THURSDAY, MARCH 15, 1877

THE TREASURY REPORT ON METEOROLOGY.

WE gave in our last number the report of the Treasury Committee on the administration of the Government meteorological grant, and we shall now offer a few remarks on it and on the evidence upon which it has been founded, as contained in the Blue-book before us.[1] The expenditure is devoted to the meteorology of the ocean, that is, to the part of it traversed by our ships and to that of the British Isles.

As regards the former, though much valuable work, especially in the practical point of view, has been done, this work belongs distinctly to a government department of the Admiralty. It does not seem desirable that charts for the direction of seamen should be made out according to different methods by two institutions, supported by national money. It is then proposed by the committee that the charting work, together with the marine superintendent of the Meteorological Office, who has done his duty so well, should be transferred to the Hydrographic Department of the Admiralty, while the scientific part should be done in connection with investigations, including observations both over land and sea. This appears a most reasonable decision.

Though the second part of the business of the Meteorological Office is limited to a small surface, yet it is one with which we are more immediately concerned, and surrounded as we are by the sea, this part really involves all the modifications which surfaces of land and water may produce on the actions of meteorological causes. It seems to be supposed that observations on the ocean must present meteorological variations in a much simpler form, because the atmosphere rests on a surface which is at once more level, and at a more constant temperature than that of the land; but it seems not to have been remarked that the conditions under which the observations are made are much more complex. If we could imagine a search into the laws of continental meteorology founded on the observations made by some passengers in railway trains across France, Germany, and Russia, the difficulty of piecing together observations of very various degrees of merit for the deduction of even accurate means would be at once evident; that of searching for laws would become still more so. It is no doubt desirable that the meteorological variations over water should be studied apart, but for this end an observatory placed on some small island in mid-ocean would be a more satisfactory way of obtaining the end in view. Whether this would aid in the search for the causes of phenomena met with under very different conditions in our latitudes is by no means certain.

The department of the Meteorological Office occupied with the meteorology of the British Isles, includes that of storm warnings; indeed this is, at present, the great practical work. There are numerous stations at which "eye" observations are made daily, and these are telegraphed to the central office in London. There are also seven observatories having instruments which register continuously the variations of the meteorological elements. The storm warnings are founded on the telegraphed observations; the registered observations have a different object. They can no doubt be employed after warnings have been issued to verify the observations and to satisfy any doubt that may have existed as to errors committed, but their chief object, in the first instance, is purely scientific.

It has long been seen that storm warnings are not founded upon laws that can be distinctly stated. Though observations made over a considerable tract of country are made use of, and a certain knowledge exists of relations between atmospheric pressure and winds, yet the warnings depend to some extent upon a practical experience which, like that of the shepherd and sailor, cannot easily be communicated to others.

The seven observatories were established to obtain good materials with which a scientific study might be founded and from which laws might be deduced giving increased probabilities of accurate prediction of the weather to-morrow from our knowledge of what it is to-day. This is not, however, the only use of the observatories. If all the scientific precautions have been taken with respect to them, they will in that case be to the meteorology of the country what carefully measured base lines are to its exact survey; each will give a point to which the observations made around it may be referred and corrected.

The great question before the Committee was how best to aid in making meteorology a science—a science from which practical results may be deduced. Millions of meteorological observations have been made and published; the seven observatories are producing continuous registers of the variations of barometric pressure, temperature, wind direction and force, &c. What is to be done with all these? Are we to go on piling Pelion on Ossa with the idea that heaps of observations will enable us to reach the mysteries they enclose? And can the Government be satisfied that they have done enough when they present the public with volumes of observation in something of the way in which Hamlet offered his friend the pipe—"Govern these ventages with your fingers and thumb, give it breath with your mouth, and it will discourse most eloquent music"?

The question then is how to get at the mysteries; or how to find a musician with breath enough to blow and skill enough to draw harmonious sounds from this giant pipe. We can only glance at parts of the testimony of the most distinguished witnesses.

When we remember that after a century of research by men of the greatest eminence—mathematicians, physicists, meteorologists—we cannot tell why the air presses heavier at ten o'clock than at four o'clock; we see that meteorological investigation includes some of the most difficult scientific problems. With this fact in view, some of the questions put to the witnesses would seem almost *comiques*, did we not know that their object was to draw out something of value in the reply. Thus, with reference to finding a "man of genius to try and get something out of the observations which have been made" (1,012), the question (1,017) is put to Sir G. B. Airy: "But you would hardly think it a safe thing to select, for instance, a young man from Cambridge, and say to him: 'Now you must take up this subject'?" When we remember, also, that

[1] "Report of the Treasury Committee Appointed to Inquire into the Conditions and Mode of Administration of the Annual Grant in aid of Meteorological Observations; together with Minutes of Evidence, Appendix, and Index." (London, 1877.)

the Astronomer-Royal has directed a meteorological observatory nearly forty years, and that he now says meteorology is not a science (940), it is naught, and in short that he has not been able to make anything out of it, we can understand with what profound conviction he replied, "I do not think that would be a safe thing."

Sir William Thomson was also examined on this question, and he thinks (1720) "the best way would be to get some thoroughly able young man, well acquainted with mathematics and of good judgment to take up the whole subject of the harmonic analysis of the observations." No doubt the harmonic analysis has some advantages as representing mean values approximately by a series of simple oscillations occupying the whole, a half, a third, &c., of the time-period considered, which can be compared when the conditions vary; but it is only a first step, one which may be misused if it is supposed that each oscillation must represent the different periodic actions of the same or of different causes. Kaemtz employed this method forty years ago on every possible meteorological variation, but we cannot say that any important result was obtained by its means.

What has to be done was indicated by the Astronomer-Royal in answer to question 1,015); men (one man cannot undertake the work in all its directions) must be "seized upon" who have displayed "talent for things of that sort," who by long study have become saturated with the facts of the science and who have shown the capacity to devise new methods and to employ them with success. Such men, as Sir George Airy says, in answer to another question (991), should be asked to devote themselves to examining the observations already made, and to "turning them over in all conceivable ways." Such men, he says (1,015), are to be taken "on opportunity," that is to say, if they present themselves we should lay hold of them. But this is true for every occupation demanding special qualifications. It would seem sometimes as if the difficulties were exaggerated, and sometimes under estimated. If we had a Newton among us, he could do little till the meteorological apple has fallen, and the tree will require, we think, a good deal of shaking first. That the specialty of turning a thing "in all conceivable ways" is not very common, may be deduced from the evidence before the committee; but many look on meteorological investigation as a kind of lottery, where just because so many blanks have been drawn, every one has a better chance of getting a prize; and some very clever people think that the affair may be done by a machine.

There is also the very urgent reason for "turning over" the observations made at the seven observatories, that it is not possible to determine their value, nor how far they can be usefully employed for strict scientific investigation till this is done. Mr. Buchan, one of the few working meteorologists examined, says (1,530), that the eye-observations "secure an exactness and accuracy which photographic self-recording instruments do not possess." This, if true, is a very serious matter, and we shall have to return to it at another time.

The subject of observatories, the most important in connection with the progress of meteorology as a science, was also brought forward by the Committee. The question was put to the Astronomer-Royal (1,045): "Might I ask what led your office to undertake the meteorological part of its work in 1840?—Because nobody else did." This answer must evidently be taken with reference to certain conditions. Had the Government been encouraged at the time to support a magnetical and meteorological observatory, paying a competent man to direct it, we can scarcely doubt that they would have done so. Sir G. Airy's reply means, we believe, that nobody was ready to undertake the duty for nothing but himself. We think it is much to be regretted that the director of the National Observatory, overcharged as he is with the duties connected directly with his office, should have been allowed to undertake scientific work, demanding so much care and devotion of time, which was really not at all in his specialty, however excellent the motives might have been which induced him to do so.

This is now well understood in other countries. In Paris there is now a magnetical and meteorological observatory with a distinct head; another observatory devoted to solar physics is rising; and similar arrangements have been made in Germany and Austria. It is the very essence of "penny wise, pound foolish" which can seek from one man to direct with success three or four observatories at the same time, when each of them will task the energies of the cleverest men in the different departments to make something good out of them.

The question is further put (1,050)—"In the former part of your evidence you spoke as if meteorology at present was scarcely in a scientific position at all, as too uncertain to be called a science at present?—It is not in a scientific condition at all, I think."

"1,051.—I want to connect that answer with the fact that in 1840 you undertook in this Government Department these particular inquiries; at that time you must have formed some idea that these studies were worth pursuing for national objects, and in a national establishment?—Observing the movement that was going on in other places, it was very desirable that Greenwich should be one of the stations in concert with them, but still I was so diffident about the success of it, that after three years, I think at the next meeting of the committee, or I forget by what name it was called, where the representatives of different nations attended, I earnestly urged them to cease. I did not see that there was any use in going on. I recommended them to do something like what I have spoken of to-day, to stop where they were, and try what they could extract from those observations that they had collected, before they proceeded further with them."

It has always been a tendency with the heads of great national scientific institutions to annex other scientific work than that for which the institutions were founded. We remember that the late Prof. Nichol described at the meeting of the British Association at Glasgow in 1840, the numerous works he was about to carry forward in different departments of astronomy; to all he added a magnetical and also a meteorological observatory, with special reference to important meteorological problems, which he proposed to take up. Photoheliography and spectroscopy were not then in existence, or doubtless they also would have been included. The Astronomer-Royal then said (we do not remember the exact words, but they were to this effect): "Let me, as an old observer, recommend Professor Nichol, as a young observer, to undertake less and he will do more."

We have much pleasure in finding that we agree so generally with Sir G. Airy's views. We do not think, however, that it was desirable to place a meteorological observatory in Greenwich Park. We have already said why we do not think it was necessary, or even advantageous to the sciences, that both magnetism and meteorology should be placed under the same direction as the National Astronomical Observatory. Indeed the Astronomer-Royal has allowed (in his evidence) for meteorology, what is well known to scientific men all over the world for magnetism, that his well-intentioned devotion to these subjects has not been repaid by the results he has obtained.

Sir G. Airy thinks the existence of the Kew Observatory unnecessary (1,028); that they can furnish observations "at Greenwich as good or better, but quite as good certainly" (995). We quite agree that Kew and Greenwich are not both necessary, but it will be seen that we would greatly prefer to see magnetism and meteorology relegated elsewhere (we do not admire the position of Kew). With reference to the comparative value of the observations made at the two observatories, it has always been to us a matter of surprise that with two observatories within a few miles of each other, no comprehensive, strictly accurate, and scientific comparisons of the observations, magnetical and meteorological, made in them, should have been made and published. We cannot tell how far they agree or disagree. One might at least have been used as an aid to the other; if there are differences, such a comparison would have led to a search for their causes, and errors might thus have been corrected. It would be a very disagreeable matter if, when compared, instruments at the two observatories should be found not to go together as well as Admiral Fitzroy's weather-glass and an aneroid barometer.

A great national observatory for the prosecution of a branch of science of so much practical importance as meteorology should not be merely observational, but also experimental. Let us take one of the simplest cases, one brought forward before the Committee: How should we place a thermometer? Sir G. Airy says (984): "The mere observation of getting the temperature of the air is one of the most difficult things I know. If you are on the north side of a building within some distance you get it too low; if you are on the south side you get it too high, and if you are close to the ground you get something different." This is all perfectly exact; and we may add, if you keep the thermometer in one place probably the sun will shine on the ground near it differently at different hours of the day and in different months of the year, so that there is a varying source of error in the same place. The Astronomer-Royal is also asked if he can estimate the probable difference between a thermometer at four feet and forty feet above the ground (987), but he cannot; and at what height a thermometer should be placed, but he replies only that four feet is the usual height.

We mention these questions to show that nearly everything has as yet to be placed on a scientific footing. We do not think four feet is a good height, and agree with the Astronomer-Royal that thermometers have been placed too near the ground, where they have been affected by many local differences which would have been to a great extent avoided at a greater height. Of course observations may be made at any height from the soil when special questions are in view. Similar difficulties exist for other instruments, and it is certain that we are making masses of observations which might have been much more valuable to science had experiments of the class indicated been made in the first instance. In such an observatory, also, there is a whole series of physical experiments which could and should be performed, independently of those which should more properly be placed in the hands of specialists.

In the Report of the Committee, we find the following (Art. 8):—"As regards the first, although it may be desirable at some future time to create a permanent meteorological establishment on some such footing as that of the Astronomical Observatory at Greenwich, with an officer of scientific eminence at its head, we think that matters are scarcely ripe for such a step at present." We have been in some cases satisfied with the report, but here, if we understand the meaning of the word "ripe," we must differ. We believe that matters have been ripe any time the last forty years; but we hope to return to this subject on another occasion.

The Report of the Committee is all that could probably be expected with the evidence before it. There are at present two purely scientific works that should be carried forward. Something should be done with the observations of the seven observatories, and much should be done to encourage research in connection with meteorological questions generally. It should not be imagined that an investigation with reference to some very small variation can have no practical value, that is to say, that the practical results which may flow from it can be measured by the amount of the variation. Nor should it be supposed that any question which touches on atmospheric variations should be neglected, in this respect, because the relation may appear remote. The movements of the sun's envelopes, the spots, the protuberances; the moon's possible action on solar emanations may all appear unconnected with our calms or our storms, and may yet all have a relation to both.

To conclude, we object to a cumulation of duties on one head, by which things are not only not well done, but through which others are prevented from doing them well. We think centralisation hurtful to science, and we regret that 1,000*l*. a-year has not been granted to Scotland, by which a healthy rivalry would have been gained.

We have given most place to Sir G. Airy's testimony because his is really the most important, but we cannot help inquiring why so few directors of observatories and meteorologists were examined. Dr. Lloyd, who has directed a magnetical and meteorological observatory for many years; Prof. Balfour Stewart, once secretary to the Meteorological Committee and director of the Kew Observatory; Mr. J. A. Broun, who has directed observatories in Scotland and in India; the Rev. Mr. Main, director of the Radcliffe Observatory; Prof. Piazzi Smyth, director of the Edinburgh Observatory; all of whom have been occupied with meteorological investigation, are all wanting, and they are all men who might have said something worth hearing on what should be done.

MR. TROTTER ON UNIVERSITY REFORM

On Some Questions of University Reform. By Coutts Trotter, M.A., Senior Fellow and Tutor of Trinity College, Cambridge. (Cambridge, Deighton.)

DURING the short life of the Oxford and Cambridge Bills of last year, it was my lot to hear from many of my London friends many dismal, sometimes almost contemptuous, prophecies concerning the future of natural science at the old universities. For myself, in looking forward towards possible and probable changes, I always lay to heart the hackneyed consolation of the unsuccessful Liberal Orator, "Time is on our side." Whatever happens, science cannot lose much and may gain largely. How great a progress might with the least possible shock to conservative principles be effected by the help of men in whose minds a broad sympathetic love of learning is associated with a delicate appreciation of the present university feelings and habits, may be learnt by any one who will take the trouble to read Mr. Trotter's brief pamphlet.

There are men who in their so-called radical ways of thinking, exalt theoretical statements above practical suggestions, and thus are led to insist that all university reform is useless which is not based on the two abstract principles :—1. That the interests of education are essentially opposed to those of learning : 2. That the interests of the colleges are essentially opposed to those of the university. Such men argue with great vehemence that it is hopeless to expect learning to flourish in a place like Cambridge, for instance, where education, so far from being neglected, as Mr. Lowe seems to think, is pushed with yearly increasing energy (they speak of it as being "rampant," and assert that the students, who have been long over-examined, are now in danger of being overtaught), and where a poor university, like an almost penniless king whose only subjects are a few wealthy barons, contends in vain with colleges which not only are at the present moment far richer and stronger than it, but must always tend to be so, since the feeling which binds a student to his university is akin to the mild emotion of patriotism, while his affection for his college is more like the family love of home.

