THURSDAY, JULY 20, 1876

THE UNIVERSITY OF MANCHESTER[1]

II.

WE have already discussed in last week's NATURE the present position of the higher education of this country, and we shall now endeavour to point out in what respect this is deficient, and in what way this deficiency may best be remedied.

One of the most important replies called forth by the pamphlet of the Senate of Owens College is that by Prof. Huxley, and this is alluded to in the following terms in a second pamphlet drawn up by members of the Senate :—

"Prof. Huxley, while holding that the increase of universities—in the proper sense of the term—is in itself desirable, questions whether the granting of degrees is essential to the character of a university. With the true honour and highest functions of a university, associated, as these are, not with its ordinary but with its choice products—with the flower of its students as they prove themselves in university and in the general national life—the power of granting degrees and the number of degrees granted are indeed not essentially concerned. But it can at the same time hardly be denied that examinations, and the preparation for examinations, are the proper channels through which the influence of teaching is brought home to the great bulk of students at any university, and that without examinations the efficiency of its teaching cannot be tested in reference to its average pupils. It is for this reason that the degree-granting power, in Dr. Carpenter's words, 'is usually held in this country to be the essential attribute of a university.' The degree is the outward sign of a standard reached ; this test the public has a claim to demand, more especially in fields of study to which no other practical test is applicable under ordinary circumstances, and this test it will continue to demand till brands go out of fashion, and till the public is composed of competent independent appraisers of proved merit."

These words embody a powerful argument in favour of keeping to our present system. When a man styles himself M.A. of Cambridge, for instance, this denotes unquestionably a certain intellectual training and acquirement, but it implies also a certain moral, social, and even physical training. It implies that during his residence at Cambridge his character was such as to satisfy the college authorities, while his social capacities must have been developed by the numerous influences of undergraduate life. The public has surely a right to demand this outward sign of a standard reached in the case of such a man—we may therefore take it for granted that in the future of this country the degree-granting power will be retained by the higher educational institutions. This preliminary question being settled in this way we must next ask whether the present degree-giving bodies of this country are, as they stand now, doing enough for our higher education, and if not, whether they can be made to do so by a legitimate extension of their present powers ; for clearly if bodies now in existence can be made sufficient for all the purposes of a higher education it would be impolitic and unnecessary to call a new institution into existence.

Now we think it cannot be denied that the present number of graduates turned annually out by the Universities of Oxford and Cambridge bears but a small proportion to the whole population of England ; nor will this be greatly modified by adding thereto the yearly result of the University of London—England will still be found deficient in comparison with other countries. One reason for this arises from locality, for even in these days of easy locomotion the element of locality retains an influence ; and we believe it has been found that the two English Universities draw the greatest relative proportion of pupils from counties in their immediate neighbourhoods, and the same may be said of the University of London. Nor is this to be wondered at, for the connection between a student and his University does not cease when he gets his degree. He only then truly begins to form a part of the institution and to take an interest in its proceedings, and he will on this, as well as on other grounds, attach himself, if possible, to a University in his immediate neighbourhood. At present, therefore, the whole north of England may be said to be without a University. Again, it may be taken for granted that the large and influential class of men residing in the great cities of the north of England who have become wealthy through the industries of the country, do not consider that their sons have at present sufficient facilities for a higher education. They wish their sons to be graduates of a University and to retain a connection with it in after life ; nevertheless, it is only a few of them that are disposed to take advantage of the old English Universities. They probably feel that the social training at these Universities, with all its excellence, is hardly such as to fit the majority of its graduates for success in industrial occupations ; and, on the other hand, they know that their scientific training is very much below the mark. As a matter of fact, therefore, a number of men, forming a very important section of the community, do not avail themselves of these old institutions, nor will they be persuaded to do so. They want a more suitable kind of education for their sons. Such an education is furnished by the various provincial colleges which are rapidly springing up, and of which Owens College is the oldest and best known representative—but none of these institutions have the power of granting degrees.

We must therefore conclude that sufficient facilities are not afforded to the inhabitants of the north of England in respect of the higher education, and this is especially felt by comparison with the manufacturing districts of Scotland as represented by Glasgow, a city which is the seat of a well-known University with all the privileges of granting degrees.

As one means of overcoming this deficiency, affiliation with one of the older Universities has been suggested. Regarding this scheme it is only necessary to quote the words of the Owens College pamphlet embodying the views of the Senate, that "where a college has already attained to a life and a character of its own it is impossible to accommodate it to institutions of an altogether different historical growth."

There is yet, however, another alternative. Why, it may be said, should not the University of London be definitely and finally recognised as the degree-giving body for all the provincial colleges? The great objection to this arrangement is its inconsistency with the true theory of a University, and besides as a matter of fact it does not work well at the present moment.

[1] Continued from p. 226.

Before proceeding to prove this, let us make a few remarks upon the general system of examination. A great deal has been said and written against this system, as if examinations in themselves were rather to be avoided than otherwise. This, however, is surely a mistake. The University of London does not, in our opinion, err in respect of its examinations being excessive, but rather in respect of its examinations being incomplete. *A properly conducted examination system tests the power of the pupil for producing his knowledge when occasion requires.* If it be the case that the Jesuits excel in this art, so much the more credit to them, for the art of producing one's knowledge is something desirable, which ought certainly to be taught.

Now the fault we have to find with the University of London is that, at least in its junior examinations, it does not test the excellence of the manner in which a candidate produces his knowledge, and can hardly be expected to do so. The London examination is not led up to by previous class examinations, in which the knowledge-producing power of the various pupils is carefully tested and commented on. If the candidate passes in, let us say, the matriculation examination, he may get credit for the quantity of his knowledge, but none for the excellence of his method of producing it. If he fails to pass from want of this facility, nothing is said—he is simply told that his knowledge has proved insufficient. If his power of producing knowledge is to be rectified, it must be done at his college, and under the eye of his teacher, but if he has no college and no teacher, it will not be done at all. And yet the University of London, from its privilege of granting degrees, has very great power over the various provincial colleges, and not only tells them by means of its calendar what things they must teach, but also the manner in which these things are to be taught. True freedom of teaching is incompatible with this system, and unquestionably the teaching that would *pay best* in an institution absolutely bound to the University of London would be of a style prejudicial to all originality. Indeed it would be a mistake for such institutions to have at the head of their departments teachers of originality and power of research. Teaching of the kind to suit this system is incompatible with research.

But if the University of London be deficient in this respect, it is even more so in the other functions of a University. It can hardly be said to take any account of the moral, the social, or the physical training of its alumni. In fine it has the paramount power of granting degrees, but without any corresponding responsibility, for it leaves the most important parts of its graduate education to be done by other institutions, or even not to be done at all.

In this article we have endeavoured to show that an extension of the system of the present Universities is inadequate to the educational wants of the country. In a future article we shall discuss in what way these wants may, in our opinion, be most properly remedied.

THE DUTCH IN THE ARCTIC SEAS

The Dutch in the Arctic Seas. By Samuel Richard van Campen. Two vols. With Illustrations, Maps, and Appendix. Vol. I.—A Dutch Arctic Expedition and Route. (London: Trübner and Co., 1876.)

MR. VAN CAMPEN is a native of the United States, evidently of Dutch descent, and is enthusiastic on behalf of the past and future glory of his native country. The two volumes, of which the first has just been published, have been written for the express purpose of inducing the Hollanders to reassume their place in the field of Arctic exploration, which as a nation they have deserted since the last voyage of the famous Barents, now nearly 300 years ago. The prominent position which the Netherlanders once held as navigators and discoverers all the world over, is well known, and as seamen they still occupy as good a position as ever. Their addition to the list of, happily increasing, Arctic explorers would certainly be an acquisition; and we are glad to see that a movement has been commenced by the Dutch Society for the Promotion of Industry to induce the Government to enter into this matter in friendly rivalry and co-operation with other civilised countries. We hope the Society, backed by the arguments urged in Mr. van Campen's work, will be successful in their endeavours.

The work referred to—including the volume which is published and the one to come—is the expansion of two articles in the *Transatlantic Magazine.* The author endeavours to rouse the spirit of Hollanders by insisting on the glories which their nation achieved in the past, by pointing out how much yet remains to be done ere the Arctic problem be solved, by showing them what other nations are doing, and by pointing out that the Spitzbergen-Novaya-Zemlya route belongs to them by inheritance. Mr. van Campen rather boldly, but no doubt with considerable justice, compares the Dutch in the earlier days of their history to the Phœnicians, who in the pursuit of trade penetrated into the most distant parts of the earth, making many discoveries of which the record is lost. He brings our own country to the front as the "grand exemplar" in the matter of Arctic exploration, and shows that the motives which now actuate nations in the pursuit of this field of enterprise are nobler than those which led in the old days to the quest for a northwest or north-east passage. Mr. van Campen is strongly of opinion that the Dutch in these old days made many discoveries which have dropped out of sight, and that not improbably even the Franz-Josef Land of the Payer-Weyprecht Expedition was long ago discovered and some of its points named by the Dutch whalers who used to frequent these seas in great numbers. Dr. Petermann seems also to be of this opinion; and we are sure if the Dutch can make good their claim to any discoveries which have been renamed, everyone will rejoice to reimpose the old Dutch names.

Mr. van Campen urges many arguments in favour of Arctic Exploration, and especially in favour of its resumption by the Dutch. These arguments we need not recount here, as all our readers have been made familiar with them in connection with the expedition, which may by this time have found the secret of the Pole. The author devotes considerable space to a discussion, or rather a comparison of opinions, as to the nature of the unexplored region round the Pole. The map prefixed to this volume shows Dr. Petermann's continuation of Greenland right across to Kellet Land, somewhat N.W. from Behring Strait. We fear few geographers will agree with this conjectural Polar continent of Petermann; all that we know points to the likelihood of the undiscovered region being broken up into an archipelago. Mr. van Campen also devotes considerable space to the question of an open Polar sea, a question which now seems to us out of date. We think, considering the object of his work, the author has made a mistake in filling up so much space with a comparison of opinions on these questions; he has done the same with the Gulf Stream and Ocean Current question, introducing large quotations from the well-known authors who have discussed it. We do not see that all this matter is quite relevant to the object for which the book has been published. The English readers, for whom the work must be meant, are already familiar with all that Mr. van Campen has brought forward, and so, we should think, are the Dutch readers who are likely to take an interest in the work. For both English and Dutch readers great compression would here have been advisable; and, indeed, we think the whole work might have been contained in one volume. All these conjectures as to the nature of the Polar region and the extent of the Gulf Stream seem to us waste of energy, as the only method of solution is to go and see. And this is what Mr. van Campen wants the Dutch to do. He also discusses the—to English readers, at least—somewhat threadbare question of routes, and with justice shows that the route for the Dutch is their old one by Spitzbergen or Novaya Zemlya. He thinks they might try either a route to the north-east by Novaya Zemlya somewhat on the traces of the Payer-Weyprecht expedition; or—and he seems to prefer this—they might make Spitzbergen a basis of operations, and with two ships establish a depôt, and by taking plenty of time, might in this way, partly by ship partly by sledge-boat, reach the Pole. Happily, however, Mr. van Campen does not hold up the Pole as the only and chief goal of Arctic exploration; he shows forcibly and fully the many great gains to science and humanity which are to be obtained by a perfectly equipped Arctic expedition. It would, we think, be fortunate both for the Dutch and for science if they could be persuaded again to occupy the field on which of old they reaped so much glory; and now that there is every likelihood of an international system of stations being established around the Polar regions, we cannot see that so important, though so small a nation, can any longer withhold itself from doing its share of the world's work in this matter. No doubt the Dutch have for long had much to do in looking after the affairs of their own household, but now there are signs that they have leisure and wealth enough to take a substantial part in cosmopolitan work. Mr. van Campen's arguments have already been brought under the notice of several prominent Dutchmen, and we think his object would be better served by the publication of a compressed Dutch edition, than it seems likely to be by this lecture read to the nation in the hearing of the English. "As certainly as the North Pole exists is it necessary to our command of the forces of nature, in the interests of mankind, that we should know in what way the ice and snow, the long nights and day, the tides and the geological formation of lands and islands about that mysterious summit of the Polar axis, react upon more favourable and fully inhabited climes. The *Alert* and *Discovery* have gone forth, then, at the call of England only, not to serve England only, but the entire world. And not less important, we may add, would prove a Dutch Arctic expedition for the service of science and mankind."

For English readers who want, in short space, to get a knowledge of the arguments in favour of Arctic exploration, of the discussion on the subject of the various routes, of an "open Polar sea," and the configuration of the unknown region, and on the question of ocean currents and the Gulf Stream, Mr. van Campen's first volume will prove useful. The second volume will, however, possess for us more of novelty and interest, as it will contain a history of Dutch Arctic enterprise. As there are no cuts in this volume, we presume Volume II. will be well supplied with illustrations and maps. We hope soon to have it before us.

OUR BOOK SHELF

Proceedings of the London Mathematical Society. Vol. VI. (London: Messrs. Hodgson, 1876.)

PROF. CAYLEY contributes to this volume several memoirs bearing on the theory of attraction. References to some of his earlier papers on the subject are given in Todhunter's "History." The titles of the present papers are "On the Potentials of Polygons and Polyhedra," "On the Potentials of the Ellipse and the Circle," "Determination of the Attraction of an Ellipsoidal Shell on an Exterior Point," "Note on a Point in the Theory of Attraction." The order of the papers will indicate the direction of growth the subject took in the author's hands. Mehler has treated of the attraction of polyhedra, but Prof. Cayley's results "are exhibited under forms which are very different from his, and which give rise to further developments of the theory." He finds general formulæ for the potentials of a cone and a shell, he then takes the case of a polyhedron or a polygon, obtains results for rectangular pyramid, rectangle, and cuboid, and verifies some of these results. The attraction of an indefinitely thin ellipsoidal shell was shown by Poisson to be in the direction of the axis of the circumscribed cone, this property was also demonstrated geometrically by Steiner. The geometrical investigation was subsequently completed by Prof. Adams so as to obtain from it the finite expression for the attraction of the shell, a result which had also been obtained analytically by Poisson. Prof. Cayley states the geometrical theorems, proves them, and obtains analytical expressions for the attraction of the shell and for the resolved attractions. The law of attraction throughout is that of the inverse square. The same writer also contributes a paper "On the Expression of the Co-ordinates of a Point of a Quartic Curve as Functions of a Parameter." This last is the development of a process of Prof. Sylvester's. Dr. Hirst's remarks on "Correlation in Space" are a mere abstract of results, a fuller statement of which is reserved for a future communication. Prof. Wolstenholme contributes a neat piece of analysis called "A New View of the Porism of the In- and circum-scribed Triangle." Prof. Sylvester contributes two interesting notes from M. Mannheim with reference to Peaucellier's cells and their application. The Rev. W. H. Laverty supplies an "Extension of Peaucellier's Theorem." Mr. Routh has a paper "On Laplace's Three Particles, with a Supplement on the Stability of Steady Motion;" Mr. Samuel Roberts contributes a paper "On a Simplified Method of obtaining the Order of Algebraical Conditions." This method is illustrated by various geometrical applications. Further papers of an analytical character are "On the Solution of Linear Differential Equations in Series," Mr. J. Hammond; "Note on some Relations between Certain Elliptic and Hyperbolic Functions," Mr. J. Griffiths; "Notes on Laplace's Coefficients," Mr. J. W. L. Glaisher. In mixed mathematics we have papers "On the Application of Hamilton's Characteristic Function to the Theory of an Optical Instrument symmetrical about its Axis," and "On Hamilton's Characteristic Function for a Narrow Beam of Light," Prof. Clerk-Maxwell; "On the Vibrations of a Stretched Uniform Chain of Symmetrical Gyrostats," Sir W. Thomson. The President (Prof. H. J. Smith) contributes papers "On the Higher Singularities of Plane-curves" and "On the Integration of Discontinuous Functions;" Major J. R. Campbell gives an account of "The Diagonal Scale Principle applied to Angular Measurement in the Circular Slide Rule." Shorter papers are "On the Method of Reversion applied to the Transformation of Angles," Rev. C. Taylor (the basis of the communication of which an abstract only is given in the "Proceedings," the full paper being printed in the *Quarterly Journal of Mathematics*, No. 53, is a work on Conic Sections, by G. Walker, 1794); "On some Proposed Forms of Slide Rule," and "On the Mechanical Description of Equipotential Lines," Mr. G. H. Darwin; and "On the Mechanical Description of a Spheroconic" and "a Parallel Motion," by Mr. Hart.

