour;" "Notice of a Skull from shell-bed, in Rock Island;" "On Teeth of a large Shark, probably *Carcharis* (*Prionodon*) *lamia*;" "On the Shell-heaps at Eagle Hill;" "Notice of some important Discoveries of the Hayden Exploring Expedition;" "Remarks on a Collection of living specimens of Fishes and Cray pikes from Mammoth Cave." Other papers are:—"Notes on the Mammals of portions of Kansas, Colorado, Wyoming, and Utah," by J. A. Allen; "On the Fertilisation of Flowers," by E. S. Morse; "Notes on examination of four species of Chitons," by W. H. Dall; "On the Change of Colour in Leaves in Autumn," by E. C. Bolles; "On the Theory of Evolution," by E. S. Morse; "Lists of Birds observed from Sacramento to Salt Lake City," by R. Ridgway.

THE *Gazzetta Chimica Italiana*, fasc. v., contains the following papers:—On the oxidation of sulphur, by E. Pollacci. The author describes some interesting experiments he made with flowers of sulphur which he oxidised into sulphuric acid in a number of different ways.—Researches on the products of the action of urea upon asparagine and on aspartic acid, by J. Guareschi.—Preliminary note upon parabanic and oxaluric acids, by the same.—On the vegetation of *Oxalis acetosella*, *Rumex acetosa*, and *acetosella* in a soil which contains no potash, by M. Mercadante.—Account of experiments made with artificial soils and of the anomalies observed in the plants obtained.—On some properties of ferric orthophosphate, by F. Sestini.—Extract of some memoirs read at the Academy of Sciences at Bologna on researches on the poisonous alkaloids, by F. Selmi. These were on some new distinguishing properties and some newly discovered reactions.—There is the usual number of extracts from other journals.

*Kongl. Vetenskaps Akademiens Förhandlingar* (Stockholm), Feb. 10.—This part contains the following papers:—On the introduction of elliptic functions into astronomical problems, by H. Gyldén.—Hepaticæ Pyranaicæ circa Luchon crescentes, by J. E. Zetterstedt.—Researches on the chemical composition of magnetic iron ore, by G. Lindström.—On the Oniscoideæ of North America, by A. Stuxberg.—On some new Lithobiæ of the same country, by the same.—On a Lithobius borealis Meinert, found in Sweden, by the same.—Researches on the Syrphus butterfly in its three states of development, by F. Trybom (with plate).—On the Arachnidæ of Gotland and Oland, by G. F. Neuman.—On old ore deposits and their present uses, by O. Gumaelius.

## *SOCIETIES AND ACADEMIES*

### Vienna

**Imperial Academy of Sciences**, April 22.—Researches on the epithelium of the stomach, by W. Biedermann.—On the formation of meteorites, by G. Tschermak.—On some measurements of temperature made in the first half of April in the Gmunden and Atter lakes, by Prof. Simony.

April 29.—On the zoological results of the Austro-Hungarian Polar Expedition, by Prof. C. Heller.—Ichthyological researches, by Prof. F. Steindachner.—On the orbit of Planet (138) Tolosa, by Director von Littrow and Dr. L. Gruber.—On the fermentation gases from marsh and water plants, by Prof. J. Boehm.

May 13.—On the genetic classification of the flora of the Cape, by Dr. von Ettingshausen.—On the lichens of Spitzbergen and Novaja Semlja, by Dr. von Hochstetter.—On the orbit of Planet (118) Peitho, by Dr. J. Holetschek.—On the galvanic dilatation of metallic wires, by Prof. Exner.—On the respiration of water plants, and on a fermentation which includes an absorption of hydrogen, by Prof. J. Boehm.—On chalk ammonites, by Dr. Neumayer.

### Berlin

**German Chemical Society**, July 26.—P. Behrend described a method for preparing chloride of sulphuryl by heating Williamson's oxychloride $SO_2OH\,Cl$ in sealed tubes to 180°.—V. Meyer gave an account of an apparatus for determining the solubilities of salts at 100°.—J. Beckmann, by treating benzophenone $C_{13}H_{10}O$ with sulphuric acid, produced a neutral body $C_{13}H_8SO_3$, while sodic benzophenondisulphate, treated with $PCl_5$, yielded two chlorides, $C_{13}H_8O_5S_2Cl_2$ and $C_{13}H_8O_5S_2Cl_4$.—F. Tiemann and Haarmann published a method for determining the quantity of vanilline in vanilla, by precipitating its solution in ether with bisulphite of soda. Mexican vanilla gave 1·6, best Bourbon vanilla 2·3, Tavavanilla 2·6 p.c. of vanilline. Tavavanilla is less esteemed, on account of other ingredients which affect its fragrance.—F. Tiemann has transformed vanilline, $C_6H_3\begin{matrix} OH \\ OCH_3 \\ COH \end{matrix}$ into the corresponding acid and alcohol, the latter by the action of hydrogen, produced by sodium-amalgam. This reagent yields also a body $\left(C_6H_3\begin{matrix} OH \\ OCH_3 \\ CH.OH \end{matrix}\right)_2$, hydrovanilloin. He has likewise introduced ethyl and methyl into the group OH.—C. Raab has treated cuminic aldehyde with hydrocyanic acid and hydrochloric acid, obtaining the corresponding amygdalic acid. By the action of hydrogen he obtained a higher hydrobenzoin.—C. Jackson has obtained tribromonitrobenzol and tribromodinitrobenzol.—The same chemist refuted a pretended reaction of acetanilide. This body does not yield a nitrile and water when heated, as published by Mr. Brackebusch.—A. Steiner has found that $NH_3$ dissolves fulminate of silver below 40° without alteration. He has also studied the action of sulphocyanide of ammonium on fulminates.—A. W. Hofmann has transformed methyl-xylidine by means of heat into a number of highly carbonated ammonias, chiefly into $C_6(CH_3)_5NH_2$.—A. Oppenheim and L. Jackson described two new derivatives of mercaptan, viz. $C_2H_5SHgBr$, a white amorphous powder and a combination of iodoform with two molecules of mercuric mercaptide, crystallising in yellow needles. No tribasic thioformate of ethyl could be produced from these compounds.—The following communications were sent by T. Wislicenus:—Under his guidance allyl-aceto-acetic ether has been transformed by F. Zeidler into allylacetic acid and allyl-acetone. L. Ehrlich produced dibenzil-acetic ether and benzyl-oxybutyric ether. H. Rohrbeck, by treating methylacetoacetic ether with hydrogen, produced methyloxybutyric acid, which, when heated, yields methyl-crotonic acid. E. Waldschmidt has obtained the corresponding ethyl-compounds. M. Conrad, by treating aceto-acetic ether with chlorine, obtained substitution compounds and dichloracetone. F. Hermann has studied the action of sodium of succinic ether. The next meeting will take place on the 11th of October.