To this class of reformers Mr. Trotter does not belong. How far he would agree with these abstract principles cannot be learnt from his pamphlet. He, perhaps, is one of those who think that abstract principles are like the timbers of a ship, which, through the very making of the vessel, come to the surface only after shipwreck. At any rate, he adopts what to many will seem the wise course of confining himself to the practical consideration of how, with the least possible dissipation of energy, education may be converted into learning, and how the university, which ought to be the seat of the latter, may be fortified without injuring that "college life" which is the natural instrument of the former, and which, to all who know it, has charms too great to be neglected by any wise reformer.

On these matters, all his remarks, coming as they do from one who, having a true love of learning, has for several years been prominently engaged in college and university business, seem to me worthy of very serious attention. I can readily imagine that his views will be condemned by two opposing parties. Many academic conservatives will call them "revolutionary." Many academic and other radicals will stigmatise them as a compromise. They do indeed favour that dreadfully commonplace "middle way"; but they possess this notable characteristic—they are tentative and progressive. They may not at first convert the university into a palace of learning; but if adopted, may, without fear of strain, be expanded in proportion to the demands of knowledge and the wealth of the united corporations.

In the first of the three divisions of his pamphlet, Mr. Trotter deals with the relations of education and knowledge; and his leading idea is the multiplication of what, in general terms, may be called professorships, the duties of which shall be so light as to afford leisure for research, and the promotion to which shall be at least largely dependent on fruitfulness in advancing learning. He would make learning and education, what the pious founders thought they had provided for their being, co-partners in the wealth of the colleges; and would sweeten and lighten teaching with the spirit of research. In this he will doubtless fail to please those who press for the endowment of research "untrammelled by teaching duties;" but is not, after all, the difference between him and them one of detail only, and not of "abstract principle?" Putting aside certain tasks of continued observation, all investigators, or at least all with comparatively few exceptions, would be assisted rather than hampered in their inquiries by having from time to time to give expositions of their particular studies to an audience of some kind or other. And that is all which is really included under the duties of professor. How much or how little teaching ought to be demanded of this or that man must depend on the particular circumstances of each case; and the few instances where absolute dumbness is an essential to successful research, might without difficulty be provided for by special arrangements.

These professorships Mr. Trotter would divide into three classes :—(1) Ordinary Professorships, such as now exist; (2) Lectureships, somewhat corresponding to the present College Lectureships; and (3), what, in the absence of any more suitable word, he proposes to call Extraordinary Professorships. The first class he proposes to limit in number and exalt in dignity so that each professor should be considered as at least the nominal head of the particular study to which he is devoted. Although he does not expressly state it, Mr. Trotter evidently intends that the men holding these offices should be eminently men of research; and hence while their incomes would be ample, their official duties would be light. The extraordinary professors would form a more numerous class and would be appointed either for fruitfulness in research or for great teaching talent, or (and it is hoped frequently) for both. The emoluments and status of an extraordinary professorship ought to be such that a man might look to it as a post for life and not merely as a stepping-stone to something else. The third class of lectureships would be still more numerous, and serve in part at least as feeders to the other professorships. Though, for them, as for the other two classes, research would be a qualification at least on a level with didactic ability, the teaching duties of a lecturer would naturally be heavier than those of a professor. It may be urged, as Mr. Trotter himself feels, that extraordinary professor is a very awkward title. Professor adjunct, or assistant professor is distinctly objectionable. It seems to me that there is much to be said in favour of calling the new professors by the simple title of professor, and of inventing for the higher and more select posts some such style as professor director, or professor rector; indeed, the duties of a member of this class would probably in many cases consist largely in a general guidance and supervision of the studies carried on in his own particular science.

His plans also provide assistants both for teaching and research, demonstrators, &c., and include the establishment of what he proposes to call "senior scholarships," *i.e.*, posts to be filled by able young men at the close of their student career for the purpose of enabling them to devote themselves free from all trammels, for two, three, or more of their best years, to learning research. This is, indeed, at present, perhaps the most crying want of the university, a want most imperfectly met or not met at all by fellowships as now administered.

The scheme by which Mr. Trotter proposes to unite the university and the colleges in the function of appointing and regulating this professoriate requires development; but it has the great merit of strengthening the hands of the various "boards of studies," and if adopted would soon grow into a natural and healthy form of government under which the hiring, by candidates for university posts, of special trains for the conveyance of their outlying voters, would become a grim and a grotesque reminiscence of the past. It must be remembered, however, that no artificial scheme will secure purity of election, unless the electors be thoroughly leavened with the leaven of loyalty to learning; and that such loyalty will only be found where research, rather than teaching, is regarded as the great aim of university life, where Leah is woo'd chiefly in the hope that Rachel may be won.

All these proposed changes, to say nothing of university laboratories, museums, &c., require money; and in the second part of his pamphlet Mr. Trotter discusses the methods by which the wealth of the colleges may be rendered available for university purposes. Here two plans present themselves. There is, first, what may be called the "social" plan. In this the colleges are supposed to undertake the care and protection of certain university posts or institutions, this college, for instance, supplying the funds, in the shape of fellowships or otherwise, for this professorship, or taking the charge of that laboratory. It may be regretted that Mr. Trotter has not entered more fully into the discussion of this plan, which is sure to find ardent supporters in the colleges. It offers the college a *quid pro quo*, and promises to strengthen rather than weaken "college life." The difficulties of the plan lie in the question of election. If the university elects, the college may have to receive into its bosom a man whom it detests; if the college elects, it may not unlikely choose the very man the university would seek to avoid. Such a scheme cannot be made to work satisfactorily even with the help of elaborate checks and counter-checks, unless the actions of both colleges and university are directed by thorough loyalty to learning.

The second plan is that of "taxation," or as a small but prominent party prefers to call it, "confiscation," by which the colleges are called upon to contribute, in proportion to their wealth, to the common university funds. And on this point Mr. Trotter's suggestion that the contributions "should be variable within limits, and fixed from time to time, in accordance with the wants of the university, by some competent authority representing the colleges," is worthy of consideration as an improvement on the older scheme of a fixed contribution in the form of a definite percentage tax on the collegiate divisible revenues. At the same time it is difficult to overlook the possible occurrence of bitter and frequent discussions as to what, at any given time, are to be considered the actual needs of the university.

The money which the colleges are in the one way or another to be called upon to devote to the university must come from the pockets of the scholars, or the fellows, or the heads of houses; and the third part of the pamphlet is devoted to a consideration of these three classes.

Concerning the fellows, Mr. Trotter, with a boldness which will undoubtedly prevent many Conservatives from recognising at first how moderate a compromise his whole plan of reform really is, writes as follows:—"On the whole, I am disposed, mainly for the reasons put forward by Mr. Sidgwick in the *Contemporary Review* (April, 1876), to advocate the abolition, or at any rate the restriction within very narrow limits, of the class of fellowships *held purely as prizes*." Such a proposal will be opposed tooth and nail by many both within and outside the university who have never attempted to answer Mr. Sidgwick's arguments; and Mr. Trotter himself states that he imagines "public opinion" is not at present prepared to support so extreme a measure.

In the matter of the scholars Mr. Trotter proposes no marked innovation, though he seems to think changes of some kind are desirable. To his general approval of present practices he will find few demurrers either within or outside the university; and yet the evil influences which the system of scholarships is secretly exercising on both education and learning are well worth consideration; *mutatis mutandis*, many of the arguments against prize fellowships might be well applied to prize scholarships.

The heads of houses form the last topic on which Mr. Trotter dwells, and those who know university life, whatever their opinions, must award to him the praise of having brought forward into open and plain-speaking discussion a subject on which, for many reasons, it is difficult for any fellow of a college to say his mind. That he boldly advocates the abolition of heads of houses is perhaps less important than that the question should be thoroughly considered. At the same time his arguments seem irresistible; he says all that can be said in favour of maintaining these ancient offices, but concludes that all the advantages they offer might be secured by other arrangements which would bring to the university at the least an annual income of 15,000*l.*, and yet eventually be felt by no college as a burden—by some, possibly, as a relief.

M. FOSTER

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.*]

Science at Oxford

THE anonymous "Oxford Man" who so effectively reformed his Alma Mater on paper in the last number of NATURE can hardly be complimented on his successful and unfilial misrepresentations. It is not true that "of all the 360 fellowships in the various colleges only five are held by persons (exclusive of professors) who have been elected to them in consideration of their attainments in physical science." At the present moment no less than six fellowships are being held by *biologists*, viz., at Exeter, two; at Magdalen, two; at Pembroke, one; and at Ch. Ch., one; and two fellowships at Merton, one at Brasenose, one at C. C. C., and two at Ch. Ch., are tenable for physics or chemistry solely. It is true that one Merton fellowship and the one at Corpus is at the moment vacant, but this does not affect the question. Thus there are *twelve* instead of five fellowships in the hands of natural science honour men, and considering the few who graduate in the science school as compared with the vast crowds who in the aggregate go out in other schools, the number is by no means despicable. There is, moreover, the equivalent of a fellowship held by the Millard Lecturer in physics, who receives from Trinity an annual grant of 200*l*. This list of prizes takes no account of those fellowships in which "the application of mathematics to physics has been allowed to count in establishing a students' claim to such fellowship."

It is difficult to make out why the statistics of 1875 should have been selected by "an Oxford Man," to whom one would imagine the calendar for 1877 should be by no means inaccessible, and the conclusions to which consideration of these statistics has led him irresistibly suggest to those who know Oxford as it is, that "an Oxford Man's" survey is retrospective.

That the public schools pay so little heed to physical science is matter for regret, which is however tempered by the assurance that a change has been inaugurated in places, and the conviction grows daily stronger that the claims of natural truth are forcing a recognition in these centres of preliminary culture. At Eton, at Rugby, and at Clifton, science is no longer a bye-word and a play, but with masters to teach and willing boys to learn, biology and physics and chemistry are fast becoming realities where, not very long ago, they were but phantom names.

It is folly to hint of "introducing any branch of physical science into any one of the compulsory examinations." Such a course would effectually crush the growing taste for natural knowledge; it is only by leaving it an optional or alternative subject that the present prejudice against the study of science can be satisfactorily subdued.

Only ignorance of the Oxford of to-day could have led to the expression "even the heads of houses are with few exceptions men who have been schoolmasters, or who hope to be so." The Master of University, and the Dean of Christ Church can alone claim to have served in the capacity which has been asserted of the majority. The conclusion of the sentence quoted is ridiculous when applied to the senior members of the collegiate bodies.

The concluding paragraph of "an Oxford Man's" article is perhaps most glaringly indicative of sublime ignorance of the Oxford of to-day. Those whose interest, it is assumed, "it is to suppress a class of studies of which they are themselves ignorant," include many names honoured even in metropolitan centres of scientific culture; and it would better become all "Oxford men" who, *in absentia*, are prone to think of the University as they knew it, to assure themselves that things have remained *in statu quo*, than to censure in ignorance that a little careful inquiry would completely dispel. CHARLES H. WADE

Magd. Coll., Oxford, March 12

Just Intonation

OTHER occupations have prevented my replying sooner to Col. A. R. Clarke's amusing charge (vol. xv. p. 353), that it is I (instead of he himself) who "confound vibration numbers with their ratios." Three examples are included in his first letter: "The vibration numbers of the diatonic scale being represented by—

$$1,\ \frac{9}{8},\ \frac{5}{4},\ \frac{4}{3},\ \frac{3}{2},\ \frac{5}{3},\ \frac{15}{8},\ 2."$$

The figures are correct in this instance, but instead of being "vibration numbers," they represent only the *ratios* of vibration. Then follows: "if we build the scale upon the dominant $\frac{3}{2}$, the vibration numbers will be—

$$1,\ \frac{9}{8},\ \frac{5}{4},\ \frac{45}{32},\ \frac{3}{2},\ \frac{27}{16},\ \frac{15}{8},\ 2,$$

and if we built upon the sub-dominant $\frac{4}{3}$, the vibration numbers will be—

$$1,\ \frac{10}{9},\ \frac{5}{4},\ \frac{4}{3},\ \frac{3}{2},\ \frac{5}{3},\ \frac{16}{9},\ 2."$$

Such ratios as these could not pass unchallenged in NATURE, therefore I drew the anonymous writer's attention to the second and third scales, only pointing to the first intervals in each, and as "oversights." It was reasonable to expect that he would submit the scales to some competent musical friend, who would correct them throughout. Instead of doing so, the Colonel announced himself, and had the courage to write, "the errors and oversights with which Mr. Chappell charges me are imaginary." Under the plea of "making the matter clearer," he changed the ratios (January 18), but still he could not set them right. Col. Clarke's third letter convinces me that he does not permit his figures to be called in question by any person. Perhaps, then, one illustration of the Colonel's system of making, or of transferring, ratios may interest the reader. I select his $\frac{45}{32}$, because its source may perhaps be pointed out. Mr. Colin Brown introduced that ratio as from F to B natural in the scale of F. The Colonel saw that F, G, A, and B *natural* were four consecutive long keys, and so also were G, A, B, and C, therefore the ratio of the one ought to do for the other. It was excellent geometry, because all the keys are of the same width; only, whether they were tones or semitones cannot have entered into the Colonel's calculation.

It may be assumed that Mr. Colin Brown did not construct any harmonic instrument of six octaves above F, in order to hear such a thorough dissonance among the quarter-tones as 45 vibrations sounding in cycles against 32, but that he had a sheet of paper before him, and added the intervals $\frac{9}{8}$ to $\frac{5}{4}$. The $\frac{9}{8}$ was for the major tone from F to G, and the $\frac{5}{4}$ for the major Third from G to B. This $\frac{9}{8}$ from F to G, might have assisted the Colonel to correct his sub-dominant scale.

Allow me to add a note which may be in time for Mr. George Grove's glossary. I now recollect that the so-called "Comma of Pythagoras" is claimed by Boethius, and, as his treatise was once a college text-book, it was in all probability from it that the moderns first applied the name "comma" to that most minute of intervals. It is a favourite plaything with mathematicians, but, being inaudible as a sound, whether as a difference, a ratio, or any other way, it may well be spared from books upon mundane music. WM. CHAPPELL

Strafford Lodge, Oatlands Park, Surrey

Typical Division of Stars.—Borrelly's Comet

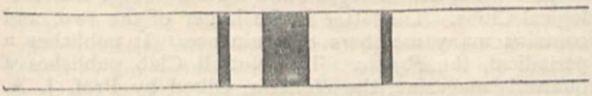
EXCUSE me asking you to allow me to rectify a statement in NATURE, vol. xv. p. 344, col. 2. It is stated there that M. Konkoly has followed M. Vogel's typical division of stars. I beg to observe that this typical division has been proposed by myself since my first publication in 1866 (*Memorie* of the Società Italiana, ser. iii. tom. i. p. 1) and *passim* in my first publications.

Again you say that M. Vogel discovered, in 1871, the bright lines of β Lyræ. I beg you also to note that these lines were announced by myself in my first publication of the same year, 1866, and even printed in the special catalogue of spectral stars, published in Paris in 1867, and widely circulated (p. 21). I have also announced that these lines were invisible in after years.

I do not wonder at these omissions, since unfortunately the Italian language is very little understood out of our country.