From this enumeration of the contents of the volume before us, it will be seen that its contents range over nearly the whole domain of pure and applied mathematics.

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.]

The Government "Vivisection" Bill

ALLOW me supply an omission in the paragraph in last week's NATURE which states that Mr. Cross "pointed out" to the deputation on this subject, "that the Bill was framed practically in accordance with the views of the Royal Commission." This astonishing assertion was of course contradicted at once, but the fact does not appear in the paragraph in question; and, though the discrepancy between the Royal Commission Report and the Government Bill is notorious and acknowledged on all sides, so few people read either the one or the other, that a statement to the contrary may be believed, if allowed to pass. Those who have given attention to the Blue-book in question know that while the evidence on which Legislation was recommended went beyond the facts, the Report beyond the evidence, and the recommendations beyond the Report, the Bill actually introduced by Lord Carnarvon did not so much exceed as contradict the recommendations of the Royal Commissioners. If a reasonable registration Bill in accordance with the Report of their own nominees had been framed by the Government, they would have spared themselves and others a good deal of trouble.

P. H. P. S.

The Boomerang

I OBSERVE a letter in NATURE (vol. xiii., p. 168) asking for information about the "boomerang." I have now taken the occasion of a number of the aboriginal natives of this district being here with me for a time, to make inquiries on the subject which might confirm or correct my own previous observations. The information I have gained as to the "boomerang" I now condense, preserving, however, as much as possible the language made use of by my informant. I have also seen the boomerang thrown by one of their best performers, a short account of which I will add in conclusion to this letter.

Two kinds of boomerang are made, one called "marndwullun wunkun," that is the "boomerang," as I may translate the term "wunkun," which turns round; "marndwullun" is equally applied to the returning flight of a bird as to a boomerang. The second kind of boomerang is called "tootgundy wunkun," that is the boomerang which goes straight on, "toot" meaning something "straight" or "erect."

The two boomerangs differ in their construction. The second (straight) kind being thicker, longer, and less curved than the first, I shall call, as a matter of convenience, the "marndwullun" No. 1, and the "tootgundy" No. 2.

With No. 1 there is no certainty of hitting the mark. It may come back too quickly, and may hit your own friends standing near you. In choosing a boomerang like No. 2, in preference, it will be more sure to hit the object, and will generally penetrate the mark with the point which has been held in the hand. A black fellow will prefer one of the kind No. 2, if required for fighting. That is, he can make more sure of hitting his enemy. With No. 1 he will probably miss or even injure his friends, as it is difficult to tell where it will come back to. If No. 1 strikes an object it will never return; besides, it is generally too light to do much execution. These statements, which I have recorded as nearly as possible as given to me to-day, quite confirm my own observations made during the last twenty years in Victoria, South Australia, New South Wales, the Queensland Back country, and Central Australia. In Cooper's Creek I have seen boomerangs No. 1 used by the natives to kill ducks and birds in general which fly in flocks. They seemed unable to calculate where its course would be among them, and some were hit; the boomerang and the bird both fell. I have often seen these weapons thrown but never saw one return after striking an object. If slightly touching an object in its course, such as the small limb of a tree, it might continue a curve to the ground, but no longer in the same plane as before, and the impetus would be destroyed. A third kind of boomerang is used in Central Australia, as far at least as near to the tropics about the 141st meridian (north of Sturts Desert), which I think is only used for fighting at close quarters. Speaking from memory this variety is probably about 4 or 5 feet in length and of very heavy wood. I have rarely seen them carried, but have found them concealed near to or lying in the huts of camps from which the natives had fled at my approach. Finally, I have great doubt whether any of the natives can tell beforehand whether a boomerang No. 1 will, when finished, be a good "marndwullun wunkun" or not; and it is not uncommon for an aborigine, if he finds his boomerang to return instead of going straight to its mark, to heat it in the ashes and straighten it, so that the blade lies in one plane.

It may perhaps be not uninteresting to your correspondent if I record an instance or two in which the boomerang has been used in the settlement of quarrels in this district.

I write as follows, using the first person, and as much in the words of my informant as is possible:—

"Once I had a quarrel with one of our Kurni (black fellows). I was angry and called him 'barrat-dun.'[1] He was very cross. I had word from a friend that Daly was going to fight me. I was obliged to go, or be called 'jeeragan' (coward). A number of Kurni who had quarrelled had to fight each other at the same time.

"Our friends decided we were to fight with boomerangs. Both of us had 'tootgundy wunkun.' 'Marndwullan wunkun' would be no use, it is too light, and you can't take sure aim. Our friends stood round to see which was best man, just as I have seen the 'lowan' (white men) do. Daly threw the first boomerang because I had called him 'barrat-dun.' We threw turn and turn about. You can see the boomerangs coming. I dodged them as well as I could or turned them off with the shield. They passed me like a wind. I had a shield. If you turn the boomerangs they slide off. If you stop them they either break your shield or carry it away. One 'wunkun' passed me and stuck three or four inches into a dargan tree (Box = one of the Eucalypts). When the 'wunkuns' were all thrown we went towards each other with the 'culluck;' he put down the 'bamarook' (shield against the boomerangs or spears) and took up the 'turnmung' (shield against culluck = club). We had each a 'culluck' and a 'turnmung.' We both hit and warded off as I have seen white men do with their big knives (sword). At last Billy the Bull, one of our friends, ran in and cried out, 'moondanna' (that will do, or enough). Then we stopped. We were then friends. Daly said to me, 'Why did you call me that name?' I said, 'I am sorry.' There was no more.

"A few years ago 'Barny' woke up in his camp in the night and saw 'Lamby' standing by his fire. He was frightened, and said, 'What do you want?' Lamby said, 'Only some fire.' But Barny thought he had been 'ngarrat bun' (made sick). Perhaps it was with the 'yertung,' the little leg-bone of the kangaroo. If you point that at a sleeping man and sing a song he will be sick. I don't know the song, I never heard it; it might be, perhaps, beginning, 'Yertung, yertung, goombart, goombart.'[2] If he could do this without being seen the Kurni believe

[1] Barrat = sickness or disease. The whole term implies having acquired a loathsome form of disease, for which the aborigines have to thank the whites.

[2] Goombart is the large leg-bone, and is ground down with a sharp point at each end and worn in a hole through the septum of the nose. It is believed to have magical powers.

the man would become sick and die. I have never seen it done.[1]

"Soon after Barny died. News went about that Lamby had killed him. Then went about also 'Laywin a ngangata' (news of war). Word was sent by the dead man's relations to come and fight at some place. It was near the mouth of the Nicholson River at the Lakes. All the Kurni from Bairnsdale to the Snowy River came. The women sate down, beat the 'possum rugs with their hands, and called the other side names for 'ngarrat bun a Kurni' (bewitching or making sick a black fellow). The two brothers of the 'poor fellow' (the term commonly used in speaking English for dead man) threw boomerangs and 'kunnin' (a straight steel pointed at each end and about 2 feet 6 inches to 3 feet in length). Lamby had a shield. At last a 'kunnin' went through his right leg just above his knee. He drew it out behind and threw it back. But he missed, it was too slippery with blood. Then they wanted to throw spears at him, but some 'Kurni' men and women stood up before Lamby, and the fight stopped. Then they were friends. Lamby had two shields (turnmung), one in his hand and one on the ground before him to be ready."

The above narratives will, I think, throw some light on the use of the boomerang, and are characteristic of the customs of the aborigines, which it is much to be regretted are going to oblivion. A careful record of these—in fact a faithful record of the customs, the beliefs, the systems of consanguinity of the Australian aborigines would throw much light on the probable early condition even of the now civilised races. I have for some years treasured

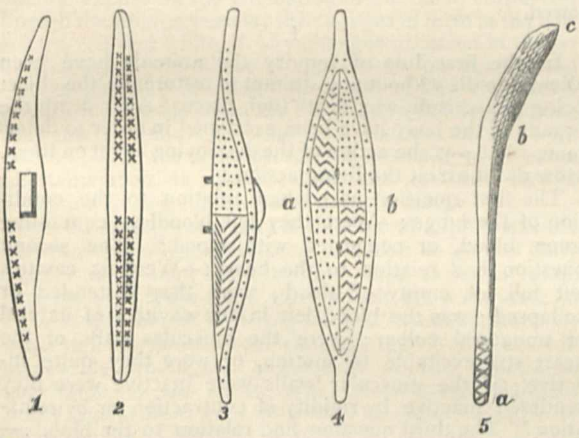


FIG. 1.—Side view of Turnmung; made apparently of stringy bark (*Eucalyptus obliqua*). Height 28 inches, circumference at handle 8 inches, circumference at end 2 inches.
FIG. 2. Front view of Turnmung.
FIG. 3. Side view of Bamarook, made apparently of stringy bark wood. Height 29¾ inches, width across (FIG. 4) *a* to *b* 6½ inches. The slightly convex surface is marked with angular or dotted incised patterns in opposite quarters.
FIG. 5.—Culluck drawn from memory. *a* to *b* rounded handle; *b* to *c* flattened and somewhat edged along the inside curve.

up for future use everything I could gather on these subjects. This mine of strange information is immense, and I regret to say not only unworked, but I fear destined to remain so—while the aborigines are rapidly fading away before the advancing wave of settlement. To anyone who has not endeavoured to collect such information through others, the utter apathy which exists throughout the Australian colonies may seem inconceivable. I regret to say that sad experience has shown me that it exists. As an instance I may mention that of some 400 or 500 circulars which I have, together with my colleague in the inquiry, the Rev. Mr. Fison, sent out asking for information as to the systems of kinship obtaining, certainly not five per cent. have produced replies, and scarcely more than one per cent. yielded results.

This is, however, a digression, and I now give, as illustrating the two above narratives, slight sketches of the "bamarook," the "turnmung," and the "culluck."

The boomerang throwing to which I have referred took place on the open flat lying between the River Mitchell and its branch known as the Backwater. It was open and well suited for the purpose, but a sea-breeze was blowing. There were present eight black fellows from different localities, extending from the Mitchell River to the Snowy River. Among them was Lamby, the hero of the fight which I have narrated, Toolabar, a brother of the man Barny, and Long Harry, the acknowledged boomerang-thrower of the whole district; so much so that when I suggested that he should be called for the future "Bungil Wunkun," *i.e.*, "He of the Boomerang," the term was received with acclamation, and it is not improbable that for the future this may be his native name. The only boomerang we had was one of the "marndwullun," or returning sort. Throws were made by all, and the defects of the throws as well as of the instrument pointed out by one or the other almost in the same terms. One arm of the boomerang was held to be too much curved for the instrument to return near the thrower. The throws proved this to be the case, as it was evidently impossible for the thrower or the spectators to tell exactly what the course of the missile would be in returning. In some cases it flew past over our heads and fell in the rear, at others flew in the opposite direction far to the front. The explanation of this given me was that it was partly due to the uncertainty of the boomerang's return flight unless of rare perfection in make, and partly due to the wind which affected its course. I found that the throws could be placed in two classes, one in which the boomerang was held when thrown in a plane perpendicular to the horizon, the other in which one plane of the boomerang was inclined to the left of the thrower.

In the first method of throwing, the missile proceeded, revolving with great velocity, in a perpendicular plane for say 100 yards, when it became inclined to the left, travelling from right to left. It then circled upwards, the plane in which it revolved indicating a cone, the apex of which would lie some distance in front of the thrower. When the boomerang in travelling passed round to a point above and somewhat to the right of the thrower, and perhaps 100 feet above the ground, it appeared to become stationary for a moment; I can only use the term *hovering* to describe it. It then commenced to descend, still revolving in the same direction, but the curve followed was reversed, the boomerang travelling from left to right, and the speed rapidly increasing, it flew far to the rear. At high speed a sharp whistling noise could be heard. In the second method, which was shown by "bungil wunkun," and elicited admiring ejaculations of "ko-*ki*" from the black fellows, the boomerang was thrown in a plane considerably inclined to the left. It there flew forward for say the same distance as before, gradually curving upwards, when it seemed to "soar" up—this is the best term—just as a bird may be seen to circle upwards with extended wings. The boomerang of course was all this time revolving rapidly. It is difficult to estimate the height to which it soared, making, I think, two gyrations; but judging from the height of neighbouring trees on the river bank, which it surmounted, it may have reached 150 feet. It then soared round and round in a decreasing spiral and fell about 100 yards in front of the thrower. This was performed several times. The descending curve passed the thrower, I think, three times. Other throws were spoiled by the wind, which carried the boomerang far to the front. I observed, and some of the aborigines confirmed it, that the thrower preferred throwing with the wind. Another method of throwing was mentioned, namely, to throw the boomerang in such a manner that it would strike the ground with its flat side some distance in front of the thrower. It would then rise upwards in a spiral, returning in the same. This was not attempted as it was decided the boomerang was not strong enough. A final throw in a vertical plane so that the missile struck the ground violently fifty or sixty yards in advance terminated the display. It ricocheted three times with a twanging noise and split along the centre. My black friends said they should soon manufacture a number of the best constructed "wunkun" to show me. I observed that the spectators stood about a hundred yards on one side of the thrower, and when the boomerang in its gyrations approached us every blackfellow had his eyes sharply fixed on it. The fact stated by them that it was dangerous was well shown in one instance, where it suddenly wheeled and flew so close over us that I and Toolabar fell over

[1] As an example I may give the snake-charm which is sung to a monotonous chant. The blacks tell me they sing this and suck the wound for snake bite:—

"Yane thay, gaylunga, gaylunga,
Yane thay, gaylunga, gaylunga,
Willeba, wirreba, wirribiyow"

repeated indefinitely. It may be translated—

"Oh, the jaw of the gaylung, the gaylung,
Oh, the jaw of the gaylung, the gaylung,
Go and hide yourself in the bush-rat's nest."

Gaylung is, I believe, a Hoplocephalus, and very deadly. It is said to frequent the rats' nests, which are made of grass, each other in dodging it. The expression used by them was "Marndwullun no good for fight; if he no hit 'em man, might come back and hit your friend beside you." I questioned the black fellows as to whether they thought a boomerang could be thrown so as to return to the hand of the thrower. Seven said "no," and characterised the statement as "jetbollan," *i.e.* a falsehood; the eighth said he once made a boomerang that when thrown on a calm day with great care would gyrate round and round until it descended to the ground not far from him, moving as slowly as a leaf falling from a tree, and that he once ran forward and nearly caught it. He said also "no Kurni (black fellow) can catch a wunkun when he flying—he would cut his hand open."

All the black fellows were unanimous in stating that a boomerang when it has struck anything ceases its course.

I have now stated all that at present suggests itself as to the boomerang. I fear that I may have trespassed too much on your space and on the patience of your readers.

Bairnsdale, Gippsland, Victoria, March 3 ALFRED W. HOWITT

Fertilisation of Flowers.—The Cuckoo

As a fact interesting in connection with the fertilisation of flowers, I have observed that in *Scabiosa arvensis* the stamens are elongated and the anthers ripened successively—not simultaneously—in each individual floret, the first having fallen off the filament, while the fourth is yet colourless and curled up in the tube of the corolla, the other two being in intermediate stages of development.

May I also state in reference to the Cuckoo, that a rhyme well known in Somersetshire, runs thus:—

"In April, come he will,
In May, he sings all day,
In June, he alters his tune,
In July, he prepares to fly,
In August, go he must."

By which it is clearly not meant that the Cuckoo ceases to sing in that part of the country at Midsummer. This break of note in June is generally to be noticed about the middle of the month. I, this year, heard it for the first time on the 28th May.