### Paris

**Academy of Sciences**, Aug. 9.—M. Frémy in the chair.—The following papers were read:—Application of the method of correspondence to questions of the magnitude of segments on tangents of curves, by M. Chasles.—Remarks on the note of M. Nicolaides read at the last meeting, by M. O. Bonnet.—A note by M. Thenard, on some blue substance found in clay.—Three reports by M. Janssen concerning the expedition sent to Japan to observe the transit of Venus across the sun's disc.—Calorimetric researches on the siliciurets of iron and manganese, by MM. Troost and T. Hautefeuille.—Researches on niobates and tantalates, by M. A. Joly.—Facts relating to the investigation of polyatomic alcohols, and their application to a new method for obtaining crystallised formic acid, by M. Lorin.—MM. G. Baker, Decoster de Wilder, Garcia de los Rios, Imbert, and Bordet then made some communications regarding Phylloxera.—M. Reech then presented a new edition of his memoir on surfaces which can be superposed on themselves, each in all its parts.—The Minister of Public Instruction sent the translation of an article, published by the Ministerial journal of Copenhagen, and treating of the volcanic phenomena which in the course of last winter have occurred in Iceland.—Discovery of Planet (148), made at Paris Observatory, by M. Prosper Henry, on the night of Aug. 7 last.—Observations of Planet (148) at the equatorial, by M. M. Henry.—Ephemerides of Planet (103), Hera, for the opposition of 1876, by M. Lereau.—Experiments with gas under high pressure, by M. Andrews.—On a property of an electrified surface of water, by M. G. Lippmann.—A note on sulphocarbonates, by M. A. Gélis.—On the preparation of crystallised monobromide of camphor, by M. Clin.—On some points in the physiological and therapeutic action of monobromide of camphor, by M. Bourneville.—On Marsh's apparatus and on its application for the determination of arsenic contained in organic matter, by M. Arm. Gautier.—On the larva forms of Bryozoa, by M. Barrois.—Observations by M. C. Dareste, on a recent communication of M. Joly.—On the temperature of the Mediterranean Sea along the coasts of Algeria, by MM. Ch. Grad and P. Hagenmüller.—On a waterspout observed at Morges on Aug. 4 last, by M. A. Foret.—On the identity in the mode of formation of the earth and the sun, by M. Gazan.

## BOOKS AND PAMPHLETS RECEIVED

American.—Report upon the Reconnaissance of the North-Western Wyoming and Yellowstone National Park: Wm. A. Jones (Washington).—The Geological Story briefly told: James D. Dana, LL.D. (Trübner and Co.)—Proceedings of the American Academy of Arts and Sciences, N.S. Vol. ii.—Third Report of the Zoological Society of Philadelphia.—Chronological Observations on Introduced Animals and Plants: Chas. Pickering, M.D. (Boston: Little, Brown and Co.)—Report of the U.S. Geological Survey of the Territories. Vol. vi.: F. V. Hayden (Washington).—How to use the Microscope: John Phin (Industrial Publishing Company, N.Y.)—Proceedings of the Academy of Natural Sciences of Philadelphia. Part I.

Colonial.—Report of Neilgherry Loranthageous Parasitical Plants destructive to Exotic Forest and Fruit Trees: George Bidie, M.B. (Government Press, Madras).

Foreign.—Bulletin de l'Académie Impériale des Sciences de St. Petersbourg. Tome xix. Feuilles 22-37, Tome xx. Feuilles 1-21.—Der Ursprung der Wirbelthiere und das Princip des Functionswechsels: von Anton Dohrn (Leipzig, Engelmann).—Die Geologie und Ihre Anwendung auf die Kenntniss der Bodenbeschaffenheit der Oesterr.-Ungar. Monarchie: von Franz Ritter von Hauer (Wein, A. Hölder).

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