Rome, February 24 P. R. SECCHI

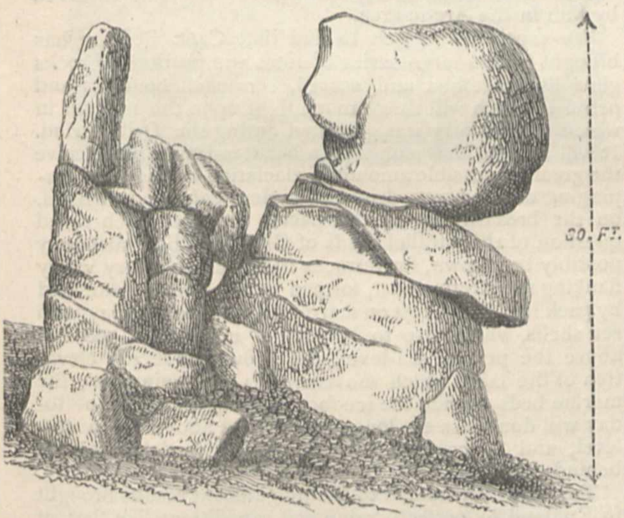
P.S.—On the 15th of this month I obtained a sight of the spectrum of Borelly's Comet. It was composed of a bright line very large in the green, another *more* refrangible in the blue, and another *less* refrangible in the yellow (?) but this was narrow and faint. Their figure was approximately as follows:—



I could not determine them better. The lines, especially the central one, were pretty brilliant.

"Stone Rivers"

THE interesting account of the mode of formation of "Stone Rivers," given in a late number by Sir C. Wyville Thomson, recalls to my mind some apparent moraines which I observed, and somewhat similarly explained, some years ago in the Hartz Mountains. In a paper read before the Geological Society of Dublin in 1872,[1] I thus speak of them: "The first thing that one notices on entering this valley [the 'Ockerthal'] from the north is that the bed of the stream is crowded with granite pebbles and boulders, which become of greater size as we proceed up the valley. The boulders are soon so large—many of them some tons in weight—and are situated so far up the slopes on each side, that the first idea is, we have here the morass of a former great glacier. I looked diligently for ice marks, but could see none; and I soon found that the causes which have the effect of scattering huge blocks of rock on the slopes and on the bed of the river are now at work and are slowly, but surely, altering the contour of the adjoining granitic mountains. . . . . All over the sides and upon the summits of these mountains are scattered the most fantastic piles of immense boulders. Some of them are over thirty feet in height and form conspicuous objects in the landscape; others, again, are deep in the forest, away from pathways, and are not to be seen until one climbs quite up to them. . . . . It is quite clear that the contiguous



A pile of granite rocks on a mountain overlooking Ockerthal.

surfaces of the blocks in these piles are undergoing a slow decomposition, that the joints are becoming gradually looser, and in consequence the cohesion of the component pieces less and less. Sooner or later the upper portions must either slip off or topple over, and roll down the mountain side. And this is not mere theory, for I hear that every now and then a boulder does fall and comes crushing down the hill until quietly deposited near the bottom. It would appear that while the surrounding rock has been decomposed and has fallen down in the manner indicated, these heaps have the longer resisted. But they are yet to follow in their turn; when the atmospheric agencies have sufficiently done their work, gravity will come in and lower the whole."

Instances of the turning over of the edges of slaty strata from the weight of the superincumbent mould and vegetation are common in the Hartz. I find in an old note-book the following entry:—"I was interested at seeing the upper slates on the left wall [of a quarry near Goslar] bent so much over that [their dip has become 75° to the north [the regular cleavage dip of the district is about 40° *south*]. Whether this is due to the weight of the ground above, to a landslip, or to the action of a glacier, I am not quite sure. I incline, however, to the first theory, for, although the slope of the hill is not high, the constant weight of the superincumbent earth and rubbish, bearing downwards for ages, would, it seems to me, be enough to cause such a result."

Scientific Club PHIN. S. ABRAHAM

[1] "Notes on the Geology of the Hartz," by P. S. Abraham, M.A., B Sc., &c. Plates VIII. to XI. Journ. R. Geol. Soc. of Ireland, vol xiii. Pt. 3, p 92. 1873.

The Measurement of the Height of Clouds

AMONG the various parallactic methods for determining cloud heights, one of which Mr. Malloch has put in practice (NATURE, vol. xv., p. 313), the use of the cloud shadow as a second station seems worthy of notice, as it requires very simple apparatus and observations.

On any partially cloudy day at the sea-side, an observer with a sextant may, from a cliff, easily determine cloud heights by the following elements:—A. Altitude of a given point of cloud above the horizon, allowing for dip. B. Depression of the shadow of the same point on the surface of the sea. C. Sun's altitude. D. Lineal elevation of observer above sea-level. The measurements should be taken when the cloud, the sun, and the observer all lie in a perpendicular plane; *i.e.*, when the cloud shadow is seen on the sheen of light reflected from the wavelets; otherwise azimuth observations, and less simple calculations, must be applied. Full moonlight might also be used at night.

On practically trying this method in September, 1875, the time of day was selected when the sun was in the direction to or from which the wind was blowing; thus the cloud shadows slowly sailed along the sheen on the sea, and could be followed by successive timed observations for half-an-hour or more, so that their velocity, and any variation in their height, could be ascertained.

The results are of course most accurate when both clouds and sun are at considerable altitudes, and I believe that this method will give results quite as accurate as the photographic process. The rounded forms are the greatest trouble, and measurements of the centres of little isolated masses of cloud are the best. The height of the observer above the sea is of course easily obtained by the angular width of a base measured on the beach.

The same method might be employed with shadows on land, by using a theodolite and a map; and though it is only applicable to one or two classes of clouds, yet its simplicity may induce some of your sea-side readers to make such observations.

Bromley, Kent W. M. FLINDERS PETRIE

The "Hog-Wallows" of California

MY friend, Mr. Thomas Belt, F.G.S., has kindly sent me the following extract from a paper by Prof. Joseph Le Conte, in the *American Journal of Science* for 1874 (p. 366), in which an explanation is given of the above-named formation (NATURE, vol. xv. p. 274) and of similar mounds farther north. It will be seen that Prof. Le Conte refers them wholly to "surface-erosion," but it is not clear whether he means "pluvial" or "aerial" erosion, or the two combined. More explanation seems required to account for the *removal* of the eroded matter over a surface thirty miles wide without producing any continuous ravines or other water channels:—

"*Prairie Mounds.*—The irregularly ramifying grassy glades or prairies already described as existing at the southern extremity of Puget Sound are studded over as thickly as possible with *mounds* about three to four feet high and thirty or forty feet in diameter at base." . . .

"The whole country between the Dalles and the upper bridge of Des Chutes River, a distance of about thirty miles, is literally covered with these mounds." . . . "The true key to their formation is given here, as it was not at Mound Prairie, by the great variety of forms, sizes, and degrees of regularity which they assume. They vary in *size* from scarcely detectable pimples to mounds five feet high and forty feet in diameter at base, and in *form* from circular through elliptic and long-elliptic to ordinary hill-side erosion-furrows and ridges." . . .

"No one, I think, can ride over those thirty miles and observe closely without being convinced that these mounds are wholly the result of surface-erosion, acting under peculiar conditions. The conditions are a *treeless country* and a *drift soil* consisting of two layers, a fine and more movable one above and a coarser and less movable one below." . . . "The necessary condition, I believe, is the greater movableness of the surface soil compared with the sub-soil." . . . "Surface erosion cuts through the finer superficial layer into the pebble layer beneath, leaving, however, portions of the superficial layer as mounds."

"Similar less conspicuous mounds, under the name of 'Hog-wallows,' are well known to exist over wide areas in middle and southern California."

The words in italics are so in the original.

ALFRED R. WALLACE

SCIENCE AT CAMBRIDGE, MASS.

THERE is marked activity in all scientific pursuits in and about Harvard University. The Agassiz Museum has at last had its management fully turned over to the University, the transfer being effected by permission from the State Legislature. At present the estimated worth of the property is $322,000; the land and buildings being valued at $100,000, and the collections at $60,000; the rest being trust funds. By the transfer, Harvard will have the use of the collections for educational purposes, and the Peabody Museum of Archæology will erect an edifice connected in plan with the Agassiz Museum. The Peabody trust provides for a Professorship of Anthropology, as well as for collections and a building. The Agassiz Museum is arranged so as to display types of the whole animal kingdom in their natural classification. Great facilities are already furnished to students and specialists, and these facilities will now be further increased. The force employed in the Museum is sufficient not only for the care of the specimens, but also to aid in new research.

There is a steady increase in the number of Harvard students in the scientific courses—physics, chemistry, natural history, botany, anatomy, and physiology. Text-books are little used in these courses; students are required to handle the things themselves, in the laboratories. "Summer schools" are conducted from June to September, in which teachers from the public schools become pupils. Chemistry has been taught in these summer schools for three years, geology and botany for two years, and zoology will be undertaken this year under Assistant-Professor Walter Faxon. Prof. Shaler's Summer School of Geology is the most widely-known of these enterprises. This year it will be conducted with headquarters successively in the Connecticut Valley, the Berkshire Hills of Massachusetts, and the Helderberg or the Catskill Mountains of New York. The class will be limited to fifty members. After the school closes, a trip will be made by those who can join in it to Cleveland, Nashville, Louisville, and the Mammoth Cave. Besides the Summer Schools, there is also organised a series of four courses of lectures to teachers, which include laboratory work. These are given on Saturdays from January to May. They embrace geology, physics, botany, and zoology, and have the services of Professors Shaler, Trowbridge, Goodale, and McCrady, and some assistant-professors of special repute. There are about forty members to a class.

The Boston Society of Natural History sustains a similar series of course-lectures to teachers during the winter months. The instruction is practical, as far as it can be made so by the illustrative specimens in the Society's collection. Prof. Shaler is also organising a system to furnish teachers with selected specimens and appropriate text-books and descriptions. It is expected that this new system will be the means of inducing teachers in the public schools to make further collections for their own use and to instruct their scholars. The Harvard Natural History Society is very actively engaged in promoting scientific education, especially among beginners in such studies. Prizes are offered for the best essays of the students upon their actual observations in natural history and botany. A free course of six scientific lectures is furnished by this Society, the lecturers being eminent specialists in the University. Two scientific associations at Cambridge are also doing active work—the Nuttall Ornithological and the Cambridge Entomological Clubs. The latter is the larger of the two, and contains many members of eminence. It publishes a periodical, the *Psyche*. The Nuttall Club publishes a quarterly magazine, the *Bulletin*, edited by Prof. J. A. Allen. This list of scientific enterprises in and around Cambridge, Mass., is by no means exhaustive, but it will give a fair notion of the activity with which they are promoted at the present time. It is hoped that the present year will be marked by even greater effort than its predecessors.

NATURAL HISTORY AND GEOLOGICAL RESULTS OF THE ARCTIC EXPEDITION

THE public will, we are sure, be glad to hear that though the Admiralty have declined to undertake or assist in the publication of the results of the late British Arctic Expedition, beyond matters purely hydrographical, the natural history and geological collections brought back by the expedition are being rapidly arranged and named. The whole of the numerous collection of fossils from the Silurian (Wenlock), Devonian, Carboniferous Limestone, and Miocene rocks of the coasts of the circumpolar sea have been examined by Mr. Etheridge, the palæontologist of the Geological Survey, and found to contain several new and interesting forms, which will be described in his forthcoming paper, at the Geological Society, on the Arctic fossils brought back by Capt. Feilden, R.A., and which will accompany a paper by that officer on the rocks and general geological facts observed by him in the Arctic area.

We especially rejoice to find that Capt. Feilden has brought back a large series of notes and portions of rocks glacially scratched and scored, scratched boulders and pebbles, which will throw much light upon the manner in which this country was glaciated during the Drift period. It will be seen that stones on a headland coast can receive the greatest possible amount of glaciation by the mere impinging of floe-bergs, driven by violent gales and currents, on the breaking up of the pack. On the much-vexed question of the parallel roads of Glen Roy, light also may possibly be thrown, for terraces fringe nearly every valley flanking the Arctic coast, formed by fresh water, dammed by pack ice. These rest on marine beds of boulder clay, with sea shells, which rise to heights of more than 500 feet above the present sea-level, and prove the recent elevation of the land, which movement is still going on; the marine beds outside the ice-foot fringing the coast of to-day will doubtless ere long be elevated above the water-level, and be covered with the latest fluviatile terrace behind the pack.

To those accustomed to the magnificent results brought to England by perfectly equipped expeditions like that of the *Challenger*, proceeding leisurely through seas teeming with the luxuriance of tropical life, the collections brought back by the Arctic Expedition may appear small; but we feel sure when the specimens are fully catalogued, and the difficulty realised of carrying heavy specimens of rocks and fossils when up to the arms in snow, and of securing insects with fingers numbed by a temperature of 50° below freezing, it will be felt that the naturalists of this expedition have made excellent use of their opportunities. We may mention that the extensive series of Miocene plants associated with the thirty-feet coal-bed of Lady Franklin's inlet will be described by Prof. O. Heer, the insects (recent) by Mr. McLachlan, and the fishes by Dr. Günther, of the British Museum.

THE PHYSIOLOGICAL ACTION OF LIGHT[1]

NEW Method of Experimenting.—One of the chief difficulties in arriving at the exact relation between the electrical variation and the luminous and colour intensity of light, was the continually diminishing sensibility to the stimulus, owing to the abnormal conditions of the eye when removed from the head. When the experiment begins, the eye is remarkably sensitive to light, and a large variation of current is obtained; but the amount of this current is gradually falling, in consequence of the gradual change in the parts of the eye, owing to their loss of vitality and sensibility. In fact, the parts are dying—the blood is not circulating, and molecular and chemical changes are slowly occurring. In the case of the frog however, it is a fact that the retina retains its sensibility from three to four hours, and sometimes longer. After a lapse of two hours the frog's eye frequently remains in a tolerably stable condition, in which it does not lose sensibility rapidly. This condition may last for four

Diagram showing arrangement of apparatus in the experiment on eye o frog. A, Eye showing the electrode, E, in contact with it. B, Skin removed, and subcutaneous tissue in contact with other electrode, E. K, Key. G, Galvanometer. Arrows indicate direction of current. Cornea, positive. Back, negative.

or five hours. In order to get rid of the difficulty of gradual death of the parts, various methods were tried in earlier experiments in the attempt to remove the eye as quickly as possible, and to make the observations rapidly. In the case of the warm-blooded animals this did not lead to good results, because the sensibility to light disappeared in a very few minutes. On several occasions the posterior aspect of the eye was exposed in the living anæsthetised warm-blooded animal, and on bringing one electrode into contact with the severed optic nerve while the other touched the cornea, the observations were tolerably constant. This method was troublesome and difficult.

These experiments are now made in a different way. By placing a frog, rabbit, or pigeon under the influence of chinoline, the animal remains motionless. A small portion of the surface of the cranium is then removed so as to expose a portion of the brain. One of the electrodes is brought into contact with the surface of the cornea, and the other with the surface of the brain. The blood is still circulating. A current is obtained; and all the effects I have just mentioned may be observed with ease. The animal remains in this condition, retaining its sensibility to the action of light, for as long a period, in the case of the frog, as forty-eight hours. These observations led to the discovery made recently, that there is no necessity for even exposing the surface of the brain. That is to say, the action of light can be traced, if needful, through the whole body. If, for example, we take a frog, place it in position, slightly abrade the skin on the surface of the head or back, or any part of the body, then adjust the electrodes, one in front of the cornea and the other upon the abraded skin, we obtain an electrical current which is affected by light in the usual way. But if the electrode in contact with the cornea be shifted to some other part of the body, a current may be obtained; but this current is not sensitive to light. In order to produce the specific action of light upon the eye, the retina must be included in the circuit. This discovery enabled us to perform many experiments without injuring the animal, except to the extent of abrading or removing a small portion of skin. It at once opened up the way for making observations upon warm-blooded animals (one of the chief difficulties in our earlier investigations). For example: give a rabbit or a guinea-pig a small dose of chinoline, and the animal remains prostrate and quiet. Then cut off a little of the hair from the surface of the head at the back of the neck, and abrade the skin so as to have a moist surface; bring the electrodes into position, placing one in contact with the abraded surface, and the other in contact with the surface of the cornea, and you will at once obtain the effect.