Ealing CHAS. FRED. WHITE

The Cuckoo

IN connection with the notes of Mr. Adair and Mr. Joyner in NATURE of July 6th and 13th, let me record that the Cuckoo has not even yet left us in the Midlands. I heard it only last evening near to my own house. There is a popular rhyme, long current in Derbyshire, concerning this bird. One couplet tells us the Cuckoo may be heard

"In April, May, June, and July,
If she sings any longer she'll tell a story;"

so that even this rude rhyme shows that it is not expected to depart earlier than this month. LLEWELLYNN JEWITT

Winster Hall, Derbyshire, July 15

ABSTRACT REPORT TO "NATURE" ON EXPERIMENTATION ON ANIMALS FOR THE ADVANCE OF PRACTICAL MEDICINE[1]

IV.

Experimentation for Determining the best means of Restoring Animation after some Forms of Accidental Death.

THE frequent occurrences of death from the administration of chloroform and other agents of the anæsthetic series led me very early to experiment for the purpose of discovering the best means of restoring life after such accidents. I commenced this research in 1851, and have continued it up to the present time. I consider it to have been one of the most fruitful in useful practical results. The details of the work have been communicated at various times to the world of science, and at considerable length. They formed the subject of a special report to the British Medical Association at its meeting in London in 1862. They formed the subject of a report to the Royal Society in 1865. They were continued in the Croonian Lecture delivered before the same Society in 1873, and they were introduced into various lectures on experimental and practical medicine, and into reports on the physiological action of organic chemical compounds made to the British Association for the Advancement of Science.

[1] Continued from p. 199.

As the account of these inquiries covers a great deal of ground and brings into light many curious and interesting topics, I shall devote a little extra time to the abstract of the experimentation.

Method of Experimental Research.

The mode of experiment in this research has consisted chiefly in testing the action of the narcotic vapours; the vapours of chloroform, ether, nitrous oxide, carbonic acid, choke damp, carbonic oxide, hydrocyanic acid, methylal, chloral hydrate, and others similar. Some inquiries have also been made relative to instant death by mechanical and electrical shocks, and to death by drowning and cold.

In every case the animal has been submitted as painlessly and rapidly as possible to the process which we call death. The rapidity and painlessness were essential to the experimental inquiry; because the more rapidly and the more placidly the animation is suspended, the less is the body exposed to the risk of organic injury.

In the course of observation two steps have been followed.

I.

In the first line of inquiry the animals have been allowed to die without any attempt to restore life, the object being to ascertain why death took place. After death the organs of the body have been examined in order to determine what was the action of the destroying agent on them. How did it arrest the living action?

The first question asked had relation to the condition of the lungs:—Were they left bloodless, containing some blood, or congested with blood? The second question had relation to the heart:—Were its cavities left full, or empty of blood; were they distended or collapsed; was the blood left in the cavities of natural or unnatural colour; were the muscular walls of the heart still excitable to motion, or were they quite inactive; if the muscular walls were inactive were they rendered inactive by rigidity of contraction or by relaxation? The third question had relation to the blood:—Had the blood undergone coagulation, and if it had not at the time when the examination was made, how long a time elapsed for the completion of the process? What was the condition of the blood corpuscles; were they scattered or massed together, were they perfect in outline or irregular? What was the colour of the blood on the two sides of the circulation; was the venous blood darker than the arterial, or were the two kinds of blood mixed in respect to colour? Were any gases escaping from the blood or had any escaped? Had the fibrine escaped from the other constituent parts? Had the blood accumulated in any of the vascular organs, or had it exuded from its vessels in whole or in part? The fourth question related to the state of the nervous organs, the brain and spinal cord:—Were these organs congested or free of congestion? Was there any effusion of blood or of serum into them? Was the appearance of the white and grey matter natural or morbid? Were the membranes vascular or pale? The sixth question had relation to the state of the visceral organs in the cavity of the abdomen:—Were the kidneys free of congestion, or were they congested? Was the colour of the intestines natural? Were the liver and spleen congested or free of congestion? The seventh question had regard to the muscular system:—How long a period elapsed before the muscles became spontaneously rigid? After what modes of death from the different agents did the muscles continue most active under the influence of the galvanic current? What sets of muscles first ceased to respond to the current, the muscles of respiration or the muscles of locomotion? What other stimulants than galvanism would excite muscular movement after systemic death?

The above-named questions follow in series in relation to the condition of the animal body and its parts after death. In addition other observations were made to which it is necessary to refer.

The influence of the narcotics on the temperature of the body immediately before and after death was studied with much care. The variations of the animal temperatures under different degrees of natural atmospheric temperatures, from summer heat to extreme of winter cold, were noted. The different modifications of temperature that occurred in different organs of the body, brain, stomach, lungs, heart, liver, and abdominal cavity immediately after death were also observed.

The influence of the anæsthetic vapours on the minute or capillary circulation of the blood was determined by microscopical observation. In these experiments the web of the foot of the frog was made the field of observation. The animals were narcotised with the different vapours, and while narcotised the state of the circulation through the minute vessels, arterial and venous, was recorded during every stage of narcotism, and was compared with the state of the same parts that existed previous to the induction of the narcotic condition. The information sought for in this part of the inquiry related to the action of the narcotic vapour on the circulation of the blood corpuscles through the minute vessels; the changes of form in the corpuscles, red and white, if any changes occurred in them; the changes in the calibre of the vessels on the arterial and venous side; the point of arrest of the circulation through the vessels when the circulation finally stopped; the point of return of motion if the circulation were restored; and, the effect of various changes of external conditions such as warmth, cold, and moisture on the circulation during the stages of narcotic sleep.

One other important part of this line of inquiry was the determination of the conditions in which an animal body assumed to be dead could be best kept so as to retain those states of organs and parts which are favourable to the re-establishment of living motion. Should the body be left in a warm or a cold atmosphere? What circumstances determine the suspension of the process of coagulation of the blood and of cadaveric rigidity? Briefly stated these were the points of inquiry sought for under the first direction of research. By them I have been able to distinguish the conditions in which all the known anæsthetics leave the organs of the body when they kill.

II.

In the second line of inquiry the objects sought after were the rational means, suggested by the previous inquiries, for recalling animation after the signs of life have ceased. In this direction the following questions were asked:—

1. What is the precise value of *artificial respiration?* What is the most perfect method of carrying out artificial respiration? How long should the process of artificial respiration be continued, and what are the proofs that its continuance will be useless? When it has proved useful in restoring natural respiration, how long should it be continued? What dangers are connected with its employment?

2. Is it possible when the phenomena of suspended animation are present, to restore the circulation? By this process, to which I have given the name of *artificial circulation* (*British and Foreign Medico-Chirurgical Review*, April, 1863), I tried to restore the current of blood through the vessels, by transfusion of other blood; by mechanically pumping the blood within the veins of the dead body, over the lungs into the arterial circuit; by attempting to draw the blood over into the arterial circuit from the venous circuit; by altering the position of the body in alternate motion up and down.

3. Is it possible to combine artificial respiration with artificial circulation? In this endeavour I tried the combination of the two methods, and with the hope of being able to drive or draw a current of blood over the lungs while the blood remained fluid, and of being able also to aërate the blood in its passage by keeping up artificial respiration.

4. Is it possible to utilise the galvanic current so as to restore animation? In this inquiry the galvanic current was employed so as to call into play the action of the muscles of respiration: the heart: the voluntary muscles.

5. Can the heart, after it has stopped, be excited into motion by injecting into it agents which stimulate it to contraction? In this inquiry ammonia and other excitants were injected into the heart, while artificial respiration was maintained.

6. What is the value of external warmth in various degrees for restoring animation? In this research the effects of warm external applications, warm sand, moist warm air, dry warm air, moist warm straw, and other similar means were carefully tested.

In the briefest terms I have thus sketched out the mode of inquiry adopted in the course of experimentation now under notice. Fuller details are recorded in the paper published in 1863 in the *Medico-Chirurgical Review*, but these now given are sufficient for this abstract.

RESULTS.

The practical results which have followed on these researches are very numerous. I will write those which seem to be most practical and useful.

On Artificial Respiration.—In respect to artificial respiration the following facts were learned:—

If artificial respiration be sustained, even with an atmosphere of chloroform that is sufficiently narcotic to keep up deep narcotism, the action of the heart continues and recovery of life is possible. In brief, the mode of death from chloroform and perhaps from all the other narcotic vapours is actually due to the arrest of the current of blood through the minute vessels in the circuit of the lungs.

Artificial respiration, when perfectly carried out, was found sufficient to restore life after natural respiration had entirely ceased, and when all external evidence of motion of the heart had also ceased. To make this fact matter of direct application, I invented a double-acting elastic hand-bellows, which performed when in action the double purpose of emptying the lungs of their contained air by one movement, and of filling them with fresh atmospheric air by another movement. I also arranged the instrument in such manner, that on emptying the lungs of air a current of blood is mechanically drawn upwards from the right side of the heart, by which the oppression of the right side of the heart from tension is removed, and its muscular contraction is recalled into play. My latest instrument for this purpose is now so graduated, that measured quantities of air can be withdrawn and introduced, and the physico-chemical action of the lungs can be imitated with the greatest refinement, and with results that are different to any that have been gained before. Thus, after death from some of the narcotic vapours I have been able to restore life as long as eleven minutes after all the external signs of life have ceased. The results of the experiments proved also that when once the natural respiration is established the artificial ought to cease, so that the enfeebled circulation and respiration may return into play together. Further, the experimentation showed that artificial respiration, while it may be made, by delicate using, an all but certain means for the restoration of life after death from narcotic vapours, it may by bad use be made the certain means of ensuring death; that in performing it any rude movement of the body, or any violent inflation of the lung, or any attempt to inflate the lung while the lung is full of air, and the right side of the heart, full of blood, is sufficient to complete the process of destruction of balance and to cause unavoidable death. In a word, the experimentation showed that as with a fire that is well-nigh burned out we can restore action by laying new fuel lightly on the remaining flame, and then by gentle blowing can communicate the flame to the new fuel, so in artificial respiration the same delicacy of procedure will reproduce the vital flame.

In the absence of experimentation these facts could never have been learned. It was necessary to see the effects of various methods under various conditions, and under various circumstances in order to arrive at certain conclusions. A century of observations on men subjected to accidents that destroy life would not have taught so much as was learned in a few hours from the observations on the inferior animals.

Artificial Circulation.—The inquiry on the subject of artificial circulation proved that the attempt to establish the circulation by injection into the vessels, or by forcing the blood over the lungs, or by drawing it over in combination with artificial respiration, failed by reason of the coagulation of blood which followed such attempts. Some countenance was given, by the experiments, to the attempt to encourage a current of circulation by the process of raising and depressing the body so as to place the head at one moment below the level and at another moment above the level of the body; but on the whole the effort to restore the circulation through the lungs was most expedient by the simple plan of artificial respiration carried out as above stated.

Use of Galvanism.—The research instituted to test the value of galvanism as a means of restoring animation had a most important practical bearing. By regulating the intermittent current with a metronome I found it possible to make the respiratory muscles of an animal recently dead act in precise imitation of life. I also found that the heart could be excited into brisk contraction by the same means. But the result came out that by this method the muscles excited by the current dropped quickly into irrevocable death through becoming exhausted under the stimulus, and that in fact the galvanic battery, according to our present knowledge of its use in these cases, is an all but certain instrument of death. By subjecting animals to death from the vapour of chloroform in the same atmosphere, and treating one set by artificial respiration with the double-acting pump, and the other set by artificial respiration excited by galvanism, I found that the first would recover in the proportion of five out of six, the second in proportion of one out of six. Further, I found that if during the performance of mechanical artificial respiration the heart were excited by galvanism, death was all but invariable. The explanation of these experimental truths is illustrated by a simple simile. If an animal reduced in power to the last degree from want of food be carried to a place of succour, it may recover; but if it be stimulated or forced to walk to the place it will possibly die on the way. So with a man or animal under prostration from shock or narcotism; if the surgeon uses his own force for the restoration of the enfeebled muscles of the man before him he may restore the muscles to power; but if he uses up the last remaining force in the muscles of his patient by stimulation he will kill them outright. Considering that in the large number of instances of sudden death by accident, the first thing "tried" for restoring life is the galvanic battery, the information on the subject thus yielded by experiment, and which could have been got in no other way, is a result which, though unexpected, is none the less valuable. Indeed the peculiarity of experimental pursuit is that something unexpected in result is always learned, and is almost always useful.

Injection of Stimulants.—The effect of injecting ammonia, and other stimulants into the heart for the purpose of exciting the walls of the heart into contraction, was found to be as faulty as the application of galvanism for the same purpose. It produced a final contraction which was fatal.

Use of External Warmth.—The research on the action of warmth on animals under suspended animation was singularly interesting. I found that when an animal under a narcotic is still breathing, however faintly, the restoration of the animal warmth is often alone sufficient to restore life. This came out of the observation of the action of narcotics in reducing temperature, and in my first researches on chloral hydrate I showed that of two animals under the same lethal dose one was safe to recover in a warm air, while the other in a cold air would die. These facts relate to animals which are still breathing though all but dead.

On the other hand, I discovered that if an animal had actually ceased to breathe, the most certain way of ensuring its death is the exposure of it to heat; the most certain way of retaining it in a condition for possible recovery and of retaining its muscular irritability under stimulus is the exposure of it to cold. Heat I found excites the final muscular contraction and causes coagulation of the fibrine of the blood; cold suspends both. Thus in a warm-blooded animal exposed, after its death from chloroform, to extreme cold in a dry air, I found every muscle in the body that I could reach vigorously active under re-applied warmth and galvanism three hours after death; while in fish and batrachians I found it possible to restore life altogether after they had been accidentally inclosed, that is to say, frozen up in ice. As we arrive at clearer knowledge of the means of restoring animation in man, these facts will have a bearing of the extremest value. Already they indicate that in the death of the human subject by drowning and cold, attempts to restore life are demanded even hours after the occurrence of the accident.

Lastly, on this head, the experimentation taught me that while in the process of resuscitation it is very bad practice to immerse the body in a heated medium like hot water, it is of the utmost importance to establish the artificial respiration with a warm and dry air. Such an air prevents condensation of water in the bronchial tubes, quickens the process of oxidation of blood, and allows the body to become warm from its own natural centres of vital heat.

Practical Applications.

The experimental inquiry herewith briefly stated is too new to have brought forth much fruit. The grand practical results for which it was pursued have to follow in course of years. Some results have, however, already been realised.

Immediately after chloral hydrate came into use, the dangers from its use were found to be imminent. I was able to point out even before such dangers had occurred that the cause of danger was reduction of animal temperature from the agent, and that in treating a person poisoned with chloral two things were required, viz., to maintain a high atmospheric temperature, and to give warm food. Twice I have been summoned to these accidental poisonings, and in both instances I have saved life by these simple and purely scientific modes of cure. Probably after a number of deaths of men from chloral, it might have been learned that the cause of death was the reduction of animal heat. The fact gained instantly by observation on the lower animals supplied the knowledge in advance of the accident.

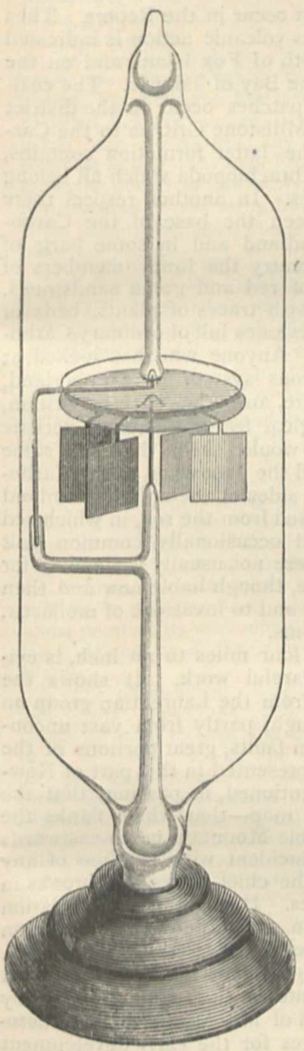
In two instances in the human subject in which after the performance of the operation of tracheotomy, life has become suspended from obstruction to the entrance of air into the lungs below the artificial opening, the obstruction has been removed, and afterwards by means of artificial respiration carried out with the instrument I have described above, life has been restored after all the ordinary evidences of death were manifested. In one of these examples of restored life the recovery was complete and the patient is now as well as ever he was. But for the long period of eleven minutes he lay in all the character of death, depending solely for returning life on the surgeon who supplemented his respiratory power and who gently fanned back into life a flame which had ceased for ever if scientific experimentation on the lower animals had not shown the possibility of its return by the hand of science.

