THURSDAY, OCTOBER 16, 1873

D'ALBERTIS' EXCURSION INTO THE INTERIOR OF NEW GUINEA

IN a preceding number of NATURE (vol. viii., p. 305) some account has been given of the new Paradise-birds and other novelties recently discovered by Signor Luigi Maria D'Albertis in the interior of New Guinea. Signor D'Albertis, who is now in New South Wales, has lately published in the *Sydney Herald* an account of his month's excursion into the interior of that *terra incognita*, from which the following particulars are taken :—

D'Albertis started from Andai, a small village about ten miles from Havre Dorey, where, along with his companion Dr. Beccari, he had been resident with a Dutch missionary. By the aid of presents to the Corono, or headman of Andai, and promises of further payment on arriving at his destination, he succeeded in obtaining the services of six natives to carry his baggage and provisions to Atam, a populous village in Mount Arfak, where there was a Corono with whom he had already made acquaintance.

An early hour on September 4, 1872, was fixed for the traveller's departure, Dr. Beccari, the botanist, proposing to remain at Andai during the absence of his companion. After crossing a small creek in a canoe, the forest was entered. Besides six natives, D'Albertis was accompanied by a Malay interpreter and the wife of one of the natives, making eight persons in all. After a short walk over level ground a steep hill was reached, and crossed by a narrow pathway, fatiguing and difficult. The forest around was mountainous and gloomy, the silence being relieved only by the deep cooing of pigeons and the hoarse voice of a black Megapode (probably *Megapodius freycineti*). One of the latter served as dinner for the day. After arriving at the summit of the hill, an hour's walk across a level forest-country succeeded, whence a descent was made to a stream of water, deliciously clear and fresh. After this, hills were again ascended, gradually increasing in height, and the road became more and more difficult. Here the Lesser Bird of Paradise (*Paradisea papuana*) was met with, and the large Crowned Pigeons (*Goura coronata*) were very numerous. At 4 P.M. a height of 1,500 feet above the sea, which was seen to the east, not very far distant, had been attained, and after a short descent an extensive watercourse, at this time nearly dry, was reached. Here natives were first encountered ; a tribe of men, women, and children, accompanied by dogs and pigs, emerged from behind the large stones of the water-course. The men were armed with bows and arrows and the *parang*, a large knife, narrowed near the handle and widened towards the extremity. Some of the men approached and were friendly and inquisitive, whilst others kept at a distance, and formed small picturesque groups about the rocks of the watercourse. The women were very timid, and also kept apart in groups along with the children. Upon inquiries through the interpreter, it appeared that these Papuans were returning from an expedition to the sea-side to procure salt. After taking leave of some of the natives, who were going in another direction, D'Albertis accompanied the others to their house, which was situated about 500 feet above the torrent. Here the forest was of the same gloomy character, but relieved by occasional clearings. At sunset a magnificent view over the harbour of Dorey and the island of Mansinam was obtained, and the birds raised their voices in chorus to salute the passing day. The house in which the night was passed contained four families. It was built on trunks of trees and entered by a long ladder. The stranger was well received, and presented with sugar canes, in return for which he gave his hosts tobacco.

The following day (Sept. 5), after some little difficulty, a start was made about 8 A.M., the chief of the house and some women accompanying the party. After descending to the watercourse passed on the previous day, the ascent of Mount Putat was recommenced, under the shade of large and umbrageous trees. At noon, the summit and village of Putat were reached, whence a fine view of the coast of Dorey and island of Mansinam were obtained. To the south-west rose some high mountains covered with dense vegetation. After an interval of repose, our traveller was anxious to depart, but was answered by the natives, that they had already arrived at Atam, and that they were not going any farther. It was not without much difficulty, and Signor D'Albertis showing them by his pocket barometer that they had not arrived at the requisite elevation of the place in question, that it was ultimately arranged that a fresh start should be made on the following morning.