Action of Light in Warm-blooded same as in Cold-blooded Animals.—By the use of chinoline we were able to make experiments of the kind just described for a considerable time, without the necessity of maintaining artificial respiration. The result of those investigations upon warm-blooded animals has been to show that in these, as in the cold-blooded, light produces first an *increase* in the electric current on impact; continued light usually causes the electrical current to diminish; and on the removal of light, there is a second rise, as described in the case of the frog. In our earlier investigations, we always observed in the case of warm-blooded animals (when the eye had either been quite removed from the body or was receiving an inadequate supply of blood), that the action of light caused a negative variation, that is, a *diminution* in the electrical current. By improved methods, however, which have the effect of placing the eye in conditions more normal, we find that light causes a *positive* variation, that is, an increase; thus agreeing with what had hitherto been observed in the eye of the frog. This is a point worthy of notice. Du Bois-Reymond showed, even in the case of sensory nerves, that physiological action caused a *negative* variation. But it appears that in the case of the retina the action of the normal stimulus is to cause a positive, not a negative variation.

Experiment with the Living Lobster.—The action of light can be readily shown in this animal. Fix it loosely in a cloth, and lay it on the table in a slightly oblique position. With a small trephine remove a circular portion of the carapace, about three millimètres in diameter, and expose the moist tegumentary surface. Bring one electrode into contact with this surface, while the other touches the cornea. The usual effects of light may then be noted; but in the case of the lobster, the variation caused by the impact is greater than what we have noticed in any other animal, often amounting to one-tenth of the total amount of current. Another interesting experiment, comparable with that of the two eyes just described, may be made on the lobster by placing an electrode in contact with each cornea. The result frequently is apparently no current, but in reality the currents neutralise each other. Light falling on the one eye causes the needle to move,

[1] Friday evening Lecture by Prof. James Dewar, M.A., at the Royal Institution, March 31, 1876. See NATURE, vol. viii. p. 204.

say to the left, while if it fall on the other eye, the needle swerves to the right. When the eye of the lobster, removed from the body, was divided longitudinally into segments, each segment was found sensitive to light. The

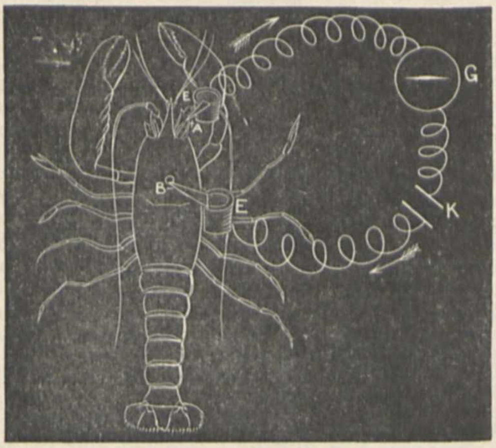


Diagram showing arrangement of apparatus in experiment on living lobster A, corneal surface, having elect ode, E, in contact with it. B, portion of carapace removed so as to expose moist surface for electrode, E. K, key. G, galvanometer. Arrows indicate direction of current.

effect of light was then to increase the primary current, but no inductive action was observed on withdrawal. This observation is interesting as a confirmation of the views of physiologists regarding the mode of action of a compound eye.

Mode of Experiment on Eye of Fish.—An experiment upon the eye of a fish may be made in a very simple way, by a method adopted in Prof. Stricker's laboratory in Vienna. Take a fish and give it a very small dose of woorara. It soon becomes almost motionless, and sinks in some cases to the bottom of the vessel. The animal would soon die in consequence of paralysis of the movement of the gills necessary for respiration. But, if we take the animal out of the water, put it upon a glass plate, introduce a little bit of cork under each gill, and then by means of an india-rubber tube placed in the mouth, allow a little water to flow over the gills, the fish will live out of water for many hours. By this method may be made the experiment upon the eye of a fish with like results.

Observation on Human Eye.—Having succeeded in detecting the action of light on the retina of the living warm-blooded animal without any operative procedures, it appeared possible to apply a similar method to the eye of man. For this purpose, a small trough of clay or paraffin was constructed round the margin of the orbit, so as to contain a quantity of dilute salt solution, when the body was placed horizontally and the head properly secured. Into this solution the terminal of a non-polarisable electrode was introduced, and in order to complete the circuit the other electrode was connected with a large gutta-percha trough containing salt solution, into which one of the hands was inserted. By a laborious process of education it is possible to diminish largely the electrical variation due to the involuntary movements of the eye-ball, and by fixing the eye on one point with concentrated attention, another observer, watching the galvanometer, and altering the intensity of the light, can detect an electrical variation similar to what is seen in other animals. This method, however, is too exhausting and uncertain to permit of quantitative observations being made.

Explanation of Variation in Direction of Current.—One phenomenon particularly attracted the attention of physiologists, and especially of those who first saw the experiments, viz., that sometimes, in the case of the eye of the frog, light produced an increase in the electrical current, and in other cases a diminution. This we could not at first account for. But we have been able to make out that the positive and negative variation, or the increase or diminution of the natural current on the action of light, depends upon the direction of the primary current, when the cornea and brain are in circuit. If the cornea be positive and the brain be negative, then light produces an *increase* of the electrical current. If, on the other hand, the cornea be negative and the brain positive, light then produces a *diminution* in the electrical current. It is thus conclusively shown that the current superadded, or if we may use the language, induced by the action of light, is always in the same direction; only in the one case it is added to, and in the other subtracted from, the primary current.

The Use of Equal and Opposite Currents.—Many experiments were performed in which equal and opposite currents were transmitted through the galvanometer at the same time. By the use of resistance coils, it was not difficult to balance the current from the eye; but, owing to the inconstancy of even a Daniell's cell in such experiments as these, it was impossible to avoid fluctuations which might possibly have been mistaken for those due to the action of light. This difficulty was got over by what was formerly called *the double eye experiment*, in which two similar eyes are placed in reversed positions on the electrodes, so that the current from the one neutralises that of the other. When this is accomplished, it is easy by means of a blackened box, having a shutter at each side, to allow light to fall on either the one eye or the other, and it is then shown that the galvanometer needle moves either to the right or left, according to the eye affected. Instead of removing the eyes from the head and balancing them as just described, it is a much better method to apply the two electrodes directly to the corneas in their natural position. By a little manipulation, it is possible to obtain two positions that seemingly give no electrical current. In these circumstances, light, allowed to fall on the one eye or the other, produces the effects above detailed.

Action of Polarised Light and Colours of Spectrum.—The next point investigated was the action of polarised light and the various complementary colours. Early experiments, by passing light through solutions having various absorptive powers and by the direct coloured rays of the spectrum, &c., lead always to the same conclusion—namely, that the most luminous rays produce the greatest effect. For studying the action of polarised light, the simple contrivance of a black box, having a hole on one side of it, placed over the eye, may be employed. Opposite the hole two cylindrical tubes of brass, each carrying a Nicol's prism, were placed, and between the two prisms a thin plate of quartz is introduced, producing the various colours of polarised light on rotating one of the prisms. The general results were exactly the same as with the colours of the spectrum. In all cases, the impact of the yellow rays produced the greatest effect. It has also been ascertained by this method that the effect of the *impact* of light is much more regular than the effect of its removal. The results of one series of observations are given in the two following tables:—

Action on Frog's Eye of Colours of Polarised Light.

	Initial Effect.	Final Effect.
Purple	rise of 3	rise of 14
Light blue	,, 5	,, 12
Red violet	,, 5	,, 15
Blue	,, 7	,, 20
Red	,, 8 5	,, 15
Orange red	,, 10	,, 22
Green blue	,, 10	,, 24
Green	,, 13	,, 24
Yellow	,, 16	,, 24
Rose	,, 8	,, 19

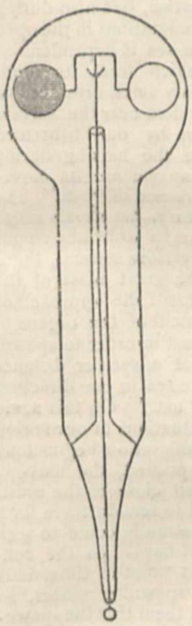
Action on Frog's Eye of Spectrum of Oxyhydrogen Flame.

	Initial Effect.	Final Effect.
Yellow, near orange ...	rise of 70	rise of 10
Green yellow	" 25	" 5
Green—low	" 15	" 0
Green—high	" 15	" 0
Green—higher	" 18	" 8
Yellow green	" 85	" 35
Yellow	" 80	" 40

(*To be continued.*)

SIR WILLIAM GROVE ON THE RADIOMETER[1]

SIR WILLIAM GROVE described some experiments he had recently made with a modification of Crookes's radiometer. After a few prefatory trials, such as coating one-half of the bulb with tinfoil and electrising it, which gave no notable results, he devised a method, shown in the accompanying sketch, by which he could electrise the whole of the internal system. Four aluminium vanes, each blackened on one side, had metallic arms and a metal point at their crossing that rested in a metal cup. The latter was united to a platinum wire that passed through a glass tube and was fused into it, the platinum wire protruding. Lastly, the glass tube was fused inside the apparatus and hermetically sealed, the end of the platinum wire being exposed. The vacuum in this apparatus was considered by Mr. Crookes[2] to be as perfect as in his radiometers generally, but Sir William Grove doubted that it was so The following were the results:—



1. With the faint light of a lucifer match or of one or two candles, the vanes invariably turned the opposite way to the normal, the polished surface being repelled. With a dark heat, as from an iron shovel heated short of redness, they went the normal way. These effects continued for several days, but not permanently; the apparatus seemed to have leaked and to have become sluggish and irregular.

2. On electrising the protruding platinum wire with a rubbed rod of glass or sealing-wax, the vanes rotated sometimes one way and sometimes the other.

3. On connecting the negative pole of a Ruhmkorf's coil the results were uncertain, but the positive pole caused the vanes to rotate steadily, and its effect was even better than that from light or heat. In the dark the effect was very beautiful, as the dark vanes moved through a phosphorescent glow. The total results were considered by Sir William Grove to be somewhat negative, but they tended to show that all the effects were due to residual air. He suggested in explanation of the last experiment, that more electricity would escape from the rough than from the polished faces of the vanes, as the former presented a vast number of points. Consequently the rough faces would produce more disturbance of the gas in front of them, and would themselves be more affected by the reaction than the plane faces. The polished surfaces being repelled by luminous heat is, however, very difficult of explanation.

In his second notice Sir William Grove described some further experiments he had made with Crookes's radiometers since the last meeting of the club. He did not now entertain much doubt that these movements are due to the effect of residual air. Mr. Crookes had kindly made a second instrument for him, and the one that he described at the last meeting, of which the vanes were metallic and in metallic connection with a platinum wire that protruded outside the apparatus, had been re-exhausted. Both now act normally, the black faces of the vanes being repelled by light and by heat. When the protruding wire is now electrised by a Ruhmkorf's coil the effects that were previously observed are altogether absent, there is not the slightest luminosity round the vanes, and the current does not pass. But although the current is now incapable of traversing the small space of one-tenth of an inch that separates the vanes from the glass, induction acts across it just as well as before. This is shown by the readiness with which the vanes follow the movements of a piece of rubbed glass or sealing-wax held near the apparatus. It is therefore evident that the effects of attenuation of air upon discharge and upon induction are not the same. When attenuation has commenced and is increasing, the discharge passes more and more rapidly, until it becomes a glow, or according to the old theory of electricity, polarisation becomes more and more readily subverted; but a further attenuation stops the discharge entirely. On the other hand, induction continues, and appears to be in no way lessened by extreme attenuation. These results cannot be accounted for by the old theory that discharge is the consequence of subverted induction.

It farther appears that a radiometer is a most delicate electroscope. By tilting it until the vanes touch the glass, the interior of the glass may be electrised, and it will then remain for days in that condition. He had performed this operation eight days ago, and the movements of the instrument by light or heat have been thereby wholly checked. Every endeavour has been made to discharge or neutralise the electricity on the glass surface, as, for example, by covering the exterior of the globe with tinfoil and connecting this with the platinum wire, nevertheless the glass remains charged, showing what a perfect insulator a good vacuum is.[1]

The above is a copy of the abstracts in the club book. They are now further published, as some partial notices of them have appeared in foreign journals. W. R. G.

[1] Abstract of two communications by the Hon. Sir William Grove, F.R.S., to the Philosophical Club, May 18 and June 15, 1876.

[2] Who kindly made it for me from my description.—W. R. G.

[1] I may state that the electricity did ultimately become dissipated, but not until several weeks had elapsed.—W. R. G.

THE NORWEGIAN NORTH SEA EXPEDITION, 1876[2]

II.

Researches relating to the Salt-water Fisheries.

BY the side of the more strictly scientific researches it was also our intention during the expedition, if opportunity offered, to give close attention to all the circumstances that might stand in any connection with or throw any light upon our most important salt-water fisheries. As I already during a series of years had been engaged in the study of our fisheries, the prosecution of these researches was committed to me.

For this reason there was added to our other equipment various fishing apparatus, as hooks and lines for deep-sea fishing, and several sorts of drag-nets with various sizes of mesh. The use of such implements could, as a matter of course, only be reckoned upon in good weather and with a pretty smooth sea, which we, however, had promised ourselves might occur at least now and then during our three months' excursion at the best season of the year. But the state of the weather was unfortunately so utterly unfavourable during our whole expedition that the employment of the apparatus we have referred to was not to be thought of. For the same reason the apparatus for measuring the velocity of the currents, exceedingly important in the first place for the physico-meteorological researches, but also for those with which we are now concerned, could not be brought into use. During the few fine days we had in the course of our expedition we were too near the coast for these researches to have any special interest.

Although the state of the weather thus laid insurmountable obstacles in the way of the researches referred to, I have, however, during our expedition, been able to establish certain facts which, in my opinion, are of no inconsiderable importance in this direction, and will be of great use in guiding us in the continued practical scientific researches concerning our fisheries. It is of these facts that I now proceed to give some details.

It is ascertained by our soundings that off our coast there are several fish-banks of whose existence there was no previous knowledge, and on which a profitable fishery with bank vessels may certainly be carried on during the summer months.

The so-called "Storegg" (great edge) off Romsdal's Amt has been from old times famous for its immeasurable richness in fish, and there has been an obscure tradition that it was not the only point where such fishing could be carried on on a large scale, but that there were to be found similar rich fish banks at many other points far out in the open sea, "were man only fortunate enough to fall upon them." The mystic account of the "Havbro" (sea

[2] By Prof. G. D. Sars From Christiania *Dagbladet* of January 27. Continued from p 414.

pier or jetty) has now been for the most part explained by the surveys set on foot during our expedition. The "Storegg" is nothing else than a piece of the edge of the extended barrier, which in the west forms the boundary line beyond which lie the cold polar sea-deeps. That so clear a knowledge of this edge within a very limited extent has been already obtained, without the least idea being formed as to its proper connection, naturally arises from the polar sea-deeps here running in closer to the coast than at any other point. A new piece of the continuation of this edge had already been found by soundings made from the steamer *Hansteen*, and we have now been able to establish its existence at several other points, and that both farther south and farther north it retires more and more from the coast to a distance of from twenty to thirty Norwegian (140 to 210 English) miles.

Although it may not be constant everywhere, it appears, however, to be the rule that at the bottom, at the farthest boundary of the barrier, before it slopes towards the great depths lying beyond it, it rises somewhat, and assumes simultaneously a hard stony character, as is the case, as is well known, at the Storegg. At the first sounding, when we went out from Husoe, we struck this edge at about twenty Norwegian (140 English) miles' distance from the coast (stations 16[1] and 17[2]). The bottom, which before had everywhere appeared to be soft, suddenly, at a depth of 221 fathoms, became hard and stony, and retained this character even after it had sloped about fifty fathoms down towards the deep sea lying beyond. That there was here a pretty abrupt descent is clear from the circumstance that we already at the next station reached far down into the cold area with a depth of 412 fathoms, and a bottom temperature of ÷ 1°·3 C. Farther north, about the latitude of Trondhjem, we found at a depth of 190 fathoms, and likewise on the boundary line between the warm and cold area, a very similar edge with rocky bottom, which falls off with a pretty steep slope towards the west (Station 89[3]). Also on the opposite side of the tract of sea we traversed, we had occasion to observe a similar state of things. Off the Færoe Islands, and at a considerable distance from them, we were fortunate enough, though the weather was exceedingly unfavourable, to find the outer edge or opposite point of the extensive Færoe bank (Station 38[4]), whereby its extent and configuration could be to some extent determined, and the state of things here appears to be very similar to the Storegg.