(*To be continued*)

SCIENCE IN GERMANY

(*From a German Correspondent*)

It is known to have been first discovered theoretically by Maxwell, that the co-efficient of friction of a gas is independent of the pressure. This law has been tested and confirmed by Maxwell and O. E. Meyer, and more recently by Kundt and Warburg (*Philosophical Magazine*, 4, vol. iv.; and fully in *Poggendorff's Annalen*, Bd. 155 and 156) with reference to the sliding of gases in limits between 760 and 1 mm. pressure of mercury. The latter experimenters observed, as Maxwell did, the decrease of vibrations of a round glass disc suspended bifilarly between two fixed plates. At pressures under 1 mm. Kundt and Warburg were unable accurately to investigate the friction. They could perceive, however, that with continued progressive evacuation by the friction apparatus, the damping force exerted by the rarefied gas on the motion of the oscillating disc, decreases; still, even in the best vacuum which could be produced, it had still a considerable value. Thus, *e.g.*, in the best hydrogen vacuum which Kundt and Warburg could produce, the damping force was not less than one-third of the value obtained with full hydrogen-pressure (760 mm. mercury).



To demonstrate the friction in such a vacuum before a large audience, Prof. Kundt recently constructed an apparatus, which he employed when giving a lecture on the gas theory before a scientific society in Berlin in March last. The essential part of the apparatus consists of two small discs of mica, suspended one over the other in an evacuated space. When the under disc, which, like Crookes's radiometer, is furnished with four light vanes blackened on one side, is set in rotation by the action of light, the upper disc begins to rotate in the same direction (though much more slowly) in consequence of the friction of some traces of air still present in the apparatus. (The upper disc of course nowhere touches the lower.) The description of this apparatus with drawings, will shortly appear in *Poggendorff's Annalen.* Here we content ourselves with the representation of a smaller apparatus not meant for objective demonstration (see annexed figure) which the eminent glass-artist, Geissler, of Bonn, has constructed at the instance of Prof. Kundt. This apparatus, like the ordinary radiometer, is entirely inclosed in glass. On a fine steel point rests, by means of a cap, the lower mica disc, with the radiometer cross fixed to it. The upper disc rests likewise on a fine steel point. This point is fixed to an arm which reaches over the lower disc, but without being in contact with it. On the upper disc a small mark is made (not shown in the figure), which enables one to perceive whether the disc rotates or not. Illuminated by the sun or candles, the radiometer cross with the mica disc fastened to it, enters into quick rotation, and the upper disc begins gradually to rotate in the same direction as the lower one. S. W.

ON MODES OF DEMONSTRATING THE ACTION OF THE MEMBRANA TYMPANI

The movements of the bones of the tympanum in connection with sound-waves were first observed and their excursions measured by Buck ("Archiv. of Ophthalmology and Otology," vol. i., 1870), and more recently by Dr. Charles H. Burnett of Philadelphia, as recorded in the same Journal for 1872. The method followed in these researches was to expose the bones and membrane by chiselling away a portion of the wall of the tympanum, sprinkling on the chain of ossicles a little powdered amylum, so as to secure bright vibrating points, throwing light into the cavity by means of a condenser, and observing, with a microscope of low power, the excursions of the vibrating points when sound was conducted into the external ear. Various interesting deductions were drawn from these experiments as regards the amplitude of the excursions of vibrating points on different portions of the conducting mechanism, and as to the effect of variations of the fluid pressure within the labyrinth on the extent of movement. In the last number of the same journal an interesting paper appears from Dr. Clarence J. Blake of Boston on "the use of the Membrana Tympani as a Phonautograph and Logograph," accompanied by a plate. Dr. Blake's method consists of exposing the membrane and chain of bones, and fixing a light style (made "by splitting long wheat straw, scraping the inner cortical substance away, and separating single fibres") to the membrane. This style is caused to record its movements on a plate of smoked glass which is "carried smoothly and at a uniform speed in a direction at a right angle to the direction of the excursion of the style." . . . "The membrana tympani being set in vibration, and the carriage [bearing the smoked glass] drawn by its weight, moving at right angles to the excursions of the style, a wave-line, corresponding to the character and pitch of the musical tone sounded into the ear, is traced on the smoked glass."

There is still a third method which I have recently devised, chiefly for class illustration. It consists in converting the tympanic cavity into a manometric capsule, according to the method of Dr. Kœnig (*Philosophical Magazine*, 1873, vol. xlv. pp. 1–18, 105–114), and of viewing the oscillations caused by sound in a revolving mirror. A preparation is easily made from the ear of the cat. After sawing out the temporal bone, clearing away all loose tissue, and exposing the tympanic bulla, I make two small holes in the latter by means of a fine trephine. Into these holes two glass tubes, of corresponding diameter, are cemented with sealing wax—the one for leading gas into the tympanic cavity, and the other out of it. The preparation (which may be preserved in a moist state in a well-stoppered jar for a long period, and be used over and over again) is firmly fixed in a vice, one tube is connected with the gas supply, and the other with one of Kœnig's small burners. By means of a third tube inserted into the external auditory meatus, sound-waves are conducted to the membrane of the drum, the mirror is rotated, and the usual pictures corresponding to the pitch and quality of the sound are seen with exquisite delicacy. I have found tones of medium pitch (ut 3 to sol 4) produce the most distinct effects, and the vowels, if uttered with sufficient intensity, produce pictures which are quite characteristic. By using a preparation in which the auditory apparatus on each side is present, it is easy to devise an arrangement for showing the effects of interference, in a manner similar to Kœnig's well-known apparatus for that purpose, constructed on the method of Wheatstone.

JOHN G. MCKENDRICK

THE GEOLOGICAL SURVEY OF NEWFOUNDLAND

DUE notice of the Report for 1874, of Mr. Murray, the Director of the Newfoundland Geological Survey, has been delayed until the appearance of the map and sections referred to in that Report. These we have now received, and as they deserve more than ordinary attention from geologists, we propose to give some account of the recent work of the Survey. The able and indefatigable Director, who, like his late chief, Sir William Logan, has grown grey in the service of the Dominion, divides his Report into two parts, one of which narrates his own labours during 1874, while the other is furnished by his assistant, Mr. J. P. Howley, of whose surveys for the same period it gives the main results. Mr. Murray's Report is marked by that quiet practical good sense which formed so characteristic a feature of his contributions to the Canadian Geological Survey. It is more occupied with plans and advice for opening up the country to settlers, and developing the great resources of the island in timber and as a cattle-grazing district, than with geological matters. The latter are treated, too, with an eye to future mineral industries. Mr. Murray, in short, is doing the solid and useful work of pioneering. That work may make no brilliant display at the time, but if, as he hopefully anticipates, there is a prosperous future before Newfoundland, the colonists will look back upon his labours as those which largely guided and stimulated that prosperity.

But Mr. Murray is too true a geologist to let any chance escape him of advancing the purely scientific treatment of geology. And he is fortunate in possessing in Mr. Howley a geologist who can carry out his views with admirable skill. From Mr. Howley's Report and Map geologists in other countries will learn some particulars not only important as regards the geology of the colony, but of general interest as bearing on the question of the nature and *modus operandi* of the metamorphic action to which the origin of such rocks as dolomite and serpentine is attributed.

Mr. Howley's labours during 1874 were, in accordance with Mr. Murray's plans, given to the survey, topographical and geological, of the western coast of Newfoundland, about the peninsula and bays of Port-a-Port, and St. George's Bay. In tracing the Lower Silurian formations of the Newfoundland coast, Mr. Murray and his colleagues have been able to identify them with more or less precision as equivalents of the Quebec and Birdseye and Black River groups of Canada. But in the course of their surveys they have at different times encountered intercalated sheets of metamorphic rocks in the Lower Silurian series overlying unaltered and fossiliferous strata. Thus at Bonne Bay, in 1862, Mr. Richardson found highly metamorphosed rocks, including white talcose slates and serpentine, in some portion apparently of the Quebec group. Four years afterwards Mr. Murray observed further south, in the Bay of Islands, that sandstones believed to represent the Sillery zone of the Quebec group passed below the serpentine of the Blowmedown mountains. Mr. Howley has now confirmed and extended these observations by mapping the country between the Bay of Islands and St. George's Bay. He has traced Mr. Murray's serpentine rocks southwards to Bluff Head, and finds that they pass unconformably over different horizons of rocks which are taken to represent the Sillery and Levis subdivisions of the Quebec group of the Lower Silurian system. The striking character of this unconformable junction is well brought out upon the map, where two large cakes of the overlying rocks are seen to sweep over both anticlinal and synclinal folds of the lower formations. These cakes consist of brecciated dolomite or limestone, chlorite-slate, diorite, and serpentine, having a total thickness of perhaps 1,500 feet. Their exact geological horizon seems not yet quite satisfactorily fixed, but they are placed provisionally between the Sillery and Birdseye and Black River formations. Doubtless further details will be given in future reports regarding this remarkable feature of Newfoundland geology, and till they appear it may be well to avoid any discussion of the theoretical aspect of the subject. It is not the first time that an instance has occurred of the higher rocks of a district being more metamorphosed than the lower, but there has probably never been observed so remarkable a case, for here the metamorphosed and contorted series is described as actually overlying unmetamorphosed strata.

Other questions of interest occur in the Report. Thus a centre of pre-carboniferous volcanic action is indicated as existing along a line north of Fox Island and on the coast to the south head of the Bay of Islands. The coal-measures, of which a few patches occur in the district surveyed, overlap from the Millstone Grit on to the Carboniferous Limestone. The latter formation contains, according to Mr. Davidson, brachiopoda which all belong to well-known British species. In another respect there is a curious analogy between the base of the Carboniferous system in Newfoundland and in some parts of Britain. In the former country the lower members of that system consist largely of red and green sandstones, clays, and conglomerates, with traces of plants, beds of gypsum, and occasional limestones full of ordinary Carboniferous Limestone fossils. Anyone who has looked at the base of the Carboniferous system in Cumberland, Westmoreland, Dumfriesshire, and other parts of Britain, will recognise these lithological features as characteristic also in this country. It would seem that the same physical conditions preceded the deposition of the Carboniferous Limestone on both sides of the Atlantic—inland seas or lakes, not far separated from the sea, in which red sediment with gypsum and occasionally common salt was laid down, but which were not usually well suited for the support of molluscan life, though liable now and then to inroads of the sea outside and to invasions of mollusca, corals, and other marine forms.

The map, on a scale of four miles to an inch, is evidently a piece of most careful work. It shows the arrangement of the rocks from the Laurentian group up to the Coal-measures, though, partly from vast unconformabilities and partly from faults, great portions of the geological series are not represented in this part of Newfoundland. It may be mentioned, in passing, that the largest fault traced on the map—that which flanks the Laurentian range from Table Mountain north-eastwards to Grand Pond—is not coincident with the line of any river, but is crossed by all the chief rivers and brooks in the district which it traverses. Hence the same relation between fracture and erosion exists there which has been so extensively traced and keenly discussed in this country. To the completion of this important map geologists will look forward with not less interest than must be taken by those who see in the labours of Mr. Murray and his associates one of the best pledges for the early development of the colony.

A. G.

THE ANCIENT BRITISH PIG

PROF. ROLLESTON has recently been making some researches on swine, the discovery of some remains buried in the alluvium, near Oxford, having directed his attention to the subject. In illustration of a paper "On the Prehistoric British *Sus*," read by him at the Linnean Society, June 15, the following specimens were exhibited:—1. Skull of *Sus scrofa*, var. *domesticus*, from a late Celtic interment. 2. Skulls of *Sus scrofa*, var. *ferus*, from alluvium near Oxford, and from Germany. 3. Skull of *Sus andamanensis*, forwarded him by J. Wood Mason. 4. Skull of *Sus cristatus*, lent by Sir Walter Elliott, K.C.S.T. 5. Skull of *Sus barbatus* wrongly named *S. verrucosus*, and needlessly *Euhys barbatus* in some mammalogical catalogues.

From these and other data the author bases the subjoined conclusions:—

1. The domesticated pig of Pre-Roman times, as exemplified at least by the specimens from the interment referred to, appear to resemble *Sus scrofa*, var. *ferus*, rather than *S. cristatus*, or the domestic variety, *S. indicus*.

2. On the other hand, *S. cristatus*, the Indian wild hog, appears to him, whilst being readily and always distinguishable from *S. scrofa*, var. *ferus*, to differ from it, mainly by the retention permanently of certain structural conformations which were only temporarily represented in the European wild species. The third molars of the male, *S. cristatus*, varied, however, concomitantly with its canines, and showed a much larger development of their posterior lobe, than either *S. scrofa*, var. *ferus*, or the females of their own species. The rearmost lobe, however, of the posterior molar, varies a good deal in *S. scrofa*, var. *ferus*, irrespective of sex.

3. Bearing in mind the elasticity of the swine type and the power for changing which their domestication has shown to possess, Dr. Rolleston has less difficulty in conceiving that the so-called *S. indicus* was really a modified *S. cristatus*, than that it had been evolved from any *Sus*, such as *S. leucomystax*, from countries farther away from Europe than India. *S. cristatus* had the malar border of the lachrymal always marked by the relative shortness insisted on by Nathusius. It had not the relatively wider palate; but upon this point too much weight had been laid.

4. A skull of a wild sow, from the alluvium, later in date than the "river gravels," near Oxford, combined the short lachrymal characteristic of young pigs and of *S. cristatus*, with the worn down teeth, elongated facial skeleton, and disproportionally small size of an old wild sow, *S. scrofa*, var. *ferus*. Such a combination of characteristics tended to suggest carefulness as to accepting the Torf-Schwein *S. scrofa*, var. *palustris*, of Rütimeyer, as a distinct species, or taking even such a point as the shortness of the lachrymal as constituting a specific difference.

5. The simplicity of the third molars in the very large skull of *S. barbatus* appear to be of greater value, as the rugose condition might have been expected to be forthcoming in so large, so well armed, and so well fed a *Sus* as this from Borneo.

6. The true *S. verrucosus* differs from *S. barbatus* in having the lachrymal's malar edges long, relatively to its orbital, as well as in the peculiarities which its specific name implies. These peculiarities were reproduced in the old Irish "Greyhound Pig" figured by Richardson "Domestic Pigs," p. 49, Ed. Warne.

7. The often-quoted paper by Dr. Gordon, *Medical Times and Gazette*, May 2, 1857, p. 429, led us to suppose that *Taenia solium* of man, infested the domestic pig of India, as it does those of other parts of the world. The facility with which the pig lends itself to domestication enables us to understand how the many-sided commensalism which now exists between man and that animal may have set up in very early times. Indeed the particular results of their commensalism which their solidarity, as regards the alterations of the generations of *Taenia solium* represents, suggests that their co-existence in time must have been more extensive than even the co-existence in space ascribed to them, not quite correctly, by Gibbon ("Decline and Fall," chap. ix. note 9, p. 392, Smith's edition).

PHOTOGRAPHIC PROCESSES[1]

II.

We next pass on to other applications of the dichromates for the production of prints, and the first I shall demonstrate is that known as carbon printing, but which is perhaps more correctly termed the autotype process. It is dependent on the oxidation of gelatine, one of the substances which you may have already guessed would be capable of being acted upon by the dichromates. If, then, we have a film of this gelatine impregnated with potassium dichromate, and after drying it be exposed to light, it will be found that all the portions acted upon will become insoluble in hot water; that is, supposing the duration of the exposure be of sufficient duration, and if the light be sufficiently intense. Imagine now that beneath a negative of delicate gradations of light and shade we place a film of sensitive gelatine, supported for convenience' sake on paper, and allow sunlight to act upon it. After a time, in what condition will the gelatine be? It will be partially insoluble, more particularly on the surface next the negative, and the lights and shades will be represented by different depths of insoluble matter, according to the intensity of light penetrating through the various parts of the negative. I must here pause, and try and explain why this is. At first sight it might seem that the *whole of the thickness of the film* ought to possess different ratios of solubility. This is not true, however; the solubility is affected to different depths. That coloured component of white light which is principally effective in producing the chemical change is blue, and which consequently finds a difficulty in piercing through the orange-coloured dichromate. The amplitude or height of the blue wave is continually diminished, till finally it is almost extinguished. Now the intenser the white light the greater will be the original amplitude of this wave, and it is at once apparent that the limit of amplitude, which is effective to cause the chemical change, will be reached at a greater depth by those rays of light which were originally the brightest. A little reflection, then, will show you that the soluble part of the gelatine will principally be next the paper, and on immersion in hot water the viscous unaltered gelatine would remain imbedded between it and the outer insoluble surface. Though several ingenious methods have been tried to render the support on which the gelatine rested sufficiently porous to allow the occluded parts to be washed away, yet, so far, no attempt has been completely successful. To get over the difficulty the principle has been adopted of transferring the gelatine film to a temporary support, the outside surface being caused to adhere to it. Evidently, by this means, the soluble gelatine can be washed away when the paper is peeled off, and a raised image insoluble in water would remain, which eventually may be transferred to its final support. The temporary supports, usually employed are metal plates, glass, paper coated with an insoluble compound, &c. A picture in gelatine alone, however, would be, comparatively speaking, of little value, as it is almost colourless; but if pigments be mixed with it the objection disappears. In the autotype process the gelatine is mixed with colouring matter and a coating is given to a piece of paper. When dried the gelatine can be rendered sensitive by floating its surface on a solution of potassium dichromate, and after again drying is ready for printing. Such a piece of prepared paper, or carbon tissue as it is technically called, we have here. It has already been exposed beneath a negative, but no trace of any image is apparent, as the dark colour of the pigment masks it entirely. In order to judge of the amount of light received during exposure resort then is had to what are called actinometers. The detail of the instruments I will not enter into; suffice it to say it is usual to judge the depth of printing by the colour given to silver chloride. Placing then the exposed tissue, gelatine side downwards, beneath water in which a zinc plate has already been immersed, and bringing the surfaces of the two together, they are withdrawn from the water with a film of moisture between. You will notice that I left the print in the dish but a very short time, for a reason which you will presently understand. By passing this "squeegee" (which is a bar of wood from which a thick strip of india-rubber projects) over the back of the paper I drive out all the water from between the surfaces, and you see how the gelatine film clings to the zinc. And why is this? You will find that it is not naturally adhesive, the light has changed the quality of the gelatine in this respect, then why does it hold so tight to the metal plate? Simply owing to the moisture left in the paper; the soluble gelatine soaks it up and expands. It cannot well expand laterally, so it expands upwards, and a partial vacuum is created between the gelatine and the plate. Now you see why I left the print in the water such a short time. Had I left it in longer the total expansion would have taken place, and the necessary vacuum could not have been created when it was pressed on to the zinc plate.

Now that it is firmly held, I can place it in hot water and remove the paper. It easily peels off, and the solvent action of the fluid can have fair play. As I move it up and down in the trough, you can see the gelatine running over the surface. After a few minutes it is clean, and the development is finished. On this plate I have another print which has already undergone similar treatment, but has been allowed to dry. This piece of

[1] Lecture by Capt. Abney, R.E., F.R.S., at the Loan Collection, South Kensington. Continued from p. 241.

transfer-paper is now heated in very hot water, and applied to the surface. It is "squeegeed" on to it, and you see it adheres, this time, however, by its "stickiness." Here is another print in the same stage, but the adhering paper is dry. Raising one corner of it by my nail, I can grasp it in my fingers, and the finished print strips off the plate held in position by the paper.

Such are the usual manipulations in autotype printing, and the pictures produced by this method should be permanent, and they must be as permanent as leather, or as the pigment which is employed to give visibility to the gelatine image. As I mentioned before, there are various modifications of the process; for instance, one is to develop the picture on the permanent support destined to bear it, using this instead of the zinc plate. A little consideration will show you that in this case the negative employed must be reversed.

We now come to a large class of printing processes known as photo-mechanical. And here I should state that the term photo-mechanical is applied to such processes as are independent of light for production of prints, after that agency has once furnished a plate or means of producing a plate. The first of these that I shall attempt to describe is that known as the Woodbury type, after the inventor, Mr. Walter Woodbury. The following outline will give some idea of the methods resorted to :—

A skin of gelatine is prepared somewhat in a similar manner to that which I shall describe in the heliotype process, only for this it receives a tough film of collodion on one surface. This surface is placed next a negative on glass, and the light from an unclouded sun or from a luminous point (such as the electric light) is allowed to fall on it. Owing to the thickness of the gelatine employed, this method of exposure is necessary in order to secure sharpness. The print is developed as in the autotype process, and we get an image in great relief, formed by the insoluble gelatine, resting on the tough collodion film. When dried, this relief picture is placed on the surface of a flat, soft metal plate, and, by hydraulic pressure, is forced into it, furnishing a mould, perfect in all its parts. The wonder is at first excited that the gelatine does not break under the enormous weight brought to bear upon it, but when it is recollected that ferns and grasses can be made to furnish similar impressions, the astonishment is diminished, in that the substance employed is now in a leathery condition.

Apparently it matters little as to which side of the relief is pressed into the plate. In one case we should have to use a reversed negative, whilst in the other any ordinary negative may be employed. This is important to the photographer, as may be surmised.

Before us we have the negative, a relief from it, and a mould taken from the relief. This mould is now placed in this press, which consists of a flat plate (which can give slightly in any direction, and is capable of being raised or lowered) and a flat hinged top, to which is affixed a perfect plane of glass. When this lid is brought down on to the mould, the lower lid gives till perfect contact is got between the two surfaces; a species of clamp enables the lid to be kept in position. You see on placing this piece of paper in the mould, the clamp closes with difficulty, but a little mechanical contrivance attached to it causes a great pressure to be brought to bear. Opening the press once more, a little warm gelatine, which has been impregnated with colour, is poured on the mould, and a piece of resinised paper placed over it; the press is again closed. The mass of cold metal soon cools the gelatine, and on opening the lid, it is found that the excess of gelatine has been squeezed out beyond the mould, and on lifting off the paper, a picture is found adhering to it. This image is really formed in precisely the same way that a cook forms her jelly in a mould, though the colouring matter in this case is somewhat different. When dry, the picture is rendered insoluble in water by passing it through an alum bath. At first sight, this process might seem to be slow, but when it is remembered that half a dozen moulds can be made from the same relief, it requires no great exercise of the imagination to surmise that the pictures may be produced almost as rapidly as a lithograph. I referred to the relief necessary to produce the mould. From what I have described it will be seen that the dried relief must be as great as the *wet print* of the autotype process in order to produce the same gradations.

The last process I shall describe is known as the heliotype process, and I have chosen it for demonstration as I am practically acquainted with its working at Chatham, and not from any inherent superiority it may possess. It is a type of all the photo-mechanical processes, if we except Woodbury, type, and it is to such as these that we must look for our book illustrations, though I am still in hopes that we may have a really good process for surface printing from a metal block, capable of being set up with type. We have a promising example of this latter process in what is known as Dallastint, the offspring of Mr. Duncan Dallas; but as it is a secret process I cannot say anything regarding its production.

In the heliotype process there are various operations.

To begin with, there is the preparation of the gelatine film on which the image is printed.

The manner of preparing it is as follows :—Gelatine is dissolved in water by aid of heat, and to it is added a sensitiser which consists of potassium dichromate, to which a small quantity of chrome alum is added. Now here I must remark that this chrome alum forms an important part of the process. Gelatine we know ordinarily dissolves in hot water, but if it be impregnated with chrome alum, not only does it render the gelatine insoluble, but it also toughens it in a marked manner when it is wetted. When the subsequent operations are explained, the importance of this property bestowed on the gelatine will be manifest. The solution of gelatine (with this sensitiser mixed in it) is flowed over a carefully levelled glass plate to such a depth that in drying it has the thickness of a piece of Bristol board. The glass plate may be ground and very slightly waxed; or it may be coated with a dilute solution of india-rubber to facilitate the gelatine leaving it, when it is required to be employed for printing purposes. A negative (which must be what is known as a reversed negative) is placed in a pressure frame, the gelatine is stripped off the plate, and the surface, which was next the glass, is in contact with the taken image. The necessary exposure may be estimated by an actinometer or by examining the image in the printing frame. When judged to be sufficiently printed, the back of the print is hardened by exposure to light. This operation gives toughness to the gelatine and renders it capable of resisting the treatment it has subsequently to undergo.

The skin of gelatine is next taken, and immersed for a few seconds in cool water (in practice a temperature of over 60° F. is found to be the best). A pewter or other metal plate, coated with india-rubber, is now placed underneath it, and the film caused to adhere to it by the use of the squeegee. The pressure of the atmosphere causes the adhesion as it does in the autotype process. For convenience' sake the edges are now run round with a solution of india-rubber in benzole and paper pasted round them, to prevent the water getting beneath the skin. The plate is then immersed in cold water for about half-an-hour, to soak out the unaltered dichromate, and it is ready for use as a printing surface after the superfluous water is blotted off.

The gelatine skin is all in an insoluble state owing to the presence of the chrome alum; but further, the part where the light has acted fully will not absorb water, whilst that which only partially absorbs water has only been partially acted on by light, and the part wholly unacted upon absorbs it greedily. When a roller containing greasy ink is passed over it, those parts which contain a great deal of water take no ink, particularly if it be stiff ink. The parts containing a little water take the ink lightly, whilst those parts which have refused to imbibe any moisture take it greedily. Evidently here we have a means of obtaining a picture of half-tone subjects in printers' ink. Another point is that thin ink takes better in a partially exposed portion than does a thick ink, hence to bring out the half tone it is customary to use two or even three inks of different consistency. The printing plate is generally placed in the bed of an ordinary printing-press and rolled up with a soft roller or rollers, charged with the printing inks. The impressions are pulled off as for letter-press, though more force is necessary. In order to have clean margins a mask is cut of the proper dimensions, and brought to certain register marks. The paper, usually employed for receiving the impressions, is enamelled, the enamel being formed of barium sulphate and gelatine. Any ordinary paper, however, may be used, if it have the power of taking up the ink. On the walls of the exhibition are some photographs printed on ordinary drawing paper, and they are effective in their way.

Mr. Edwards, the patentee of this process, proposed to use a series of gelatine printing surfaces from the same negative, to form a species of photo-chromotype, and I have seen some specimens which are very successful. Little seems to have been done, however, in this direction at present. When drawing your attention to the manufacture of the gelatine skins there was one point to which I did not allude. You may make your skin of jelly or of blanc mange. I have found that a certain proportion of milk added to the gelatine in lieu of the water gives more delicate pictures than does gelatine alone. There are several kindred processes worked at present, amongst which I must notice that of the Autotype Company. In their process an exceedingly thin layer of gelatine is formed on the plate and hardened by means of gum resins. The gelatine is not removed from the plate, but it is printed from whilst still on it. The film is hardened from the back. The glass plate can be inked in as described for the heliotype process, and can be pulled in a lithographic press or in an ordinary printing-press. M. Thiel, of whose process we have beautiful examples on the walls of this room, uses an ordinary lithographic printing-press.

I have only been enabled to give you a brief outline of these few processes, specimens of all of which are to be found in this exhibition. Short as have been the descriptions, I hope, however, that they have been sufficient to enable you to see the immense strides in the methods of producing prints that have been made in the last dozen years. When we consider that the autotype, the Woodbury type, and all the other mechanical printing processes have been worked out in that time, you will see that the inventive faculties of those who labour in the art-science have not been allowed to lie dormant. Perhaps in no other occupation is there such a field for discovery and improvement as in photography; and considering the many workers in it, and the large industry it represents, we may surely hope that in 1886 we may again be able to record a still further advance; it may be, perhaps, in the line I have already indicated, and in colour pictures.

OUR ASTRONOMICAL COLUMN

THE COMET OF 1686.—This comet, so far as the European observations are concerned, offers a very similar case to that of the comet of 1533, for which two totally different orbits have long appeared in our catalogues. As regards the latter, it was shown by Olbers that the observations of Apian between July 18 and 25 were insufficient to decide whether the true direction of motion was in the order of signs or the opposite, the node at the commencement of Leo or the end of Capricornus, or the perihelion in Cancer or in Scorpio; but the publication of the Chinese observations since Olbers wrote, has afforded evidence which tends to give the preference to his direct orbit, as already intimated in this column. The best observations of the comet of 1686, are those of Père Richaud at Pau, on four mornings between September 7 and 15; from his positions for the 7th, 10th, and 15th, the following orbit was obtained, and for the sake of comparison Halley's orbit, the only one previously computed, is copied.

	New Orbit.	Halley's Orbit.
Perihelion Passage, G.M.T. ...	Sept. 19·2046 ...	Sept. 16·6063
Long. of Perihelion	23° 35′·4 ...	77°·0′·5
,, Ascending Node ...	149 13·2 ...	350 34·7
Inclination	32 10·1 ...	31 21·7
Log. Perihelion Distance	9·48730 ...	9·51188
Motion.	Retrograde.	Direct.

If we compare these two sets of elements with Richaud's places, we find the differences between calculation and observation to be, for 16h. Paris M.T., as assumed time—

	New Orbit. Long.		New Orbit. Lat.	Halley's Orbit. Long.		Halley's Orbit. Lat.
	° ′		° ′	° ′		° ′
Sept. 6 ...	0 0	...	0 0	+0 11	...	−0 32
,, 8 ...	−1 18	...	+0 11	−0 27	...	0 0
,, 9 ...	−0 26	...	+0 14	+1 32	...	−1 3
,, 14 ...	0 0	...	0 0	−0 8	...	−0 4

So that from these eight days' observations only it would be difficult to give a decided preference to either orbit. But it fortunately happened that before the comet was seen in Europe, it had been a very conspicuous object in more southern latitudes; at Para, in Brazil, it had been observed during the whole month of August, the nucleus as bright as stars of the first magnitude, with a tail 18° in length; in Siam by the French Jesuit missionaries, who fixed its position approximately between August 17 and 23, and at Amboyna on August 15, a little south of the belt of Orion.

On comparing the two orbits with the Siam observations, it is at once evident that they decide in favour of Halley's elements, and on making a further calculation in which the August positions, which are only rough ones, are introduced, the following orbit finally results:—

Perihelion Passage, 1686, September 15·8249 G.M.T.

Longitude of Perihelion	75° 58′·4	Equinox of 1686.
,, Ascending Node ...	354 3·8	
Inclination	34 55·7	
Log. Perihelion Distance	9·52636	
Motion ...	Direct.	

On the morning of August 17 the comet was distant from the earth 0·316, and at the time of Richaud's last observation, 0·973.

While writing on a cometary subject, we are reminded of what appears to be an unusual dearth of comets not of known period, in these parts of the system since the last one was detected by M. Borrelly on December 6, 1874, or more than eighteen months ago. It is true that generally the weather during this interval has been abnormally bad for such work as comet-hunting; still considering that several of the observers who of late years have given most attention to the search for these bodies, are located in very favoured climates, this appears hardly to explain the absence of any discovery. It may be anticipated that a systematic search for comets in the southern heavens will soon be organised by some zealous amateur in the other hemisphere; it is certain that he would in this way be likely to render material assistance in the advancement of cometary astronomy, and as we have before urged, he might succeed in bringing to light again one or two comets which were assuredly moving in elliptical orbits of short periods when last observed, but from one cause or another have since got adrift, and are not so likely to be recovered in the northern as in the southern hemisphere.

NEW MINOR PLANET.—M. Leverrier's *Bulletin International* of July 13 notifies the discovery by M. Paul Henry, at the Observatory of Paris, on the previous evening, of another small planet in R.A. 15h. 56m., N.P.D. 111° 59′. This planet, which is estimated 12·5m., is called No. 164, but it is to be remembered that we do not know the actual positions of so many as 164 of these bodies, and until the elements of any newly-detected one are well determined, there is the chance of identity with one or other of several which have been previously observed and even calculated, but for want of continuous observation are now lost.