By the carefully-planned soundings which were undertaken from Ramsen Fiord westwards, there could be established at a comparatively inconsiderable distance from the coast, the existence of a hitherto quite unknown, well-defined, steep bank of considerable extent, with a hard bottom, and a depth of only 62–93 fathoms (Stations 63,[5] 64,[6] 65[7]). Beyond this there was a very gentle and even descent towards the great deeps, but we did not here meet with any true edge as at the Storegg. It may be added that in the outer part of Søgne Fiord (Sognfjœen), we found a pretty extensive plateau, with a hard stony bottom, and a slope both inwards and outwards (depth from 206 to 211 fathoms).

That all the points mentioned above are excellent fishing-grounds I have not a moment's doubt. Everywhere, where at a considerable distance from the coast, such banks with hard or stony bottom have been found, there have always on closer examination been found large quantities of fish, and although an attempt made by us by attaching to the lead a short line with hooks and bait was unsuccessful, there cannot be any negative conclusion drawn from this method of research, which was unfortunately, by reason of circumstances, very unsuitable for the purpose.

The kinds of fish which are found on the sea-banks are, as is well known, principally ling, torsk (*Brosmus vulgaris*), halibut, and cod, the so-called bank cod. I have already, in my reports to the department, clearly set it forth as my opinion that the so-called bank cod is not a different variety from the well-known winter cod, or *skreid*, which in winter and all through the spring, visits our coast for the purpose of spawning. The earlier hypotheses concerning the migrations of the winter cod (*skreid*) from great distances in the sea, I have, after a close study of the nature of this fish, been obliged entirely to abandon, and the experience obtained during our expedition confirms me in this. It is my conviction that the winter cod, which is to be found along our coasts during winter, and which is the object of some of our most important fisheries, is during the rest of the year distributed only over that tract of sea whose bottom forms the barrier against the polar sea-deeps lying beyond it, and that the outer boundary of this barrier (the so-called Havbro), with its well-developed animal life and favourable bottom, forms a suitable habitat for innumerable multitudes of this fish.

Very dissimilar are the circumstances with reference to the second of the varieties of fish most important for our fisheries—the herring. Here my earlier researches have led me just to the opposite conclusion. While the cod is evidently a genuine bottom fish, and as such dependent on the nature of the bottom and partly on the depth, the herring, on the contrary, in consequence of its whole nature, is a genuine pelagian fish, and its occurrence is therefore exceedingly independent of the depth or the nature of the bottom, but, on the contrary, dependent on the physical and biological conditions in the upper stratum of the sea. As these are very changeable, this species of fish may have been furnished with means to enable it speedily to seek out the most favourable tract of sea. The herring has also, as contrasted with the cod, obtained its elegantly-compressed, wedge-like form, whereby with the speed of an arrow it can shoot along through the water, and in a comparatively short time traverse long distances. Although I do not adopt the old ideas, according to which the spring herring comes as it were from the ice-covered sea about the North Pole, I am, however, inclined to believe that, not only when it visits the coast to spawn, but also during the rest of the year, it undertakes irregular migrations in the open sea. The distribution of the herring in the sea is dependent on the distribution of the small animals which form its food. These small animals are all pelagian, mainly small crustacea of the order Copepoda, which keep more or less near the surface of the sea, and are commonly known by our fishermen under the name of "aat." Only when the herring during winter resorts to the coast to deposit its spawn are its movements for the time independent of the occurrence of "aat." The whole other part of the year, on the contrary, the shoals range through the open sea, inasmuch as they prefer to betake themselves to that region of the sea where, at various seasons, there is the greatest abundance of "aat." The great mass of the herring shoals can thus very naturally, towards the approach of winter, or at the time when the development of the organs of generation drives them to resort to the coast in order to spawn, be found sometimes at a less, sometimes at a greater distance from their spawning places according as the sea in one direction or another has the greatest abundance in "aat." On this again mainly depends, I am convinced, the fluctuations in our spring herring fisheries. For as the spawning migration begins long before the roe or milt are ready to be deposited, the mass of herring, if at that point of time it finds itself close to the coast, will reach it so early that it will be obliged to remain there for a considerable time, during which it will naturally come to seek closer in towards the coast in the fiords and bays. In the contrary case, when the mass of herring at this point of time finds itself at a considerable distance from its spawning places, so long time will have passed before it reaches them that the spawning process will go on immediately after their arrival at the coast. The herring will then remain only a short time along the coast, and the spawning will then for the most part be carried on on the outermost banks, less accessible to the fishermen, in other words, the spring herring fishery will be very short or exceedingly unsuccessful.

This is, in short, the theory which I already, several years ago, in consequence of researches made by me along our coasts, was led to advance as in my view the only probable scientific explanation of the remarkable irregularities which in course of time are observable in our spring herring fisheries. I have, however, unfortunately this time only very few facts to support my theory with, and I cannot, therefore, be surprised if it has been received with mistrust, as merely a hypothesis. There are, indeed, a few reports from seamen of their having observed large herring shoals far out in the open sea, immediately before the beginning of the spring herring fishing, as there have been observed by others at various seasons of the year great masses of "aat" at different points in the sea, and we have information concerning this last phenomenon, partly also from trustworthy scientific men (Kroeyer), and that just from that region of the sea, which here most interests us; but these statements were, however, too few to form complete evidence that the open sea is in fact a suitable dwelling-place for the enormous masses of herring which at certain seasons of the year move towards the coast.

[1] Station 16, lat. 62° 23′ 9″; long. 2° 17′ E. from Greenwich.
[2] Station 17, lat. 62° 33′; long. 2° 4′ E. from Greenwich.
[3] Station 89, lat. 64° 1′; long. 6° 7′ 5″ E. from Greenwich.
[4] Station 38, lat. 62° 57′; long. 3° 47′ W. from Greenwich.
[5] Station 63, 64° 41′ 3″ N. L., 9° E. from Greenwich.
[6] Station 64, 64° 42′ N. L., 8° 50′ E. from Greenwich.
[7] Station 65, 64° 42′ 5″ N.L., 8° 39′ E. from Greenwich.

During our expedition I therefore considered it a very important object to examine closely the distribution of the "aat" in the tract of sea over which we sailed. For this purpose the sea was examined almost daily, often several times a day, by the help of a surface-net. The results of these examinations completely confirmed my previous view on this point. During the whole passage from Norway to the Færoe Islands, the sea was found everywhere filled with enormous masses of the so-called "red aat" (almost exclusively *Calanus finmarchicus*) which, as is well known, forms the food best liked by the herring, and, what deserves to be remarked, the quantity of this "aat" appears to increase with the distance from the coast, being greatest at a distance of about twenty Norwegian (140 English) miles. Besides the "red aat" we also observed farther out to sea, great quantities of another pretty blue sort of "aat" (*Pontella Patersonii*), which appears to belong more to the Atlantic Ocean, and which, to distinguish it from the other, might be called the "mackerel aat," as it probably forms the principal food of the mackerel at those seasons of the year when this fish is not in the neighbourhood of the coast. This "aat" also shows itself sometimes, particularly during great takes of herring in summer, among the "red aat" close to the coast. When we went northwards from the Færoe Islands toward Iceland, it was remarkable that the "aat" almost entirely disappeared from the sea. At the same time the sea had assumed a very different colour. While during the whole passage from Norway to the Færoe Islands it had been a deep blue, it was now [a light, dirty, greyish-green. This peculiar circumstance, for which I cannot yet account, but in which a peculiar relation of the ocean currents certainly plays a considerable part, appears to stand in close connection with the occurrence of "aat," and will be the subject of careful researches during our next expedition. I had a very convenient opportunity of observing this phenomenon from my cabin, the light of which was almost on a level with the sea. When, by the pitching of the vessel, the glass was washed over, the whole cabin was clearly illuminated with a very beautiful, intense dark blue light, and I have often, when, after my work was ended, I was taking a little rest in my cabin, been greatly delighted with this phenomenon, which so strikingly reminded me of my stay in the south the preceding winter, and my ever-memorable visit to the blue grotto at Capri. Now, on the contrary, the illumination was quite different, namely, light greenish. This colour remained constant so long as we were in the navigable water near Iceland, and the sea was everywhere, as has been stated, almost completely free from "aat." The previously-observed state of things recurred first when we, on our return voyage, approached the coast of Norway. The water resumed its beautiful blue colour, and the sea swarmed with "aat." I cannot help supposing that the conditions observed during our expedition is not always the same, as several recent accounts state that the sea about Iceland is specially rich in "aat." It appears as if the constant westerly storm, which we had to put up with during our expedition, in combination with the strong up-going current, had had a disturbing action, and forced the mass of "aat" farther in towards the Norwegian coast. If this should in fact be the case, a supposition which in the mean time with the little experience we have yet had on the point can scarcely be supported with full evidence, there may be seen in this (if the above-mentioned theory of mine with reference to the migrations of the herring be accepted) a good omen of the improvement of the spring herring fishery in the near future. That the herring is where the herring food (the "aat") is, I consider a settled point. Although we unfortunately had no opportunity of directly establishing the presence of herring by the help of our nets, there were not wanting the best signs of it at the points where the "aat" was most numerous. Not a few whales (both *sildehval*, *Physalus antiquorum*, and *staurhyrning*, *Orca gladiator*) were observed at such places, as well as large numbers of birds (chiefly kittiwakes), and, at a considerable distance from the coast at stations 75 [1] and 76 [2], there were large brown spots in the sea, like extensive sea-weed fields, but which on a closer examination were found to be enormous masses of "aat" closely packed together, on which the fulmar petrels (*procellaria glacialis*), our constant companions during our excursion, feasted to their heart's delight. That these enormous "aat" masses could not be packed together here by pure accident is evident, and that the current alone should be able to do this here far out in the open sea I cannot believe. I am rather of opinion that the herring shoals have driven this "aat," together in the same way as may often be observed in the case of coal-fish, and that there, under these brown spots on the sea, there were enormous shoals of herring (*sildebjerge*).

I am much disappointed that circumstances did not permit us to use our nets here. We might have been able in this way readily to establish the occurrence of the herring far out at sea. It is to be hoped in the mean time that in our next expedition we shall be more fortunate in the weather, and we shall then put this herring question in the first rank, the rather as we shall be then farther north or nearer the waters, which, in my opinion, are the proper home of spring herrings (*vaarsilden*) and the great herrings (*storsildens*).

[1] Station 75, lat. 64° 47′ 2″; long. 7° 13′ E. from Greenwich.
[2] Station 76, lat. 64° 47′ 4″; long. 7° 3′ 6″ E. from Greenwich.

OUR ASTRONOMICAL COLUMN

THE SUSPECTED INTRA-MERCURIAL PLANET.—M. Leverrier, in a circular addressed to astronomers, has again directed attention to the importance of close and frequent observations of the sun's disc, on March 21, 22, and 23, but especially on the intermediate date, with the view to detect the small planet, which he assumes to have been already observed in transit on six occasions, and which there would appear to be just a possibility, may be again projected upon the face of the sun at this time. In his reasoning upon this subject, M. Leverrier adopts for the place of the node, the value he had deduced from the well-known observations of Dr. Lescarbault on March 26, 1859, but the uncertainty attaching to the result renders it impossible to pronounce definitively on the occurrence of a transit in the present month.

The six observations to which reference is made above are those of Fritsch, at Quedlinburg, October 10, 1802; Stark, at Augsburg, October 9, 1819; Decuppis, at Rome, October 2, 1839; Sidebotham, at Manchester, March 12, 1849; Lescarbault, at Orgères, March 26, 1859; Lummis, at Manchester, March 20, 1862.

Attributing these observations to the passage of a single planet across the sun's disc, he found a formula for the heliocentric longitude at any time, in which an indeterminate entered, allowing of several solutions of the problem of finding the period of revolution, and hence the mean distance of the body from the sun. Two of the solutions appear to possess equal precision in the representation of the observations; in the first, the time of revolution is found to be 33·02 days, and the mean distance from the sun 0·201, that of the earth being taken as unity: in the second solution the length of the revolution is 27·96 days, and the mean distance 0·180. Whichever period we adopt, we find from M. Leverrier's formula that the suspected planet should be in conjunction with the sun on March 22, astronomical reckoning, for the meridian of Greenwich, though to decide definitively as to the passage or otherwise of a planet across the sun's disc at this time, it will be necessary to examine it not only throughout the whole of the corresponding revolution of the earth upon her axis, but owing to uncertainty in the data for prediction, during the twenty-four hours preceding and following, or as already stated, on March 21, 22, and 23.

It is difficult to understand how six observers, without, as M. Leverrier remarks, any relation with each other, nor any knowledge of the periods under discussion, can have fallen by chance upon six exact epochs of a phenomenon explicable by the motion of a single planet. Though suspicion has attached in the minds of some astronomers to one or two of the observations to which we have referred, the fact pointed out by the illustrious French astronomer does appear very strongly confirmative of their reality. At any rate, the existence or otherwise of such a body may be decided by systematic examination of the sun's disc, near the calculated epochs of conjunction, within the assumed transit-limits; but it so happens that after the present month there is very little probability of a transit taking place either at the spring or autumn node for several years, and hence the greater necessity for continuous observation of the sun at the period named.

Extensive preparation has been made on the recommendation of M. Leverrier; the Astronomer-Royal availing himself of the telegraph, has notified observers at Madras, Melbourne, Sydney, and at Wellington and Canterbury, New Zealand, and we believe intends to organise a careful watch upon the sun's disc at the Royal Observatory, Greenwich. We know that a similar scrutiny will be carried into effect in American longitudes, so that it is not probable that a planet can present itself upon the sun on this occasion without being detected. Photography will be brought into requisition at more than one station. Where it is not available in the event of a planetary body being detected, it will be necessary to determine the differences of right ascension and declination from the sun's limbs at frequent intervals as long as the object is projected upon the disc; from such observations carefully made the position of the orbit will be very approximately determined, and we should be enabled to follow up the new member of the solar system.

THE NEW OBSERVATORY AT KIEL.—Prof. Peters has issued a brief description of the new observatory just erected a little to the north of Kiel, the present head-quarters of the *Astronomische Nachrichten*. The unfavourable position of the observatory at Altona, so long directed by Prof. Schumacher, and the desire to bring the establishment into nearer relation to the university at Kiel, led to successful negotiations about twelve years since for a suitable site near the town. The buildings were commenced in 1871 and are now completed. There is a free horizon and a considerably better climate than at Altona, and no interruption from surrounding buildings.

The instruments in the new observatory include Reichenbach's meridian circle, formerly at Altona, which was so far improved by Repsold, as described in the *Astronomische Nachrichten*, that it may be considered a new instrument. The Repsold equatorial, also at Altona, is mounted in one of the smaller towers, and in another, a parallactically-mounted comet-seeker, to which is attached a 4-feet refractor, its optical axis being parallel to that of the comet-seeker. Prof. Peters explains that the refractor being provided with a high power, may be useful in deciding whether any nebulosity caught up in the seeker is a comet, or a star-cluster.

About two months since, an equatoreally mounted refractor by Steinheil of Munich, with an object-glass eight Paris inches in diameter, was added, of the performance of which Prof. Peters promises details at a future date. The meridian circle is at present employed in the observation of all stars to the ninth magnitude, within 10° from the pole, the same class of work, indeed, in which Schwerd and Carrington so long occupied themselves.

The position of the new observatory at Kiel is in longitude 0h. 40m. 35·5 E. of Greenwich, and latitude 54° 20′ 29·7″.

Besides its connection with the Kiel University, the observatory is also in relation to the Danish Marine, and contains facilities for testing the rates of chronometers at different temperatures, and a time-ball, apparently very similar to the one at our Royal Observatory, which is dropped at noon, mean time at Kiel.

65 OPHIUCHI (FL.).—Of this star Baily says, "Observed by Flamsteed on May 6, 1691, at 14h. 10m. 58s., and regularly reduced by him. . . . But no such star is now to be found. It is neither Piazzi xvii. 308, nor xvi. 251, as conjectured by that astronomer. Prof. Airy has been kind enough to look for this star, at my request, but has not been able to discover it." The place of this star, given in the British Catalogue, brought up to 1850, is—

R.A. ...	... 17h. 51m. 37·6s.	Precession	+ 3·506s.
N.P.D.	... 107° 59′ 18″	,,	+ 0·732″

There is no star in this position in Argelander's southern zones, nor in the zones observed at Washington; neither is there any star in these zones with which it can easily be identified, on admitting any probable error of observation. Did Flamsteed observe an object of the class which we are accustomed to term "new stars?" The Chinese annals record the appearance of an extraordinary star in the year 386, which remained stationary from April to July in the same "sidereal-division" that 65 Ophiuchi would fall, and then disappeared. It may be worth while to watch any small stars near its position.

BIOLOGICAL NOTES

FLORA OF NEW GUINEA.—Letters from Sydney of January 12 state that the Italian traveller, D'Albertis, had returned there from his last trip to New Guinea, and was engaged in preparing an account of his voyage up the Fly River. His fine collection of dried plants is in the hands of Baron von Mueller at Melbourne, who is describing many of the new plants in his "Papuan Flora." Among them is a grand *Hibiscus*, which Baron von Mueller has named *Hibiscus albertisii*; its nearest affinity is with *Hibiscus tupiliflorus* of Hooker, of Guadaloupe and Dominica, in the West Indies. There is also a new *Mucuna*, which he has named *Mucuna bennetti*. D'Albertis describes this as one of the most beautiful of all the flowers seen in New Guinea; it is abundant on the banks of the Fly River, and the pendulous masses of large red blossoms cover the loftiest trees from the base to the summit and form one of the most gorgeous sights it is possible to conceive. There was also a yellow flowering species of the same genus which was rare, and only met with in the interior of New Guinea, in lat. 6° south, on the banks of the Fly River. The flowers of this species were only seen on the tops of the trees, forming a dense mass of blossoms. There was likewise another species of *Mucuna* met with, bearing blue flowers. All these and a number of other novelties will duly appear in Baron von Mueller's forthcoming part of his "Papuan Flora."

SALMO ARCTURUS.—We are informed that the Salmonoid brought home by the Arctic Expedition from Grinnell Land is a new species of Charr, described by Dr. Günther under the name of *Salmo arcturus*. It resembles in some points the Loch Killin Charr from Inverness-shire.

PROF. OVSIANNIKOFF ON THE FUNCTIONS OF THE CEREBELLUM.—In the seventh volume of the *Memoirs* of the St. Petersburg Society of Naturalists Prof. Ovsiannikoff communicates the results of experiments he has made in collaboration with M. Weliky on the physiological functions of the cerebellum. Preventing, by the tying of the carotid artery, the effusion of blood which usually accompanies the cutting out of the cerebellum, Prof. Ovsiannikoff proved by a series of experiments that the last operation does not at all paralyse the co-ordination of motion. A rabbit remained alive during two weeks after all the upper half of the cerebellum was cut out, and did not show any traces of such paralysis, nor did it lose its faculty of co-ordinating its movements after all the cerebellum was cut out, until an effusion of blood produced this result. A long series of varied experiments made by M. Ovsiannikoff on rabbits, pigeons, fishes, and frogs, confirms this result, as well as some well-known pathological cases reported by Brown-Sequard, Marc, Combetta, and others.

FAUNA OF LAKE GOKCHA.—The seventh volume of the *Memoirs* of the St. Petersburg Society of Naturalists contains interesting information, by Prof. Kessler, on Lake Gokcha, lying in the Erivan government (Caucasus), at a height of 6,419 feet. It is surrounded with mountains from 9,000 to 12,000 feet high, and occupies about 660 square miles. Altogether its average depth is from 150 to 250 feet, reaching only in one instance t

361 feet. The lake has only a small and shallow outflow, the river Zanga, running into the Araks. The fauna of the lake and of its shores is varied. *Spongillæ*, not determined as yet, are very numerous. Among the *Vermes* the most common is the *Nephelis vulgaris*; the *Crustacea* are represented by a variety of microscopical forms and by a species of *Gammarus*, this species being probably all but the only representative of that kind, as the dredging was not pursued to depths greater than 150 feet. The snails are remarkably numerous, and all belong to species common in European lakes (*Limnæus stagnalis*, *L. ovatus*, *L. varicularius*, and *Planorbis carinatus*); they differ only by their unusually fine and brittle shales. The common frog (a local variety) and the *Bufo viridis* are numerous. The number of fishes is immense, but they belong to only five species, of which three are new. These three, which occupy an intermediate position between the *Salmo fario* and the *S. trutta* and *S. lanestris*, will be described by Prof. Kessler under the names of *Salmo ischan*, *S. hegarkuni*, and *S. bodschac*. The fourth species of fishes is very nearly allied to the *Capoeta fundulus*, Pall., a species most characteristic of Central Asian waters. The fifth is akin to the *Barbus cyri*, De Fillipi; it inhabits mostly the short and cold rivers running from the mountains.

ANTS.—Mr. McCook has recently brought before the Academy of Natural Sciences of Philadelphia, an account of his investigations on *Formica rufa*. He finds that ants descending the tree-paths, with abdomens swollen with honey-dew, are arrested at the foot of the trees by workers from the ant-hill. The descending ant places its mouth in contact with that of the food-seeker, the two being reared on hind legs. Frequently two or three of its fellows are thus fed in succession by one ant, mostly complacently, but sometimes only on compulsion. Mr. McCook made many experiments, which lead to the conclusion that there is complete amity between the ants of a large field, embracing some 1,600 hills, and many millions of creatures. Insects from hills widely separated always fraternised completely. A number of ants from various hills were placed in an artificial nest, and harmoniously built galleries and jointly cared for the cocoons.

NEW FORMS OF HALIPHYSEMA.—The second half of the second volume of *Biologische Studien*, by Dr. E. Haeckel, has just reached us. It contains an account of a wonderful family of minute forms belonging to the genera Haliphysema and Gastrophysema, and some supplementary remarks on the Gastræa theory. Six plates illustrative of the new forms accompany this part. The genus Haliphysema was established by Bowerbank for *H. tumanowiczii* and *H. ramulosum*. The species described as *H. echinoides* seems almost certainly to be that described in 1870, by Perceval Wright, as *Wallichii*, but the two new species described as *H. primordiale* and *H. globigerina*, the latter with a mosaic of Globigerina shells laid over it, are most extraordinary and interesting forms. The presence of a pore area in the tiny form figured in the previous note seems to points to its no having any close affinity to this new family of Haeckel.

NOTES

PROF. SIR C. WYVILLE THOMSON, F.R.S., has been appointed Rede Lecturer at Cambridge for the ensuing year. Sir Wyville Thomson will deliver a lecture in the Easter term.

A BOTANICAL Congress assembles at Amsterdam on the 12th of April.

THE Iron and Steel Institute meets in London on March 20 and following days. On Wednesday, the 21st, at the rooms of the Institution of Civil Engineers, Dr. Siemens, F.R.S., will deliver his inaugural address, and the Bessemer Medal will be presented to Dr. Percy. A number of important practical papers are set down for reading.

CAPT. ALLEN YOUNG has presented to the Museum of the Royal College of Surgeons a collection of the skulls of Esquimaux obtained by himself and the surgeon of his vessel, Mr. Horner, during the last cruise of the *Pandora*. The honour of knighthood has been conferred upon Capt. Young.

SIR JOHN LUBBOCK'S Ancient Monuments Preservation Bill was, we are glad to say, read a second time in the House of Commons on Wednesday week. We hope none of its important provisions will be impaired in the select committee to which it has been referred, but that it will be passed essentially as it stands.

THE *American Chemist* for December, 1876, contains an interesting Inaugural Address to the American Chemical Society on "Science in America," by Dr. J. W. Draper. The Address on a similar subject by Vice-President C. A. Young, at the last meeting of the American Association for the Advancement of Science, has been printed separately. In both addresses the important work done by Americans in various departments of science is justly insisted upon, and the future of science in America spoken of in hopeful terms. Men of science in England, we are sure, will heartily endorse all that Professors Draper and Young claim on behalf of their countrymen as original workers in science, and there is every reason to believe that there is a bright future for science in America.

As soon as the news that Mr. Edward, the Scottish Naturalist, had resigned the curatorship of the Banff Museum spread over the country, he was pressed to accept various situations, among others one in Aberdeen and another in Durham, the latter in the University of that city. He has been obliged to decline all these offers owing to the state of his health. He had been solicited by the Meteorological Society of London to become one of their observers. This request he had owing to the same cause declined. The work is, however, congenial, and does not demand a change of residence, and we believe he has yielded to a second very pressing application.

THE Sedgwick Prize, founded in honour of the late Prof. Sedgwick, for an essay on a geological subject, has been adjudged to Alfred John Jukes-Browne, B.A., of St. John's College, Cambridge. The subject of the essay is "The Post-tertiary deposits of Cambridgeshire, and their relation to deposits of the same period in the rest of East Anglia." The subject for the Sedgwick Prize to be awarded in 1880 is the best essay on "The Fossils and Palæontological Affinities of the Neocomean Beds of Upware, Wicken, and Brickhill." The prize is open to the competition of all graduates of the University of Cambridge who have resided sixty days during the twelvemonth preceding the day the essays must be sent in, that is, before October 1, 1880.

A PRELIMINARY meeting has been held in Paris by some influential followers of the Positive Philosophy for the purpose of establishing a course of lectures according to the system of Auguste Comte, as modified by Littré. Important resolutions were passed as to the teaching of the several sciences which, according to the theoretical view adopted by Comte, constitute the encyclopedic education. At the next meeting resolutions will be proposed for meeting the expenses of the institution and regulating its administration.

AN arrangement has been made with the Cassel publisher, Theodor Fischer, whereby the hitherto very expensive publication *Palæontographica*, will be published in yearly volumes at not more than forty-five shillings each.

THE Balloon Commission of the French Government, styling itself "Commission pour les Communications par Voie Aérienne," has become a standing institution, and includes within its province carrier pigeons as well as æronauts and balloons.

IN the *Journal of the Society of Arts* for March 9 will be found an important and interesting lecture by Prof. A. B. W. Kennedy, C.E., on "The Growth and Present Position of the Science of Machines."

THE unification of the meridian has been advocated at Rome before the Italian Society of Geography, by M. Boutillier de Beaumont, the president of the Geneva Geographical Society. He proposes to adopt the Behring meridian which has been chosen by the American meteorological service for the universal daily observations. M. Boutillier de Beaumont proposes also to adopt the division into hours of fifteen degrees for angular divisions as well as for temporal minutes.

MANY of us will have read with interest Capt. Wiggins' account of his endeavours to establish sea-communication with the great rivers of North Siberia, as given in the last number of the *Geographical Magazine*. Capt. Wiggins has now just started on his return to the Yenisei, overland, to bring back his ship which he stowed away in October last at Kureika, on that river. He is accompanied by Mr. Seebohm, F.Z.S., a distinguished member of the British Ornithologists' Union, who has embraced this opportunity of visiting the nesting-haunts of some of our rarest and least-known European birds, and otherwise exploring an almost unknown country.

A "SOCIÉTÉ des Voyages d'Études autour du Monde" has been constituted at Paris by the liberality of M. Bischofsheim and others. Its object is to organise a regular service of voyages round the world for the instruction of those who are able to afford the expense. The first departure is to take place from Marseilles in the end of May next. The voyage will occupy less than a full year. Opportunities will be given to cross South America from Monte Video to Valparaiso, and to visit the United States and India. The commander of the steamer will be M. Biard, a lieutenant in the National Navy and the promoter of the Society. Passengers may be registered up to April 10 next. A library, instruments for experiments, and a staff of competent teachers will be on board.

AMONG the papers in the January number of the *Bulletin* of the French Geographical Society are the following:—On a journey into the Sahara and to Rhadames, by M. Largeau; Across the Pampas, by M. Désiré Charnay; on the French Expedition to the Ogové, by M. Savorgnan de Brazza; a letter from Dr. Halub on his travels in South Africa.

WE regret to notice that the Marquis de Compiègne, the French West African explorer, has died of a wound received in a duel at Cairo.

A GEOGRAPHICAL Society was established at Marseilles in the beginning of March. The president of the new Society is M. Rambaud, a merchant who is acting as representative of the Sultan of Zanzibar. Not less than 200 members subscribing 1*l*. were registered, and donations have been collected to the amount of 800*l*. A public library has been opened, a course of public lectures on geography established, and the Society is arranging a Museum of Raw Materials from every country.

THE *Daily Telegraph* announces the receipt of important letters from Mr. Stanley, under date Ujiji, August 7 and 13. Mr. Stanley has made a complete survey of Lake Tanganyika, apparently settled the questions of outlet and level, and made important discoveries at the north end of the lake. He also describes his discoveries at and about the Nyanzas, though it does not appear that he has succeeded in circumnavigating Albert Nyanza. Mr. Stanley intended to cross the country to Nyangwe, where he would determine his final course.

AT the meeting of the Royal Geographical Society on Monday the business consisted of the reading of papers "On the Distribution of Salt in the Ocean," by Mr. J. Y. Buchanan; "A Journey through Formosa," by Mr. H. J. Allen; and "A Trip into the Interior of Formosa," by Mr. T. L. Bullock. The first paper summarised experiments which had been made during the cruise of the *Challenger* on the specific gravity and saline strength of the ocean water at various depths. 1,800 samples had been obtained, and by the testing of them Mr. Buchanan had ascertained, first, that the specific gravity of sea-water was greater than that of fresh; and, second, that the variations in its specific gravity pretty exactly indicated the amount of salt held in solution. It had been found that the water was freshest at the equator and at the poles, and most impregnated with salt in the intermediate regions. The papers on Formosa were descriptive of the journeys through the island taken by the respective readers, and entered into details of the character of the inhabitants—Chinese, semi-barbarians, and aborigines.

ON March 26 Sir George Nares will read a paper on the "Geographical Results of the Arctic Expedition," at the Royal Geographical Society.

WE have received from a correspondent a very detailed account (illustrated by drawings) of the Kimberley diamond mine in South Africa. The conclusion as to the mode of origin of the diamonds to which his study of the district appears to have led our correspondent is as follows:—That they were formed in volcanic vents which have been opened in the midst of sedimentary rocks (sandstone and shale, with thin coaly seams), which vents probably existed at a considerable depth under the sea. As to the material which by its decomposition may have yielded the pure carbon in a condition ready for crystallisation, our correspondent suggests that it was probably some hydrocarbon derived from the coal by distillation.