A PHYSICAL SCIENCE MUSEUM

THE President of the Royal Society, Dr. Hooker; Mr. Spottiswoode; Dr. Burdon Sanderson; and Dr. Siemens, had an interview on the 17th inst. with the Lord President of the Council, the Duke of Richmond and Gordon, and presented the subjoined memorial from gentlemen who have been connected with the Loan Collection of Scientific Apparatus at South Kensington. His Grace discussed the subject of the proposed permanent Science Museum with the deputation, and stated that he would consult his colleagues.

MY LORD DUKE,

We, the undersigned, beg to submit for your Grace's consideration the importance of establishing a Museum of Pure and Applied Science; that is to say, a Museum to contain Scientific Apparatus, Appliances, and Chemical Products, illustrating both the history and the latest developments of Science; where the methods and results of investigations which have marked important stages in the advancement of Science may be studied, and where also the most highly perfected instruments of the day may be found.

Among the various advantages which in our opinion would accrue from the establishment of such an Institution, we would mention the following. Investigators would be saved much time and labour by being enabled to see how far, and by what processes, others have advanced in the line of research which they may be pursuing: thus leading them to a knowledge of the facts and laws already established. From an educational point of view such a collection would assist teachers, by enabling them to select, or by showing them how to construct, the best apparatus for illustrating the subjects of their lessons. Great benefit would also accrue to the constructors of Mechanical and Philosophical Apparatus from being able to refer to the original Apparatus which they might be required to reproduce or to improve. To every one connected with Experimental Science, it would be of great service to see the actual instruments, many of which could otherwise be only known to them by description, and, under proper supervision and instruction to learn their actual manipulation and performance. We would also contemplate lending to investigators, under suitable restrictions, such instruments as might be profitably employed in the researches they were pursuing.

In considering this subject our attention has naturally been directed to the existing Museum of Patents. While fully recognising the value of many of the objects now belonging to that collection, we are of opinion that, as standing alone and purely as subjects of a patent, their value is far less than if they formed part of a general collection, and were placed in juxtaposition with instruments of a similar nature, some of which, though not patented, are better adapted to their purpose, and of greater instructional value. The object of a Scientific Museum is the promotion of knowledge, and the establishment of the scientific principles which must underlie all invention; and it would not only prove of great advantage to both scientific investigators and the public if the two objects could be combined in one undertaking, but we believe that the objects of a Patent Museum would be better served by a museum of the character here proposed than by a special collection, such as has hitherto subsisted. We are decidedly of opinion that the state of knowledge in reference to any invention would be only very imperfectly represented by the exhibition of patented instr uments and products only.

In support of the views which we have ventured to submit, we would draw your Grace's attention to the Fourth Report of the Royal Commission on Scientific Instruction, §§ 80-94. In § 93 the Commission state:—"We accordingly recommend the formation of a Collection of Physical and Mechanical Instruments; and we submit for consideration whether it may not be expedient that this Collection, the Collection of the Patent Museum, and of the Scientific and Educational Department of the South Kensington Museum should be united and placed under the authority of a Minister of State."

We understand that the Royal Commission for the Exhibition of 1851 has offered to erect a building for the purpose contemplated in this memorial, and we would desire to point out that the purchase of objects need not entail any large outlay of public money. We contemplate the gradual formation of a collection of such objects as might be voluntarily left at the close of the existing Loan Collection, and others which might be contributed from the existing Patent Museum and other public departments, from the parliamentary grants administered at the request of Government by the Royal Society, and from such private societies and individuals as might be disposed to avail themselves of the Museum as a depository of scientific apparatus, appliances, and chemical products.

We have the honour to be, my Lord Duke,

Your Grace's obedient Servants,

(Signed) J. D. Hooker, President of the Royal Society.
John Evans, F.R.S., Chairman of the Conferences in the Geographical Section.
E. Frankland, F.R.S., Chairman of the Conferences in the Chemical Section.
J. Burdon Sanderson, F.R.S., Chairman of the Conferences in the Biological Section.
C. W. Siemens, F.R.S., Chairman of the Conferences in the Mechanical Section.
W. Spottiswoode, Treasurer and Vice-President R.S., Chairman of the Conferences in the Physical Section.
Charles Brooke, F.R.S.
Alfred S. Churchill, Chairman of the Society of Arts.
William Kitchen Parker, F.R.S.
H. W. Bristow, F.R.S., Director of the Geological Survey of England.
William B. Carpenter, F.R.S.
Latimer Clark, late President Soc. Tel. Engineers.
W. H. Flower, F.R.S., Conservator Hunterian Museum.
J. H. Gilbert, F.R.S.
Robert Main, F.R.S., Radcliffe Observer.
Fredk. Jno. Evans, V.P.R.S., Capt. R.N., Hydrographer of the Navy.
P. de M. Grey Egerton, F.R.S.
Hampton, F.R.S., President of the Institute of Naval Architects.
Joseph Prestwich, F.R.S.
T. M. Goodeve, M.A.
W. de W. Abney, Capt. R.E., F.R.S.
G. W. Royston Pigott, M.A., M.D., F.R.S.
Robert H. Scott, F.R.S., Director Meteorological Office.
George Robert Stephenson, F.R.S., President Institute Civil Engineers.
F. H. Wenham.
George Bentham, F.R.S.
Nevil S. Maskelyne, F.R.S.
H. S. Eaton, President of the Meteorological Society.
E. Atkinson, Treasurer of the Physical Society.
F. A. Abel, F.R.S., President of the Chemical Society.
T. Hawksley, President of the Institute of Mechanical Engineers, past President of the Institute of Civil Engineers.
William H. Stone, F.R.C.P., &c.
W. J. Russell, F.R.S.
David Forbes, F.R.S.
Richd. Collinson, Vice-Admiral, Deputy Master of the Trinity House.
B. Woodcroft, F.R.S., late Superintendent of Patent Office Museum.
C. W. Merrifield, F.R.S.
Andw. C. Ramsay, F.R.S., Director General Geological Survey.
C. P. B. Shelley.
James Baillie Hamilton.
F. Eardley-Wilmot, F.R.S., Major-General.
Henry Cole.
Warren De La Rue, F.R.S.
Frederick Guthrie, F.R.S., Prof. Physics, Royal School of Mines.
C. O. F. Cator.
Thomas Savage.
Alfred Barry, D.D., Principal of King's College.
Wm. Chappell, F.S.A.
A. J. Mundella, M.P.
William C. Unwin, Prof. Engineering, Indian C. E. College.
George T. Clark.
Joseph Woolley, LL.D.
John F. Twisden.
Richard Strachey, Major-General, F.R.S.
Frank Bolton.
D. Glasgow.
William Rutherford, M.D., F.R.S.
Henry E. Roscoe, F.R.S.
J. Hopkinson.
A. W. Reinold.
John Tyndall, F.R.S.
John Torr, M.P.
Aberdare, President of the Royal Horticultural Society.
Robert James Mann, M.D.
Albert Günther, V.P.R.S.

H. C. Rawlinson, F.R.S., late President Royal Geographical Society.
W. B. Baskcomb.
James K. Shuttleworth.
Geo. Busk, F.R.S.
Geo. J. Allman, F.R.S., President of the Linnean Society.
J. Arthur Phillips.
T. H. Huxley, Sec. R.S.
E. Ray Lankester, F.R.S.
H. C. Sorby, F.R.S., President of the Royal Microscopical Society.
W. T. Thiselton Dyer, Assistant-Director, Royal Gardens, Kew.
Henry W. Acland, F.R.S., President of Medical Council.
H. W. Chisholm, Warden of the Standards.
D. T. Ansted, M.A., Cant., F.R.S.
J. H. Gladstone, F.R.S., Fullerian Professor, Royal Institution.
J. Scott Russell, F.R.S.
A. Lane Fox, Colonel, F.R.S.
Rayleigh, F.R.S.
Robert S. Ball, LL.D., F.R.S., Astronomer Royal, Ireland.
H. C. Seddon, Major, R.E.
Charles V. Walker, F.R.S., President of the Society of Telegraphic Engineers.
Joseph Whitworth, F.R.S.
G. Carey Foster, F.R.S., President of the Physical Society.
Balfour Stewart, F.R.S.
R. B. Clifton, F.R.S., Professor of Experimental Philosophy, Oxford.
W. F. Barrett, Prof. Physics, Royal College of Science, Dublin.
J. Norman Lockyer, F.R.S.
Francis Galton, F.R.S.
J. Cameron, F.R.S., Major-General, Director Ordnance Survey.
M. Foster, F.R.S.
E. A. Schäfer.
B. Samuelson, M.P.
E. Klein, F.R.S.
W. N. Hartley.
Francis Guthrie, LL.B.
P. Martin Duncan, F.R.S., President of the Geological Society.
P. L. Sclater, F.R.S.
J. E. Davis, Capt. R.N., Hydrographic Department, Admiralty.
H. Dent Gardner.
John Allan Brown, F.R.S.
William Hackney.
Ettrick W. Creak, Staff Commander, R.N.
W. H. Preece.
W. Chandler Roberts, F.R.S.
A. B. Kempe, B.A., Barrister-at-Law, Western Circuit.
Alex. Crum Brown, Professor of Chemistry, Edinburgh University.
James Dewar, Professor of Mechanism, Cambridge.
Urban Pritchard, M.D.
R. H. M. Bosanquet, M.A., F.R.A.S., F.C.S., Fellow of St. John's College, Oxford.
Sydney H. Vines.
Alfred E. Fletcher.
Herbert M'Leod, Prof. of Experimental Science, Indian C.E. College.
Alex. B. W. Kennedy, C.E., Prof. Engineering, University College.
Arch. Geikie, F.R.S., Director, Geological Survey, Scotland.
Cornelius B. Fox, M.D., F.M.S.
Nicholas Brady, M.A.
Thomas Stevenson, F.R.S.E., F.G.S., M. Inst. C.E.
John Jellett, D.D., F.R.S.
Thomas Pigot, Prof. Engineering, Royal College of Science, Dublin.
J. P. O'Reilly, Prof. Mineralogy and Mining, Royal College of Science, Dublin.
T. Lauder Brunton, M.D., F.R.S.
J. E. H. Gordon.
W. Galloway, Prof. Chemistry, Royal College of Science, Dublin.
Henry E. Armstrong, F.R.S.
Thomas Andrews, LL.D., F.R.S., President of the British Association.
James Thomson Bottomley, M.A., F.R.S.E.
W. F. Donkin.
Claude R. Conder, Lieut. R.E.
Charles E. De Rance, F.G.S., H.M. Geological Survey.
Nathl. Barnaby, Chief Constructor of the Navy.
W. Topley.
J. Clerk Maxwell, F.R.S., Prof. of Experimental Physics in University of Cambridge.
G. G. Stokes, Sec. R.S. Lucasian Professor, Cambridge.

NOTES

THE current number of the *Fortnightly Review* contains an article by Dr. Bridges, in which he tries to prove that Harvey did not discover the circulation of the blood by vivisection. Harvey's own statements are so explicit, and the methods he employed have been so often expounded, that there is little new to be said on the point. Harvey, as Dr. Bridges admits, discovered the true functions of the heart, and inferred the existence of the complete systemic circulation by observations on living animals, interpreting the facts observed by aid of the faculty of reasoning. Malpighi demonstrated the capillary part of the circulation by other observations on living animals, dealing with his new facts by aid of the same faculty. But to say that the movements of the heart were discovered by vivisection and the brains of Harvey, but the circulation of the blood "by the microscope of Malpighi" is as absurd as to ascribe the glory of the former discovery to Harvey's scalpel and that of the other to Malpighi's brains.

THE following are the numbers of visitors to the Loan Collection of Scientific Apparatus during the week ending July 15:—Monday, 3,464; Tuesday, 3,300; Wednesday, 602; Thursday, 495; Friday, 451; Saturday, 3,403; total, 11,715. During the present week 13 demonstrations of apparatus were given on Monday, 11 on Tuesday, 5 on Wednesday; 6 are to be given to-day, 5 on Friday, and 5 on Saturday.

THE annual meeting of the Helvetic Society of Natural Sciences will take place at Basle, on August 20–23. Scientific men of all countries are cordially invited to the meeting; and those who wish to make any communication are requested to write, before August 1, to Dr. H. Christ, 5, Bäumleingasse, Basle.

THE Scientific Societies of Belgium held their first united Congress at Brussels this week, from the 16th to the 18th. The following, we learn from the *Society of Arts Journal*, are some of the subjects which have been discussed:—Greater facilities for the transmission of scientific objects; as to the opening of public scientific institutions at convenient hours, and especially in the evening; the organisation of libraries and scientific collections in the towns and communes; the publication of elementary treatises on various branches of science; establishment at one of the littoral towns of a collection of works concerning the coast; a study of the geological formation of the district round Brussels; the part played by molluscs in nature; the malacological zones of Belgium. On the 18th there was to be a scientific excursion into the environs of Brussels.

AT a meeting of the Council of the Yorkshire College of Science, held last Friday, an offer by Mr. George Salt, of 150*l*. a year for three years as a temporary provision for a professorship of Biology, was accepted, Mr. Salt's stipulation that Mr.

L. C. Miall, F.G.S., be appointed professor being also agreed to. Mr. Miall will also deliver a short course of lectures annually at Bradford.

WE rejoice to hear that *L'Explorateur* was mistaken in announcing the death of Dr. Petermann. The French journal seems to have been led astray by the death of Prof. A. H. Petermann, the distinguished orientalist.

ON Saturday, July 8, the French and Swiss Alpine Clubs met together at Giromagny, to ascend a number of mountains in the French Vosges; a number of interesting observations were made.

THE Awards made by the Council of the Institution of Civil Engineers for original communications during the Session 1875-76, have just been announced. Fifteen out of twenty-three communications have been rewarded, including a Telford medal and premium for "Motion of Light Carriers in Pneumatic Tubes," by Prof. W. C. Unwin, B.Sc. Telford premiums have been bestowed for "Movement of Air in Pneumatic Tubes," by C. Bontemps; "Pneumatic Transmission of Telegrams," by R. S. Culley and R. Sabine; "Floods in England and Wales in 1875," by G. J. Symons; "Evaporation and Percolation," by C. Greaves; "Tidal Changes in the Mersey," by J. N. Shoolbred, B.A. The Miller Scholarship of the value of 40*l.* a year for three years was gained by the Hon. R. C. Parsons, B.A., for an inquiry into the "History and Theoretical Laws of Centrifugal Pumps."

MR. W. VIVIAN, of Mwyndy, Llantrissant, Glamorganshire, sends us the following instance of a joint-stock concern in the poultry yard. Two hens sat on, or by, one nest, and thus between them hatched one chick. They have since, for some weeks been parading the yard, each clucking and manifesting all the anxiety and care of a true mother over this one. The hens never quarrel, or show the least appearance of jealousy or rivalry.

A MEETING of the West Riding Geological and Polytechnic Society was held at Settle on Wednesday week. The meeting was well attended, and Mr. Tiddeman gave an excellent address on the history, method of working, and the results that have been brought to light by the exploration of the Victoria Cave, Settle.

FURTHER particulars have been published concerning Gessi's circumnavigation of Lake Albert Nyanza. He found it 140 miles broad by 50 wide. No river of importance enters it, the south end is shallow, and the lake seems subject to violent storms. The true Nile, after leaving the lake south of Duflé about 100 miles, splits into two branches, one of which goes to Duflé and Gondokero, the other, the natives say, goes far inland. Colonel Gordon had no news of Stanley on May 2, but expects he went across from Victoria Lake, saw the south end of Albert Lake, and has got into a nest of lakes, which, Colonel Gordon thinks, exist between the Albert and the Tanganyika.

WE have received the Proceedings of the American Oriental Society for May and November, 1875, and May, 1876. At these meetings many valuable papers on the department with which the society is connected, were read; among these is one by Prof. W. D. Whitney replying to some criticisms of his work by Prof. Max Müller.

THE Paris Society of Agriculture and Insectology has asked from the Municipal Council of Paris, whose zeal for instruction is laudable, the grant of a piece of ground at Montsouris for the purpose of establishing a model apiary, a botanical collection of all plants likely to be of use in feeding bees, a model establishment of sericiculture, and a collection of all trees likely to be of use in feeding silkworms. The request is to be granted on condition that the establishment be open free to the pupils of the several municipal schools.

SATISFACTORY accounts are given of the boring of the shaft for the Channel Tunnel. A depth of 80 yards has been reached, and no fault has been observed from which any difficulty may be expected in the execution of the Tunnel.

VIOLENT shocks of earthquake were felt again on the 5th inst. at Corinth and the surrounding district. The direction of the motion was east to west. Shortly after noon on Monday an earthquake occurred in Vienna. Three violent shocks, lasting two seconds, were felt. A panic ensued. Several houses are damaged, and a portion of the old walls has been split.

WE have received the Forty-second Annual Report of the York School Natural History, Literary, and Polytechnic Society. This must surely be the oldest School Society in the kingdom. The Report, of only four pages, shows that a considerable amount of work has been done in the various departments with which the Society deals, and we should think that the Society is an important element in the educational means of the school.

THE Twelfth Annual Report of the Lewes and East Sussex Natural History Society states that the Society is numerically and financially in good condition. The Society is doing a fair amount of good field-work, and contemplates the publication of lists of the fauna and flora of East Sussex.

THE *Geographical Magazine* for July contains a paper, with maps, by Mr. Ravenstein, exhibiting some interesting conclusions as to the birthplace and migrations of the populations of the British Isles, drawn from the census tables. The magazine also contains some important statistics on Danish Greenland, furnished by Dr. Rink, a paper on the Andaman Islands, an account of Schweinfurth and Güssfeldt's recent journey into the Arabian Desert of Egypt, and a vindication of genuineness of Verrazano's narrative, by Mr. R. H. Major.

THE Municipal Council of Paris has voted, in accordance with the suggestion of M. Leverrier, a sum of 30,000 francs for the purpose of constructing precision clocks at the Exchange, Tribunal de Commerce, and Hôtel de Ville. A competition will be opened between the clock-makers. All these clocks are to be connected together electrically, and will distribute the time to the several parts of the city. The perplexing discrepancy between the different public clocks in Paris will be abolished entirely.

A MEETING was held on Tuesday in connection with the proposal to establish a Museum of Hygiene at University College, London, as a memorial to the late Dr. E. A. Parkes, F.R.S. Subscriptions to the amount of 675*l.* were announced.

MR. PRESCOTT G. HEWITT, F.R.S., has been elected President of the Royal College of Surgeons for the ensuing year, in room of the retiring President, Sir James Paget.

AT a recent meeting of the Paris Academy, M. Woillez described an apparatus which he calls a *spirophore*. It is for the resuscitation of asphyxiated persons, especially those who have been in danger of drowning, and newly-born infants. It consists of a sheet-iron cylinder, closed at one end. The body of the individual is introduced up to the neck, the aperture round which is then closed by a diaphragm. A strong bellows, containing more than 20 litres of air, situated without the case, communicates with this by a wide tube, and is worked by a lever, the descent of which causes the air to be drawn off from the case, while the return motion restores the air. Through a piece of glass in the cylinder, the chest and abdomen of the patient can be seen, and a rod, movable in a vertical tube, rests on the sternum. When a vacuum is made about the body by depressing the lever, the external air penetrates into the chest, the walls of which rise as in life. They return to their former position when the lever is raised, and these respiratory movements may be repeated fifteen to eighteen times a minute, as in a living man. By means of a tube communicating with a reservoir, and inserted in the windpipe, M. Woillez found that a litre of air, on an average, entered the air passages at each artificial inspiration, whereas the physiological average is only a demi-litre. Thus, more than a hundred litres of air can be passed through the lungs of an asphyxiated person in ten minutes. There is no danger of rupturing the lungs, however strongly the lever be wrought, for the force of penetration of the air is never superior to the weight of the atmosphere.

THE direction of plant-growth, it is known, is determined both by light and by gravity. The geotropism, or action of gravity exclusive of light has before been examined; and recently M. Müller (Thurgau), we learn from *Flora*, has endeavoured to study the converse fact of heliotropism, by excluding the influence of gravity as far as possible. He grew his plants in a cylinder rotating about its horizontal axis. The apparatus was so arranged that the light, coming through an aperture in the shutter of a dark room, fell parallel to the axis; the bendings observed were thus purely heliotropical. Among other results he found that only those zones which were not fully grown out, showed heliotropic bendings; that the most strongly growing parts of the stem were most sensitive to one-sided illumination; that the bending takes some (variable) time to manifest itself and continues some time after removal of the cause; that the rate of bending is at first slow, gradually increases to a maximum, and thereafter diminishes; that the bending is greater the intenser the light, &c.

IN the *Upsala Universitets Arsskrift* for 1874, Dr. Hamberg gives a most interesting paper, illustrated with eight coloured maps, on the night-frosts which have occurred in Sweden during 1871–72–73, from May 20 to September 30, or during that portion of the year of most interest to agriculturists. The observations of 285 Swedish observers are elaborately discussed, from which it appears that 80 per cent. of these frosts occur with northerly winds on the day preceding and on the days following them, but that during the night of the frost either the wind is very light or the air is calm. The map exhibiting the distribution of the spring frosts shows an abnormal excess on the south or lee side of the great lakes, arising, in all likelihood, from the low temperature of these lakes in spring. In autumn, on the other hand, when the temperature of the lakes is high, no such excess of frosts occur over the region south of them. One of the most striking results is the relatively small number of frosts over the district immediately to the north of Lake Wener, a result which may be due to the remarkable deflection of the wind in summer over this part of Scandinavia, so that winds are there south-westerly when they are north-westerly and westerly on the west of Norway. Six of the maps show well the intimate relation existing between the frosts and areas of high barometric pressure, and suggest that, if desired, the telegraph might be employed to give warning of these frosts, which are so destructive to vegetation.

THE *Supplemento alla Meteorologia Italiana* for 1875, fasc. iii., is entirely occupied with an exhaustive discussion of the temperature of Modena, by Prof. Ragona, director of the Royal Observatory there, based on the observations of the twelve years ending 1874. Among the more interesting points discussed with considerable fulness, are the anomalies of temperature which have occurred during the twelve years, particular attention being given to those anomalies which show a tendency to recur about the same dates from year to year. The prevailing winds at Modena are west and south-west from November to February and north-east during the other months, and the changes of these winds is a point of the greatest importance in their relations to the anomalies of temperature which accompany them. Fasc. iv. contains an account by P. A. Serpieri, director of the Observatory of Urbino, of the earthquake which occurred in the night of March 17–18, 1875; and a notice, by Almerico da Schio, of the stations established, or in the course of being established, in the province of Vicenza, for meteorological observations, or for observations of rainfall, of weather, or of the depth of the rivers. Upwards of sixty such stations are indicated on the map of the province accompanying the paper.

Two important publications, constituting Nos. 5 and 6 of the *Bulletin* of the U.S. National Museum, by Mr. G. Brown Goode, Assistant Curator of that establishment, have lately been published by the Interior Department. The first, a catalogue of the fishes of the Bermudas in the collection of the museum, gives the first complete account of the ichthyology of that portion of the world. These were principally obtained by Mr. Goode during a visit to the islands in the months of February and March, and are notes on the character of the species, containing many important facts in regard to their natural history. Seventy-five species in all were actually obtained, and the existence of others determined, but not established by specimens. A chief value of the paper is in the description of the colours of the fish while living, and the notes on their size and hints on their popular names, their capture, and economical value. The second publication was prepared by Mr. Goode as a classification of the collections made by the Smithsonian Institution and the United States Fish Commission for the Centennial Exhibition at Philadelphia.

THE additions to the Zoological Society's Gardens during the past week include two Royal Pythons (*Python regius*) from West Africa, presented by Mr. J. J. Kendall; a Greater Sulphur Crested Cockatoo (*Cacatua galerita*) from Australia, presented by Mrs. Baliol Scott; two Striped Hyænas (*Hyæna striata*), an Alligator (*Alligator mississippiensis*) from North America; two American White Cranes (*Grus americana*) from North America; a Green-winged Trumpeter (*Psophia viridis*) from Brazil, purchased; three Shoveler Ducks (*Spatula clypeata*) hatched in the Gardens.

SCIENTIFIC SERIALS

Journal of the Chemical Society, April.—A paper on oxynarcotine, a new opium educt, and its relationships to narcotine and narceine, is contributed by Dr. Wright and Mr. G. H. Beckett. This new body is obtained from an indistinctly crystalline mass, which, during the preparation and purification of narceine from opium liquors, is often left undissolved on boiling the partially purified narceine with water. This crude product contains the new opium alkaloid, bearing to narcotine the relationship of benzoic acid to benzoic aldehyde.—Dr. H. E. Armstrong and Mr. George Harrow contribute two papers: one on the action of potassic sulphite on the haloïd derivatives of phenol, the other on the action of nitric acid on tribromophenol. The length of the chemical names made use of in these papers is positively alarming, *e.g.*, dichlorophenolorthosulphonate and diorthobromoparanitrophenol.—Mr. Cornelius O'Sullivan contributes a paper on maltose, which is intended to show that maltose, obtained by the action of malt-extract on starch, is a simple body, isomeric with cane-sugar, and not a mixture of dextrin with dextrose, as M. Bondonneau, in a note recently presented to the Academy, regards it.—Mr. M. M. Pattison Muir, F.R.S.E., gives a method of estimating bismuth volumetrically. Potassium chromate or potassium dichromate solution is run into a nearly neutral solution of bismuth nitrate until the whole of the metal is precipitated in the form of chromate. The final point of the reaction is determined by the formation of red silver chromate, when a drop of silver nitrate is brought into contact with a drop of the supernatant yellow liquid.—Mr. Thomas Fletcher gives a brief note on a simple form of gas regulator, differing only in form from one described by Mr. Page in the January number of the *Chem. Journ.* for 1876.—Mr. Thomas Carnelley, B.Sc., F.C.S., contributes a paper on high melting-points, with special reference to those of metallic salts. The author describes a new method which he proposes for determination of high melting-points, and the results of his investigations by this new method. The principle of this new method is as follows:—In a platinum crucible a small quantity of a salt is placed, and the crucible suspended in the flame of a Bunsen's burner or of a blowpipe. If the temperature at which the salt fuses is not above a certain point, the temperature of the crucible after a time reaches that point. If, at the instant the salt is seen to melt, the crucible be dropped into a known weight of water of known temperature, and the rise in temperature noted, from the equation for specific heats, we obtain the initial temperature of the crucible at the time the salt melted, and hence the temperature at which the fusion occurred, assuming that the mean temperature of the crucible is the same as that of the salt at the moment of melting.—Numerous abstracts of papers published in other journals, together with a full account of the anniversary meeting of the Chemical Society, complete the contents of this number.

American Journal of Science and Arts, June.—We have here some interesting observations on Saturn, made by Mr. Trouvelot during the last four years with the refractors at Harvard, Washington, and Cambridge Observatories. He notes, *inter alia*, some singular dark angular forms on the inner margin of the first ring, outside the principal division of the rings; it seems due to a jagged conformation. The three outer rings have shown a mottled or cloudy appearance on the ansæ; the cloud-forms at some parts attain different heights, and change their relative positions. The dusky ring is not transparent throughout, as has been supposed; and it grows more dense as it recedes from the planet, so that, at about the middle, the limb of the planet ceases entirely to be seen through it; further, the matter of this ring is agglomerated here and there into small masses.—The "1474" line, which is reversed in the spectrum of the solar corona, coincides with one of the short lines in the spectrum of iron. It appears in ordinary spectroscopes like a fine hard black line; but in lately examining this part of the spectrum with a diffraction spectroscope armed with a silver glass "gitter platte" of 8640 lines to the inch, Prof. Young found the line to be unmistakeably double. The more refrangible line he regards as the real corona line; the other belonging to the spectrum of iron. —Mr. J. Lawrence Smith, in a paper on carbon compounds in meteorites (here concluded) arrives at some important results. The phenomena of the graphite nodules are very puzzling; the presence of such substances as free sulphur, and a hydrocarbon in the interior of the graphitic concretions was certainly not to be expected. We now know of celestial carbon (Mr. Smith says) in three conditions, viz., in the gaseous form as detected by the spectroscope in the attenuated matter of comets; in meteorites in the *solid* form, impalpable and diffused through pulverulent masses of mineral matter; also in the *solid form, but compact and hard*, like terrestrial graphite, and imbedded in metallic matter, that comes from regions in space.—From experiments on the diminution of the minute distance between two surfaces in contact, with the increase of the contact pressure (the substances being iron, brass, and plate glass), Prof. Norton found that the diminutions were very nearly the same, whatever the nature or condition of the surfaces in contact; that they were nearly independent of the extent of the surface in contact; and that the diminution of contact-distance for an increase of one ounce in the pressure, was nearly inversely proportional to the pressure.—Mr. Carey Lea describes experiments on the sensitiveness of silver bromide to the green rays as modified by the presence of other substances. Finding no red substance capable as such of increasing this sensitiveness, and on the other hand, many colourless substances which have that effect, he is confirmed in the opinion that there is no relation between the colour of a substance and that of the rays to which it increases the sensitiveness of silver bromide.—We further note a translation of M. Hartt's first report on the geological survey of Brazil, a paper by Mr. King on palæozoic divisions on the fortieth parallel, and an account of a nebula photometer, by Mr. Pickering.—Prof. Marsh describes some new fossil birds.

Archives des Sciences Physiques et Naturelles, Feb. 15.—From researches on the specific heats of saline solutions, described in this number, M. Marignac concludes that the specific heat depends not solely on the nature of the acids and bases of the salts; so that one cannot calculate it from their composition. It may be modified by other causes special to each salt, and the nature of which is still unknown. These causes do not seem to be connected with the greater or less tendency of salts to combine with water and form definite crystallisable hydrates.—It is a disputed point among physiologists whether fat is a product of decomposition of albumen. M. Secretan here describes an investigation on the subject His experiments were on albumen decomposed in current water, and in the ground. He considers that the transformation in question is improbable, and accepts Orfila's theory, that the fat of dead bodies is only formed where there is already fat present, and an azotised matter.—In a paper on the constituents of woman's milk and cow's milk, M. Lachenal finds that the latter is richer in nitrogen, and consequently in albumenoid substances than the former, in the proportion of 3·51 to 2·53. After coagulation, the serum of cow's milk no longer contains either caseine or albumen, whereas the serum of woman's milk holds in solution a quantity of albumenoid matters which may be estimated at a half of the nitrogenised substances of the milk.—M. Gillieron studies the traces of ancient glaciers of the valley of the Wiese in the Black Forest.—In a reply to M. Soret, on the temperature of the sun, M. Violle describes some interesting observations on the radiation from incandescent steel.

SOCIETIES AND ACADEMIES

London

Royal Society, May 18.—"Note on a Simultaneous Disturbance of the Barometer and of the Magnetic Needle," by the Rev. S. J. Perry, F.R.S.