WE notice the following details on the Jurassic flora of Eastern Siberia in a memoir by Dr. Oswald Heer, published in the *Memoirs* of the St. Petersburg Academy of Sciences. This formation occupies about 200 miles along the shores of the Amoor, between the villages Oldoy and Vaganova, and borders, probably, the south-western foot of the Stanovoy ridge. In the Irkutsk government it occupies a large space in the south-eastern corner of this province, where the district around the village Ust-Baley (on the Angara, forty miles to the north of Irkutsk) will be now, after the appearance of Oswald Heer's description, one of the most typical representatives of the Jurassic flora, by its beautifully preserved plants, insects, and fishes. All Siberian Jurassic plants belong to the period of the Brown Jura, and their nearest relations are the Jurassic deposits of Scarborough and of Cape Bogeman, in Spitzbergen. They mostly belong to new species; the most common of previously-known species being only the *Asplenium* (*Pecopteris*) *Whithiense*, and the *Gingko Huttoni*. Three still existing kinds, *Asplenium*, *Thyrsopteris*, and *Dicksonia*, have their representatives among the East Siberian Jura. The most interesting group, by the variety of its forms, is the group of the Coniferæ (more than thirty species), and especially the group of the Salisburiæ. Altogether, the Siberian Jurassic flora occupies the first rank by the variety of species it affords (eighty-three species), the richest yet known flora, that of Yorkshire, numbering only seventy-three species.

A CORRESPONDENT writing from Knoxville, Tennessee, U.S., states that on two occasions he has witnessed true towering in wild ducks, one a call duck the other a summer duck. He adds to the list of towering birds already named the Virginia quail (*Ortyx virginianus*), and wild pigeon (*Ectopistes migratoria*).

A PRACTICAL Society of Natural History has been recently established in Paris under the title of Société Parisienne. Its special aim is to procure young people the means to study nature by lectures and excursions.

FROM researches on the nature of the vowel "clang," in Prof. Helmholtz's physical laboratory, M. Auerbach (*Pogg. Ann.*) comes to the following conclusions, which appear to throw new light on some unsolved problems :—1. All clangs, especially the vowels of the human voice and speech, are to be defined as the consequence of the joint action of two moments, a relative and an absolute. 2. The relative moment is the mode of distribution of the whole intensity among the individual partial tones as determined by their ordinal number. The absolute is the dependence of the whole intensity on the absolute pitch of the partial tones, and the modification of the distribution, on change of the fundamental tone, therewith connected. 3. The difference of the vowels in the former relation is a result of the power of changing the form of the mouth-cavity. The differences of the absolute pitches characterising the various vowels, and of their influence, are a result of the power of changing the volume and size of the mouth-cavity. 4. The first partial tone is always the strongest in clang; it deserves, therefore, the name of fundamental tone. 5. The intensity of the partial tones as such decreases in general as their ordinal number increases; exceptions indicate the nearness of the boundary of the consonant region. 6. The intensity of the partial tones decreases more slowly the nearer the vowel clang is, therefore more quickly the duller this is. 7. The characteristic pitch is higher the clearer, and deeper the duller, the vowel clang. 8. The variations of the intensity, in consequence of the influence of the characteristic pitch, are greater the fuller the vowel is. Very slight variations indicate the nearness of the consonant region. 9. All the vowels admit of being sung within the whole range of the human voice; but the dull speak in very high, the clear in very deep, positions. 10. A little attention only is needed to perceive in a vowel clang the over-tones (often comparatively very strong) without artificial aids. They then sound very similar to the pure tuning-fork tones.

CONTINUING his researches on fluorescence, M. Lommel (*Pogg. Ann.*) arrives at the following conclusions :—1. There are two kinds of fluorescence. In one each excitant homogeneous ray falling within the limits of the fluorescence-spectrum excites not only rays of greater and equal, but also rays of shorter wave length; the latter so far as they belong to the region in question. In the second kind, each homogeneous ray excites only rays of greater or equal wave length. 2. There are substances which have only the first kind of fluorescence; each excitant ray excites the whole fluorescence spectrum. Hence they are not subject to Stokes's law. Such are naphthalin, red chlorophyll, and eosin. 3. There are substances which have only the second kind of fluorescence, and which therefore, throughout their fluorescence spectrum, obey Stokes's law. Such are most of the fluorescent substances hitherto examined. 4. There are substances which have both kinds of fluorescence, so that the first kind is proper to a certain portion of their fluorescence spectrum, and the second kind proper to their remaining parts. Hence these obey Stokes's law only in part. Such are chamaelin red, blue, and green.

THERE are several ways of decomposing water with only one electrode. One is this: let some water in a glass be brought in contact with a Wollaston electrode (*i.e.*, a fine platinum wire inclosed in glass and touching the water only by its extreme section), and connect the wire with the conductor of an electric machine in action. Fine bubbles of oxygen are liberated at the point. What becomes of the hydrogen? M. Lippmann replies (*Journal de Physique*) that so long as the water continues charged the hydrogen remains in excess. On discharging the water it escapes at the platinum point, this being then the electrode of exit. But may it not be that the hydrogen is set at liberty within the liquid or at its surface while the corresponding oxygen is liberated (there being, according to this view, two electrodes, one the platinum point, the other diffuse and of large surface)? The objection, M. Lippman says, cannot be refuted by direct experiment, but the impossibility of the hypothesis appears on considering the quantities of chemical and electrical work called forth during the experiment. He gives two demonstrations of this.

WE have received the first two numbers of a new Italian monthly periodical, *l'Elettricista*, the object of which is to give an account of the progress of the science of electricity. This publication is one of many signs that the countrymen of Galileo have made up their minds again to take an active part in scientific investigation, and especially not to forget that branch which owes so much to Volta. The papers do not lay claim to originality, but the first number especially is interesting, and if kept up on the same standard the periodical can do a great service in spreading modern ideas in Italy. We note especially the paper on absolute electrical units, by Naccari, and on some phenomena presented by electrified powders, by A. Ricco. The second number contains chiefly abstracts from foreign periodicals. Padre Secchi draws some conclusions from imaginary results, which he believes were obtained by Mr. Chrystal in his verification of Ohm's law.

IN a paper read the other day by M. Fulke, before the Wissenschaftlicher Club of Vienna, on German emigration to the United States, it was estimated that from 1820 to the present, nearly 10,000,000 must have emigrated, or a fourth of the entire population of the United States. M. Fulke lamented the extent of the movement, also the facility with which the Germans in America seemed to lay aside their customs and usages, and even their native tongue. In conclusion, he drew a parallel between the Germans in the United States, and the Germans in the whole of Austria. Here, too, the German element was about a fourth of the whole population, but what a contrast to the other case!

THE additions to the Zoological Society's Gardens during the past week include a Bonnet Monkey (*Macacus radiatus*) from India, presented by Mrs. Payton; a Rose Hill Parrakeet (*Platycercus eximius*) from Australia, presented by Mr. J. J. Chapman; a Rufous-vented Guan (*Penelope cristata*) from Central America, presented by Mr. Daniel Miron; two Hooded Crows (*Corvus cornix*), European, presented by Mr. F. Cresswell; a Macaque Monkey (*Macacus cynomolgus*) from India, deposited; a Two-Wattled Cassowary (*Casuarius bicarunculatus*) from the Aroo Islands, a Hooded Crane (*Grus monachus*) from Japan, a Hodgson's Barbet (*Megalæma hodgsoni*), two Striated Jay Thrushes (*Grammatopila striata*), three Black-headed Sibias (*Sibia capistrata*), three Brown-eared Bulbuls (*Hemixos flavala*), two Rufous-bellied Bulbuls (*Hypsipetes Mclellandi*), a Red-headed Laughing Thrush (*Trochalopteron erythrocephalum*) from the Himalayas, purchased.

SCIENTIFIC SERIALS

FROM the *Naturforscher* (January, 1877) we note the following papers:—On radiation in space, by H. Buff.—On cave-insects, by L. Bedel and E. Simon.—On the germination of the fruits of mosses, by P. Magnus.—On the action of a di-electric body upon an electric one, by R. Felici.—On the preparation of pure alcohol yeast, by Moritz Traube.—On the limit between chalk and tertiary deposits in the Rocky Mountains (U.S.), by M. Delafontaine.—New researches on Bacteria, by E. v. M.—On the specific power of glycose (grape sugar) of turning the plane of polarisation, by B. Tollens.—On the exhalation of carbon acid and the growth of plants, by L. Rischawi.—Researches on assimilation in plants, by A. Stutzer.—On the assimilation of water and lime salts by the leaves of plants, by J. Böhm.—On the phenomena of heat accompanying muscular action, by J. Nawalichin.—On the molecular volumes of sulphates and selenates, by Otto Pettersson.—Electro-dynamic theory of matter, by F. Zoellner.—Elements of the orbit of the double-star 24 η Cassiopeiæ, by Ludwig Graber.—On the action of an electric discharge upon solid isolators, by W. Holtz.—On the external sexual differences upon our fresh-water fish, by V. Fatio.

THE *Memoirs of the St. Petersburg Society of Naturalists*, vol. vii., contains a series of valuable physiological contributions, the most important of which are :—On the comparative anatomy and metamorphology of the nervous system of the Hymenoptera, by E. K. Brandt.—On the influence of condensed air, oxygen, and carbonic acid on the nervous irritability of animals, by M. Tarkhanoff.—On changes in the eye produced by the section of the *nervus trigeminus* by M. Chistoserdoff.—On the psycho-motor centres and on the bifurcation of electric currents in the cerebellum and corpora quadrigemina, by MM. Weliky and Shepovaloff.—On the influence of salicylic acid on the circulation of the blood, by MM. Dubler and Chistoserdoff.—The action of chinine and atropine on the hearts of frogs and rabbits, by Mdlle. Pantéléeff, and on the nucleus of the red globules of the blood, by A. F. Brandt.

SOCIETIES AND ACADEMIES

LONDON

Royal Astronomical Society, March 9.—Prof. Cayley, F.R.S., vice-president, in the chair.—The minutes of the previous meeting were read by Mr. Glaisher, F.R.S., the recently-elected secretary.—Two communications of immediate importance were made by the Astronomer-Royal. The first of these referred to the supposed intra-mercurial planet, and he expressed a wish that it should be published as widely as possible without delay in order that amateur astronomers might lose no opportunity of scrutinising the sun's disk during the latter half of the present month, but especially on the 22nd instant, from sunrise till sunset. He had been requested by M. Leverrier to make known that his computation of the elements of the supposed planet, from such reported observations as were available, pointed to March 22 as the day on which it might be expected to transit the sun's disk. He recommended that the disk should be continuously watched for several days before and after that date. The second communication of the Astronomer-Royal referred to the opportunity which will occur next autumn of determining the solar parallax by observations of Mars in opposition. He read an extract from a paper of his own published some years ago in the *Monthly Notices*, showing the great importance he attached to this method as compared with others, and pointing out that fifteen years from the present time must elapse before another nearly equal opportunity will occur of applying it. He dwelt with much emphasis on the ease and simplicity of the observations required and on their singularly inexpensive character. Lord Lindsay had offered to lend his heliometer, and Mr. Gill had offered his services gratuitously for an expedition to St. Helena or Ascension for the purpose, so that the money required would not exceed 500*l*. The Government would be asked to supply this sum, but if they refused, other means should be taken to raise the money, and if a subscription list became necessary, he would gladly contribute 20*l*. himself. Another Fellow, a member of the Council, then suggested that a part of the Carrington bequest might be available, and failing that, offered to contribute 100*l*. towards the expedition if it had to be carried out by private means.—Mr. Gill was called upon to explain the peculiar merits of this method of determining the solar parallax. It depended upon the difference of R.A. between Mars and certain stars measured early and late on the same day, which measures could be made by the heliometer with extreme accuracy.—Papers were presented by Prof. Zenger, C. Todd, A. T. Arcimis, S. W. Burnham, Dr. Robinson, A. de Gasparis, E. J. Stone, A. Marth, J. Tebbutt, Capt. Tupman, Prof. S. Newcomb, Capt. Abney, Sir G. B. Airy, T. W. Backhouse, Rev. S. J. Perry, Dr. Ball, Dr. Royston Piggott, Mr. Penrose, Mr. Knott, Mr. Neison, and Mr. Kobel, some of which were read. Four new Fellows were elected.

Linnean Society, March 1.—Prof. Allmann, F.R.S., president, in the chair.—Messrs. R. Gillies, H. Goss, Dr. A. Gunther, and M. Moggridge were elected Fellows, and Dr. M. C. Cooke an Associate of the Society. The embryo of *Dyospyros embryopteris*, Pers., upon the fruit and seed of which species Gærtner founded his genus *Embryopteris*, was exhibited by Mr. W. P. Hiern. He explained how the immature fruit was gathered in India for the sake of the tannin contained, and hence the probability of Gærtner's having been misled as to the true structure of the seed and imperfect embryo, which Mr. Hiern now correctly describes.—Dr. Maxwell Masters brought before the meeting a series of specimens illustrative of what is commonly known as "Burrs" or "Witch-knots." The examples exhibited were collected by Mr. Webster, gardener to the Duke of Richmond and Gordon. Some of these productions were illustrations of dimorphism or bud-variation, probably reappearance of latent ancestral characteristics or disjunction of parental forms usually amalgamated. Others doubtless owed their origin to some injury to the terminal bud, subsequent hypertrophy of the branches, and excessive development of adventitious buds. Injury apparently was frequently the result of insect puncture, as in the case of the birch, the "burrs" on which had been lately discovered by Miss E. Omerod to be produced by a species of *Phytopus*, at other times it was the result of parasitic fungi or of injury consequent on frost, the wounds caused by birds, the action of wind, &c.—A most important communication on the flora of Marocco (*Spicilegium Floræ Maroccanæ*) was read by Mr. John Ball, F.R.S. (Pres. Alpine Club). By a sketch map he pointed out the peculiar physical features of the territory penetrated at several points by Dr. Hooker, Mr. G. Maw, and himself in 1871, and he mentioned how that Marocco, though within but a few days' sail of London, was in many respects a *terra incognita* to Europeans. Whilst the Sultan and population of Marocco generally are averse to the admission of Christians and strangers into their country, the hill tribes, derived from the warlike Berbers, are decidedly hostile and indeed dangerous to travel among. The flora, then, of this interesting region, is necessarily very imperfectly known. Mr. Ball gave a lucid historical account of what little had been done by earlier botanists, Zanoni 1675, Spotswood 1673, and Broussonnet 1790-9. The collections of the latter having been distributed to several European botanists, and here and there incidentally noticed by them ; Cavanilles of Madrid temporarily secured to Spain a fair share of honour by his publications in the scarce periodical *Ann. d. Ciencias Nat.* M. Cosson has lately been working Broussonnet's material deposited in the Montpellier Museum. Schousboe, Danish Consul at Mogador, commenced 1801, but left unfinished a flora of Marocco. Jackson (1809) in his account of the Empire of Marocco, has noticed the curious Cactoid Euphorbias. P. Barker Webb in a short visit (1827) to Tangier and Tetuan, discovered a new genus of Cruciferæ. Between 1840-1870 several Frenchmen touched at various points, and the "Pugillus Plantarum" of M. Boissier, contains merely a germ of future work.—The Rev. Mr. Lowe contributed to the Linnean Society, 1850, a list of plants observed by him at Mogador. But notwithstanding the preceding labours, a mere tithe of the flora has yet been worked out, and almost nothing satisfactorily. Mr. Ball, in 1851, attempted to reach the higher summits of the Lesser Atlas, but the disturbed condition of the district obliged him to desist. M. Balansa was likewise repulsed in 1867 (though fortunate in collecting numbers of new and remarkable species) ; but Mr. Maw was more successful in 1869. Messrs. Hooker, Maw, and Ball's routes in 1871 were then pointed out, and detailed but technical description of the plants collected, given. In giving a summary of results in a tabular form, Mr. Ball showed that the proportion of Compositæ, leguminosæ, and Liliaceæ, is unusually large, whilst Gramineæ, and Ranunculaceæ is exceptionally small. Of Rosaceæ there are 16, of Saxifrageæ 5, of Primulaceæ 7, of Gentianeæ 8, and of Cyperaceæ only 28 species, thus showing the peculiarity that but a small proportion of these natural orders are present, which otherwise are so characteristic of the mountainous countries of the north temperate zone. It seems as if five temperate floras were represented as follows :—1, Mediterranean in general ; 2, Peninsula ; 3, Desert ; 4, African mountain flora ; 5, Macaronesian—to which may be added 6, Cosmopolite or widely-spread European species. The total number of phanerogamous plants now described are 1618 species, and among these many novelties.—Mr. J. G. Baker then read a paper on the Liliaceæ, Iridiaceæ, Hypoxidaceæ, and Hamodoraceæ of the late Dr. Welwitsch's Angolan Herbarium, which, through the courtesy of the executors, he has been enabled to work out. Not only are there a large proportion of the species new to science, but many genera are new though pertaining to Central African types already known. The excellent condition of the specimens, the care taken in selection of various stages and characters of the plants, and descriptions taken on the spot by Dr. Welwitsch have rendered Mr. Baker's study very complete and satisfactory.—A technical descriptive paper by Mr. Charles Knight on the Lichens of New Zealand, was taken as read.—The Secretary also read a short notice of a new form of Ophiuridæ from the Philippines, by Mr. Edgar A. Smith. The distinctive characters of the specimen the author regards as sub-generic, and names it (*Ophiomastix*) *Acantharachna mirabilis*.