Linnean Society, June 15.—Prof. Allman, president, in the chair.—Prof. Rolleston read an interesting paper on the prehistoric pig of Britain, illustrating this by a series of skulls of species, wild and tame.—Dr. Masters followed by remarks on the superposed arrangement of the parts of the flower. The alternate arrangement in the parts is so general that exceptions are invested with peculiar interest. "Alternate" and "superposed" the author used in preference to the term "opposite," and he stated superposition exists in a large number of very diverse families. He then gave instances of apparent or false superposition in certain of the cultivated varieties of Camellia, &c. Real superposition may arise from (1) superposition of whorls, exemplified in the monstrous Daffodil (*Narcissus Eystettensis*; (2) spiral arrangement of parts, *e.g. Sabia*; (3) enation, chorisis, between which it seems necessary to draw a distinction, although the differences in the adult flower may not be always obvious (in chorisis the original organ is repeated, in enation the process is subsequent to the first stages of development, example scales before the petal in *Silene*); (4) abortion or suppression of intermediate whorls, *e.g*, Vine, &c.; (5) pleiomery, when numbers of successive whorls are unequal, some of the additional parts become superposed *Nigella* cited; (6) substitution of one organ for another, in *Zanthoxylum*; (7) torsion of the axis, either between two successive whorls or of constituent elements of whorl, exemplified in leaves rather than flower.—Dr. Masters then drew attention to illustrations of the relative position of the perianth and andrœcium in genera of the *Tiliaciæ* and *Olacacæ*.—A paper by Dr. J. Anderson on the skeleton and feathering of the spoon-billed sandpiper (*Eurynorhynchus pygmaeus*) was read, and Mr. E. Harting in exhibiting skins of this rare Indian bird and its allies, made remarks thereon. Dr. Anderson shows that, excepting deviation in the bill, *E. pygmaeus* in detail agrees with the genus *Tringa*.—Mr. W. Archer gave a summary of a paper of his on the histology and development of the genus *Ballia*. The material for research was furnished partly by the *Challenger* and partly by the Transit of Venus expeditions, and obtained in Kerguelen's Land. The author found that the septa separating contiguous cells contained circular "pits" which were closed by plano-convex "stoppers," the purpose of which is difficult to determine. The pits do not communicate and the pair of stoppers, easily disturbed from their positions, resemble a rivet passing through the septum. He further described the peculiar manner in which the cells of the rachis are jointed together, the mode of development of the branches, the origin of the cortical investment of confervoid filaments, and tantamount modifications in nearly-allied species.—A second communication of Mr. Archer's was on fresh-water algæ collected by Mr. Moseley in Kerguelen's Land.—Prof. Duncan then delivered an oral epitome of a joint research by himself and Major-General Nelson, R.E., on some points in the histology of certain species of Corallinaceæ. Quekett, about 1851, gave a good account of the minute textural peculiarities of the hard structures of corallines generally, and in 1866 Rosanoff published a memoir on the Melobesiæ, therein bringing to light many details of the softer structures omitted by the former. Major-General Nelson and Prof. Duncan now supplement the foregoing by further microscopic investigations on the living forms of Bermuda and Britain. On the shores of the former island the high and constant temperature conduces to a development and growth of the corallines not witnessed on our own sea-board, and the colours, moreover, are rich in proportion; for these and other reasons a more complete study of their development and physiology has been made. Starting from Quekett's and Rosanoff's labours, the recent researches show the presence of remarkable filamentous appendages to the dermal layer, which latter is composed of a loose cellular envelope, permitting the existence of large sub-dermal areas. The interior more aggregated cellular substance has certain radiating fibres running through, and which are modified at the joints. The growth of the cell-structure, semilunar bodies developed in the primordial utricle, the manner in which the deposition of carbonate of lime takes place, and other interesting facts, the authors elucidate and place on record.—Mr. R. B. Sharpe, in exhibiting a collection of birds from South-east New Guinea, collected by the Rev. S. McFarlane, and now deposited in the British Museum, pointed out that most of the forms had already been obtained by former travellers, though one species, *Graucalus augustifrons*, was new to science, as probably was a Bird of Paradise, so injured, however, as to prevent a correct description being made. The nest of a Bower-bird was also commented on.—A memoir on the Oxystomatous crustacea, by Mr. E. I. Miers, was taken as read, also two papers on New Zealand Ferns, by Mr. J. H. Potts; and notes on algæ collected by Mr. Moseley, of the *Challenger* Expedition, by Prof. Dickie; besides a paper by the Rev. J. M. Crombie, on lichens from the Island of Rodriguez, obtained by Dr. I. B. Balfour, 1874.—In an additional note relative to the Norwegian Lemming, Mr. W. Duppa Crotch referred to some recent information obtained supporting his formerly expressed views.—In the form of an oral abstract, Mr. S. H. Vines gave a lucid account of some late experiments and chemico-physiological investigations of his into the nature of the digestive ferment of *Nepenthes*. In the Pitcher-plant, at least, he pretty clearly proves that a secretion and other phenomena equivalent to the digestive process of animals obtains.

Anthropological Institute, June 27.—Col. A. Lane Fox, F.R.S., president, in the chair.—The election of two new members was announced.—Mr. Walhouse exhibited arrow-heads from Southern India, closely resembling forms met with by Lieut. Cameron in Central Africa.—Remains of red deer, wolf, with portions of a human skull, from the foundation of the Bath gas-works, were exhibited by Miss A. W. Buckland.—Mr. Hyde Clarke read a paper on serpent and siva worship and mythology in America, Africa, and Asia. The first part of the paper was devoted to an account of the Bribri and other Indians of Costa Rica in Central America, and of the immediate relations of their languages to those of Western Africa. This furnishes another connection of language besides the Carib with the Dahomey, the Guarani with the Agan and Alkhass, and the Quichua, Aymara and Maya, with Accad and Cambodian. The rest of the paper was devoted to trace the Central American one god Sibu, and his mythology to the old world. This word, as Sowo and Nebo, is in company found with Kali in West and Central Africa, over a wide area, representing god, spirit, idol, navel, &c. It was then illustrated with Siva and Kali, and the cosmogony and serpent worship in India; and further with Nebo in Babylonia, Seb in Egypt, Seba in Arabia and Phrygia. The title Sabaoth was referred to. The American legend appeared to point to a unity of God in the prehistoric epoch.—Mr. Park Harrison described marks found last summer on the chalk at Cissbury, some upon the walls of the galleries, and the remainder on rounded pieces of chalk.—Dr. Gillespie read a short note on the use of flint cores as tools.—The remaining papers were "on the term Mediterranean," as applied to a part of the human race; and a minute account of the Javanese, Mr. Kuhl.

Physical Society, June 24.—Prof. G. C. Foster, president, in the chair.—The following candidates were elected members of the Society:—Prof. James Dewar, F.R.S.E., and the Hon. F. A. Rollo Russell.—Prof. Guthrie showed the action of Prof. Mach's apparatus for exhibiting to an audience the effect of lenses on a beam of light passed through them. It consists of a long rectangular box with glass sides, in which are several movable lenses. A parallel beam of light falls on a grating at one end of this box and is thus split up into a number of small beams, which are rendered visible by filling the box with smoke. After passing through the first lens the rays fall on a movable white rod, which may be placed to indicate the focus. The light then falls on another lens partly covered with red and partly with blue glass in order to more precisely exhibit the paths of the rays.—Baron Wrangell exhibited the apparatus employed by Petrochovsky in his magnetic experiments. These experiments had reference to (1) normal magnetisation, (2) the measurement of the distance of the poles of a magnet from its ends, and (3) a thermo-electric apparatus. The determinations were very much simplified by employing a unipolar magnetic needle, formed by bending a small bar magnet at right angles at about a quarter of its length from one end. The needle is then suspended by a fibre attached to the end of the short arm, and the longer arm is maintained horizontally by a brass counterpoise weight. It will be evident that as one pole is in the axis of rotation, it cannot have any effect on the motion of the needle. By turning up each end in this manner the moment of the magnet may be ascertained without knowing the exact positions of the poles. If a magnetic needle be so placed that a bar magnet parallel to it has no effect in deflecting it from the meridian, and the bar be then struck with a brass hammer, the state of equilibrium will be disturbed, as is shown by the motion of the needle. This, however, is not the case with a piece of soft iron round which an electric current is passing. The apparatus employed in the experiments on "normal magnetisation" consisted of an arrangement for passing a current round rods of soft iron of varying lengths, so constructed that any number of the surrounding coils can be removed in the manner of an ordinary rheostat. After the current has been passed round the bar, it is moved until its residual magnetism has no effect in deflecting a delicate unipolar needle from the meridian. The current is then passed round it, and the coils are adjusted until the magnetised bar has still no effect on the needle. The effect of the coils themselves is counteracted by means of a subsidiary coil. When the current is thus adjusted, the bar is said to be "normally" magnetised, and M. Petrochovsky has ascertained that this condition is satisfied when the length of the coil is 0·8 times that of the bar, and this is independent of the strength of current. This, then, is the only case in which the position of the poles is the same as when the bar is charged with residual magnetism. For the determination of the positions of the poles of a bar magnet a somewhat complicated apparatus was employed. A large unipolar magnet about eight inches in length, provided with a bifilar suspension, was enclosed in a glass box. A fine silver wire was stretched parallel to the axis of the needle between two projections on it, and it also carried a fine index at the horizontal end. The wire is focussed in a telescope which can be made to travel along rails parallel to the magnet, and the index at the end can be observed by another telescope. A small magnet at right angles to the large magnet can be moved with the first telescope, and the point at which its effect in deflecting the unipolar is the greatest is ascertained by varying its position parallel to itself along a graduated scale and then observing the space through which a subsidiary magnet must be moved in order to restore the unipolar to its original position, as observed in the second telescope. When this point is reached it must be exactly opposite the pole of the large magnet. It was thus found that the poles are at a distance of one-tenth of the length of the magnet from its ends. To determine the position of the poles of a horse-shoe magnet a delicate magnetic needle is placed below a fine wire in the meridian and a horse-shoe magnet is brought so that its two ends are immediately below the wire and near the needle. In the case of an electro-magnet the point at which its effect is greatest is found to vary when the coils are moved towards the ends, and is nearest to the ends when the coils project slightly beyond them. The third series of researches referred to was on the influence of an electric current on the thermo-electric action of soft iron. A number of strips of iron are connected by means of copper studs, and when currents are passed round the alternate strips it is found that the system acts as an ordinary thermopile. This question is, however, still under investigation. In reply to a question of the President, Baron Wrangell stated that the effects of increasing the number of coils in the horse-shoe magnet on the position of the poles is also still under investigation.—Prof. Barrett then made a brief communication on the magnetisation of cobalt and nickel. He has recently made some experiments on these metals with a view to ascertain whether they undergo any elongation or contraction similar to that experienced by iron during magnetisation. From this first experiment he concluded that cobalt elongates slightly, but that there is no effect on nickel, but this latter result may have been due to the fact that the metal was not absolutely pure. He has, however, obtained through Mr. Gore a fine bar of pure nickel about two feet in length, and now finds that it contracts, and that the amount of this contraction is about the same as the expansion of a like iron bar when similarly treated.—Prof. Guthrie then described some experiments on the freezing of aqueous solutions of colloid substances, which he has been studying in connection with his recent investigations on cryohydrates, &c. If a solution of sugar be gradually cooled the temperature at which ice separates out is always below 0° C., and the extent below increases with the amount of sugar in solution; but he finds that in a solution of gum having exactly the same chemical formula, the ice always separates at 0° C., whatever be the amount of gum present. Thus while every crystalline substance forms a freezing mixture when mixed with ice or snow, colloids are incapable of doing so. The gum and the water do not recognise each other: and similar results were obtained in the case of gelatine and albumen. These facts are strictly in accordance with the results of Prof. Graham's classical researches. It almost follows that, when heated, similar effects are observed, and Prof. Guthrie has found that solutions of gum in varying proportions always boil at 100° C. Mr. W. Chandler Roberts said that this important discovery was one that his late distinguished master would have welcomed, and he expressed a hope that Dr. Guthrie would continue his experiments with the series of colloids actually prepared by Graham.—Prof. Guthrie then showed the experiment by which Dr. Kerr has recently proved that glass, resin, and certain other substances exhibit a depolarising effect when under the influence of a powerful electrical tension. With the help of Mr. Lodge, Dr. Guthrie has succeeded in repeating these exceedingly delicate observations, but the effect is very slight and ill-suited for the lecture-room. A beam of polarised light traverses a thick plate of glass in which two holes have been drilled nearly meeting in the centre, and two wires are fixed in these and connected with the terminals of a powerful coil. The light after passing through the analyser falls on the screen. If now the analyser be so turned that the illumination is least before the current is turned on, the brightness of the field will be seen to increase as soon as the circuit is closed, and this brightness will increase up to a certain limit. The effect is greatest when the light is polarised at an angle of 45° to the line joining the terminals.—The President then adjourned the meetings of the Society until November.

Paris

Academy of Sciences, July 3.—Vice-Admiral Paris in the chair.—The following papers were read:—On the fermentation of urine, by MM. Pasteur and Joubert. The ferment of urea, M. Musculus considers of the class of soluble (and not organic) ferments. The authors affirm that his soluble ferment is produced by the small organic ferment of urea.—Observations on M. Pasteur's communication, and on the theory of fermentations, by M. Berthelot.—Reply by M. Pasteur.—Note on M. Cros' paper regarding photographic reproduction of the colour of bodies, by M. Becquerel.—On the carpellary theory according to the Amaryllideæ (third part: Galanthus, Leucoium), by M. Trecul.—Third note on electric transmissions through the ground, by M. du Moncel. The currents due to difference of humidity in the ground about the plates arise through difference in facility of oxidation. Those due to unequal extent of surface of the plates arise because the electric action from physical contact of two heterogeneous bodies varies with their surface of contact, and because oxidable bodies are more attacked when they present a small surface to oxidation, than when they present a large.—Examination of new methods proposed for finding the position of a ship on the sea (continued), by M. Ledieu.—New series of observations on the protuberances and solar spots.—Letter from R. Secchi (June 28). A table is given for the first six months of 1876. Few protuberances; hardly any eruption; threads of gas rising straight and vertically, and of short duration. The issuing hydrogen seems to push aside the darker layer of absorbing metals, and thus produce very small faculæ. Since March almost no spots with nucleus and penumbra. Maxima of activity in latitudes 10° to 20°, and 50° to 60°.—On a luminous phenomenon at Port Said and Suez, on June 15, by M. de Lesseps. This was a luminous globe which burst like a rocket, with loud detonations.—On the metallic nickel extracted from ores of New Caledonia, by MM. Christofle and Bouilhet.—On the mode of employment of sulpho-carbonates, by M. Jaubert.—Present state of vines subjected to treatment with sulpho-carbonate of potassium since last year, by M. Mouillefert.—Experiments on the destruction of Phylloxera, by M. Marion.—Automatic discharges for electro-atmospheric rods, by M. Serra-Carpi.—On Glaucoma and the climate of Algeria by M. Tavignot.—Studies of astronomical photography, by M. Cornu. Any telescope may be immediately adapted for it by separating the two lenses of the object-glass, by a distance depending on the glass, but rarely more than $1\frac{1}{2}$ per cent. of the focal distance. The original achromatism of the visible rays is transformed into achromatism of the chemical rays necessary for photographic images, and there is no aberration in the images.—On linear differential equations of the second order, by M. Fuchs.—On the isochronism of the cylindrical regulating spiral, by M. Caspari.—On Mr. Crookes's radiometer, by M. Govi.—On the explanation of the motion of the radiometer by means of the theory of emission, by M. de Fonvielle.—On the radiometer, by M. Ducretet.—New peroxide of manganese battery, by M. Leclanché. He compresses strongly a mixture of 40 per cent. of the peroxide, 55 per cent. of retort carbon, and 5 per cent. of gum lac resin. The depolarising mass is thus made to yield more electricity.—Action of hydracids on selenious acid, by M. Ditte.—On the decomposition of insoluble carbonates by sulphuretted hydrogen, by MM. Naudin and de Montholon.—On a new method of substitution of chlorine and bromine in organic compounds, by M. Damoiseau. This is by bringing them together in presence of animal charcoal.—On the synthesis of allantoin, by M. Grimaux.—On a new butylic glycol, by M. Nevolé.—New method of alcoometry by distillation of alcalinised spirits, by M. Maumené.—Researches on fuchsine in wines, by M. Jacquemin.—On nitralizarine, by M. Rosenstiehl.—New mineral contained in a meteorite (daubrelite), by Mr. Lawrence Smith.—On the presence of nickel in ferruginous atmospheric dusts, by M. Tissandier. This favours the idea of their cosmic origin.—Comparative micrographic analysis of atmospheric ferruginous corpuscles, and fragments detached from the surface of meteorites, by M. Tissandier.—On the physiology of the musical apparatus of the grasshopper, by M. Carlet. A special muscle distends the plaited membrane, which thus reinforces the sound. There is no tensor muscle of the timbal, and the two timbals producing the sound vibrate synchronously.—On the toxical action of methylic, cuprylic, œnanthylic, and cetylic alcohols, by MM. Dujardin, Beaumetz, and Audigé.—Anatomical characters of the blood in the anæmic, by M. Hayem. In chronic anæmia the globules are smaller, deformed, and less coloured.—Anæsthesia by the method of intravenous injections of chloral, by M. Linhart.—Lichens brought from Campbell Island, by M. Filhol, determined by M. Nylander.—On a hippopotamus with six lower incisors found in Algeria, by M. Gaudry.—On the morphology of the dental system in human races and its comparison with that of apes, by M. Lambert.

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