Zoological Society, March 6.—Dr. E. Hamilton, vice-president, in the chair.—Mr. E. W. H. Holdsworth exhibited and made remarks on a specimen of *Geocichla layardi*, from Ceylon.—Prof. Owen, C.B., communicated some notes made by Mr. G. F. Bennett, while exploring the burrows of the *Ornithorhynchus paradoxus*, in Queensland, with comments on them.—A communication was read from Lieut.-Col. R. H. Beddome, containing the descriptions of three new snakes of the family Uropeltidæ, from Southern India.—M. A. G. Butler read the descriptions of some new species of Heterocerous Lepidoptera in the collection of the British Museum, from Madagascar and Borneo. Amongst the latter was the type of a new genus, proposed to be called *Mimeuplœa*.—Mr. G. French Angas read a paper in which he gave descriptions of a new species of *Bulimus* from Western Australia, and a *Paludinella* from Lake Eyre, South Australia; these he proposed to call respectively *Bulimus ponsonbyi*, and *Paludinella gilesi*.—A second paper by Mr. Angus contained the descriptions of one genus and twenty-five species of marine shells from New South Wales.—Mr. Angus also read a further list of additional species of marine mollusca to be included in the fauna of Port Jackson and the adjacent coasts of New South Wales, with remarks on their exact localities, &c., thus bringing up the number of species now ascertained to inhabit Port Jackson and the adjoining shores to a gross total of 693.—Mr. Phineas S. Abraham, M.A., B.Sc., read a paper containing a revision of the Anthobranchiate Nudibranchiate Mollusca. The paper comprised a general and historical introduction to this group of Nudibranchs, *i.e.*, those which bear the branchiæ upon the dorsal surface, more or less surrounding the arms, and allusion was made to all the principal work which had been done upon these animals. The second part consisted of definitions of the larger divisions and of the genera, with the enumeration, synonyma, references to and habitat of, as far as possible, every species hitherto published. In the last general list, viz., that by H. and A. Adams, but 163 forms were mentioned; this list included 457. The third part contained descriptions of forty-one hitherto undescribed species belonging to the genera *Doris*, *Chromodoris*, *Hexabranchus*, *Acanthodoris* and *Doridopsis*.—A communication was read from the Count Salvadori, containing notes on some birds mentioned by Dr. Cabanis and Mr. Reichenow, as collected in Papuasia and in the Moluccas during the voyage of the *Gazelle*.

Geological Society, February 21.—Prof. P. Martin Duncan, F.R.S., president, in the chair.—Samuel Arthur Adamson, William Mason Cole, Thomas Floyd, William Stukeley Gresley, Edward Pritchard, Joseph Pryor, and John Gwillim Thomas were elected Fellows of the Society. The following communications were read:—On possible displacements of the earth's axis of figure produced by elevations and depressions of her surface, by the Rev. J. F. Twisden, M.A., Professor of Mathematics in the Staff College. Communicated by John Evans, F.R.S. The object of this paper is to discuss the question of the possibility of a displacement of the earth's axis of figure under the conditions indicated in a question (suggesting the possibility of a displacement of the axis of figure from the axis of rotation, amounting to 15° or 20°) put to mathematicians in a passage of the Anniversary Address delivered to the Society by its president, Mr. J. Evans, on February 18, 1876. The treatment of the question is kinematical; the forces by which the elevations and depressions might be effected do not come under discussion. In determining numerically the amount of the deviation from the formulas investigated, approximate numbers seem to be sufficiently exact for every useful purpose. The conclusions arrived at are as follows:—(1) The displacement of the earth's axis of figure from the axis of rotation that would be effected by the elevations and depressions suggested in the question above referred to would be less than 10′ of angle. (2) A displacement of as much as 20° could be effected by the elevations and depressions of the kind suggested only if their heights and depths exceeded by many times the height of the highest mountains. (3) Under no circumstances could a displacement of 20° be effected by a transfer of matter of less amount than about a sixth part of the whole equatorial bulge. (4) Even if a transfer of this quantity of matter were to take place, it need not produce any effect, or only a small effect, on the position of the axis of figure, *e.g.*, if it took place in a way resembling that suggested in the question, it would produce a displacement amounting to but a small part of 20°. (5) If, however, we suppose a deviation of the axis of figure from the axis of rotation amounting to as much as 20° to have been by any means brought about, the effect would be to cause a sort of tidal motion in the ocean, the greatest height of which would tend to be about twice the depth of the ocean. The author suggests as probable that the effect of this tendency would be to cause the ocean to sweep over the continents in much the same way that a rising tide sweeps over a low bank on a level shore. (6) The notion that a large deviation of the earth's axis of figure from its axis of revolution may be effected by elevations and accompanying depressions is at first sight an inviting way of bringing polar lands into lower latitudes, and thereby accounting for the more genial climate that is believed to have once prevailed in such countries as Greenland. The investigation by which the above results have been obtained seems to show that the desired explanation is not to be sought in the direction indicated by Mr. Evans's question. Whether there is any other agency by which a gradual displacement of the pole geographically could be effected is a question of far wider scope than that discussed in the present paper, and one which the author does not profess to determine.[1]—Note on a specimen of *Diploxylon*, from the coal-formation of Nova Scotia, by J. W. Dawson, F.R.S. The author described the occurrence in Coal-measure sandstone at the South Joggins of an erect stump of a Sigillarian tree 12 feet in length. It originated in a coaly seam 6 inches thick, and terminated below in spreading roots; below the coal-seam was an underclay 3 feet 4 inches thick, separating it from an underlying seam of coarse coal. The stem, which tapered from about 2¼ feet in diameter near the base to 1¼ foot at the broken end, was a sandstone cast, and exhibited an internal axis about 2 inches in diameter, consisting of a central pith cylinder, replaced by sandstone, about ⅝ inch in diameter, and of two concentric coats of scalariform tissue, the inner one $\frac{1}{16}$ inch in thickness, the outer constituting the remainder of the axis. The scalariform tissue of the latter was radially arranged, with the individual cells quadrangular in cross section. A few small radiating spaces partially filled with pyrites obscurely represented the medullary rays, which were but feebly developed; the radiating bundles, passing to the leaves, ran nearly horizontally, but their structure was very imperfectly preserved. The cross section, when weathered, showed about twenty concentric rings; but these under the microscope appeared rather to be bands of compressed tissue than true lines of growth. The thick inner bark was replaced by sandstone, and the outer bark represented by structureless coal. On a small portion of one of the roots the author traced the remains of stigmarioid markings. From the above characters the author identified this tree with *Diploxylon* of Corda, and stated that it was the first well-characterised example of this type of Sigillarians hitherto found in Nova Scotia. The author compared the structure of this stem with that of other Sigillarians, and remarked that it seemed to come within the limits of the genus *Sigillaria*, but to belong to a low type of that genus approaching *Lepidodendron* in structure; those of the type of *S. elegans*, Br., and *S. pinulosa*, Renault, being higher in organisation, and leading towards the still more elevated type described by him in 1870. He further discussed the supposed alliance of these trees with Gymnosperms, and the probability of the fruits known as *Trigonocarpa* being those of *Sigillaria*, and expressed the opinion that the known facts tend to show that there may be included in the genus *Sigillaria*, as originally founded, species widely differing in organisation, and of both Gymnospermous and Acrogenous rank.

Royal Microscopical Society, March 7.—H. C. Sorby, F.R.S., president, in the chair.—A letter received from Mr. Frederick Ebsworth, Australia, descriptive of a supposed new method of using the micrometer, which the author had found

[1] The first draught of the paper, of which the above is an account, was drawn up last August, and was shortly after sent to Mr. Evans. It was written independently of the wider view of the subject taken by Sir W. Thomson in his Address delivered at the last Meeting of the British Association, and by Mr. G. Darwin in his paper, of which an abstract has been published in No. 175 of the *Proceedings* of the Royal Society.

very useful in measuring the fineness of wool, was read by the Secretary.—A communication from the Rev. W. H. Dallinger, entitled "Additional Notes on the identity of *Navicula crassinervis*, *N. rhomboides*, and *Frustulea saxonica*" was read by the Secretary, and some further observations on the subject were made by Mr. Ingpen, Mr. Slack, and Mr. Chas. Brooke.

CAMBRIDGE

Philosophical Society, February 26.—A communication was made to the society by Mr. Creighton on the order in which the secreting and the conducting parts of an acinous gland appear in the individual development and in the succession of animals.

PARIS

Academy of Sciences, March 5.—M. Peligot in the chair. —The following papers were read:—On the temperatures of combustion, by M. Berthelot. M. Bunsen's hypothesis, that the specific heat of the components and that of the products are constant quantities, independent of temperature and pressure, does not always apply; *e.g.*, to gases formed with condensation. Still his measurements allow of calculating without any hypothesis on specific heats, two limits between which the temperature of combustion is necessarily comprised. That of carbonic oxide by oxygen at constant volume is between 4,000 and 2,600; by air, between 2,200 and 1,750. That of hydrogen by oxygen, between 3,800 and 2,400; by air, between 2,100 and 1,700.—Physical and mechanical action of incandescent gases after combustion of powder; application of these facts to certain characters of meteorites and bolides, by M. Daubrée.—Agreement of the laws of mechanics with the liberty of man in his action on matter, by M. de Saint-Venant.—Observations of solar protuberances during the second semester of 1876; rotations lxix. to lxxv., by P. Secchi. Very few protuberances; average 5·4 (and even this exaggerated, including small jets), average height 40·8 seconds. Few protuberances over 68 seconds, general maximum between 40° and 50° latitude. The most notable point is the frequency of thin, very high and straight hydrogenic threads, sometimes one minute high; this indicates great calm. Metallic protuberances rare, and always preceding or accompanying spots. In December there was an important instance of a spot with apparent rotation; two nuclei in same penumbra, then separated by a bridge, which ere long was broken. The movement was in the direction of the hands of a watch, and the spot near the equator gained on that further north.—Observations of the spectrum of Borrelly's comet, by P. Secchi. Three bright bands, a broad one in the green, a narrower in the blue, a third still more narrow and less refrangible, but difficult to define.—Report, in name of the Academy, on measures to be taken against Phylloxera, in regions uninvaded or threatened. The Commission advise interdiction of exportation and importation from phylloxerised regions, thorough destruction by fire of any vines attacked, and vigorous disinfection of ground and stocks in neighbourhood.—Dr. Bastian, in a letter, proposed to come to Paris and make his experiments before the Commission on spontaneous generation.—On the asymptotic lines of a surface of the fourth degree, by M. Rouché.—Demonstration, by the principle of correspondence, of a theorem on the contact of surfaces of an implex with an algebraic surface, by M. Fouret.—On the extension of the theorem of Fermat generalised, and of the *Canon Arithmeticus*, by M. Lucas.—On the mechanical theory of heat, by M. Levy.—Method of extracting platinum from chloroplatinates, by M. Duvillier. He utilises the property which salts of platinum have of being reduced in boiling by alkaline formiates in the presence of alkalies.—On the isomerism of rotatory power in the camphols, by M. de Montgolfier.—On a vat of aniline black, and on the transformation of aniline black into a fluorescent rose colouring matter, by M. Goppelsroeder. —Researches on the acidity of the gastric juice of man, and observations on stomachic digestion, made with a gastric fistula, by M. Richet.—Action of hydrosulphite of soda on the hematosin of blood, by M. Cazeneuve. The change of colour might prove useful in legal medicine.—Experimental study on the *rôle* of the blood in transmission of vaccinal immunity, by M. Raymond. He inoculated children with blood from newly-vaccinated children. Neither was vaccination thus produced nor was there ulterior immunity. But, resorting to transfusion of blood from a vaccinated heifer to another heifer, he obtained immunity, in the latter, without any eruption.—On the maintenance of constant temperatures, by M. D'Arsonval. In his system are two concentric cylindro-conical vessels; the interior, open above, being the cavity of the stove; the water bath is in the concentric space, and its dilatation acts on a caoutchouc membrane governing the passage of gas into the Schlœsing regulator.—On "grisoumetres," or firedamp measuring apparatus, by M. Coquillon. Their principle is, that hydrogen or any of its compounds in the gaseous state is completely burnt in presence of oxygen and a palladium wire white hot.—On the unity of the forces in geology, by M. Hermite. Gravity may serve as the common measure of the forces which maintain the equilibrium of continents.—Chemical examination of turnerite, by M. Pisani.—Observation of a parhelion on February 5, by M. Soucaze.—On the treatment of cancerous affections by acetic acid and the acetates, by M. Curie.—Results of microseismic observations, by M. Bertelli.

VIENNA

Imperial Academy of Sciences, February 1.—On Peltier's experiment, by M. v. Waltenhofen.—On space-curves of the fourth order with a double point, by M. Weyr.—On the theory of electrodynamics, by M. Lippich.—On the theory of algebraic equations, by M. Igel.—New method of deduction of Taylor's series, by M. Zimels.—Report on the excavation of a bone deposit at Zeiselberg, by M. Wurmbrand.

February 8.—On collateral innervation, by M. Stricker.—Contributions to knowledge of hydrate of chloral, by M. Cech. —Researches on vaporisation, by M. Baumgartner.—On the condition of heat equilibrium of a system of bodies with reference to the force of gravity.—On the diffusion of vapours through liquid films, by M. Exner.—Observations during 1876 at the Central Institution for Meteorology and Terrestrial Magnetism.

ROME

R. Accademia dei Lincei, February 4.—Palæontological notes on the fossils of Genoa marls, by M. Issel.—Thirty years' experiments of Messrs. Lawes and Gilbert at Rothamsted, by M. Ronna.—On some palæozoic fossils of the Maritime Alps and the Ligurian Apennines, studied by Michelotti.—The tertiary formation of Reggio in Calabria, by M. Seguenza.—Monograph of tertiary nuculidæ found in the southern provinces of Italy, by M. Seguenza.—On the quaternary sea, by M. Moro.—On the existence of realgar and orpiment in the hills of Santa Severa in the province of Rome, by M. Sella.—On the modular equations of Prof. H. J. Stephen Smith, by M. Cremona.—On a new difficulty proposed against Melloni's theory, by M. Volpicelli.—Effect produced by the mass of Monte Mario on the vertical of the observatory on that hill, by M. Kella.—Experimental researches on electric discharges, by M. Righi.—On a class of finite and continuous functions which have only one derivative, by M. Dini.—On the degeneration of cut nerves, by M. Colasanti.—On the coloration proper of the retina and modifications of it, by M. Boll.—On the constitution of chlorammonium and aldehydes of ammonium, by M. Schiff.

CONTENTS

PAGE