The next day, accordingly, the party quitted the village of Putat, escorted by about 20 additional men, women, and children, and after descending to about 700 or 800 feet above the sea-level, commenced to re-ascend up the bed of another watercourse. About noon, a small stream of fresh water afforded an opportunity for refreshment, and at evening, after a further ascent, night-quarters were discovered in some uninhabited huts. On continuing the journey next day the party still ascended, until the summit of the mountain at an elevation of 3,600 feet was obtained. Here a halt was made in some huts similar to those used for the previous night, and Atam was visible to the west on the farther side of a deep valley. At this spot the Superb Bird of Paradise (*Lophorina atra*) was first seen, but examples were not obtained. To the south of the halting-place lofty mountains arose, considered to be 9,300 feet in height : to the east the view was impeded by thick forests of noble trees.

On continuing the journey a steep and difficult descent of about 900 ft. was made to the bed of a large river, containing more water than other streams previously passed, and said by the natives to flow into the Bay of Geelvink. After following up this river-bed for two or three miles, a rough track led away to Atam, the first houses of which were reached about 3 P.M. Here Signor D'Albertis determined to stop, being much exhausted by the journey, the latter part of which had been rendered fatiguing by the slipperiness of the paths caused by heavy rain. Next day messages were sent for the Corono or headman of Atam, who was resident higher up the mountain. D'Albertis was anxious to proceed farther himself, but his guides refused, stating that they had accomplished their agreement to bring him to Atam, and of this our traveller was satisfied, finding himself now at an elevation of 3,500 ft. above the sea-level.

Whilst waiting for the Corono, D'Albertis rambled about in the vicinity of his habitation, and found a fine young male of the Six-shafted Bird of Paradise (*Parotia sexpennis*), which had never been previously obtained except through native agency, and in imperfect condition. · Other examples of both sexes were subsequently obtained, the adult male being always found alone in the thickest parts of the forest, whilst the female and young birds are usually met with at a lower elevation. Respecting this Paradise bird D'Albertis states that it is very noisy and feeds upon various kinds of fruit, more especially on a kind of fig which is very plentiful upon the mountain ranges. To clean its rich plumage, it scrapes a round place clear of grass and leaves, where the ground is dry, and rolls itself in the dust like a gallinaceous bird, at the same time elevating and depressing its plumage, and also raising and lowering the six remarkable plumes on its head, from which it derives its specific name. On the following day (Sept. 9), D'Albertis was fortunate enough to obtain adult specimens of the Six-shafted Paradise Bird just described, and also of the Superb Paradise Bird which he had observed on his way up the mountain. The latter is found on the same mountains, and feeds upon similar fruits; it flies about from branch to branch among the trees of the forest, uttering a cry of "ni-ed, ni-ed," and from this peculiar note is named by the natives, "Niedda," while the Six-shafted Paradise Bird is called "Coron-a." After skinning his Paradise Birds, Signor D'Albertis roasted their flesh for his dinner, and found it of an excellent flavour; his meal, however, was interrupted by the arrival of the Corono and his suite. Hearing a noise at the door, he turned and saw a number of men armed to the teeth. They entered, and defiled before him in silence, laid down their arms, and arranged themselves about the room. They were all adorned with necklaces and bracelets formed of shells, whilst quantities of flowers of bright and rich colours ornamented their hair, ears, and arms. After the men, followed women and children, until the house was full; last of all came the Corono himself, armed like the others, and lavishly adorned with flowers. He was followed by his son and daughter, both albinos, with hair of a clear white colour, eyes blue, and skin very white. Having entertained the Corono with a cup of cognac, Signor D'Albertis received a present of yams, maize, and oranges in return, and was informed that he was welcome to the country. Next day he received numerous visits from natives, and made large additions to his zoological collections. Finding the locality so rich, Signor D'Albertis determined to take an adjacent house, for which a rent of 4 metres of blue calico and four brass bracelets was demanded. On September 11 possession was taken of the new habitation, and the Italian flag hoisted on the summit. The house was divided by some pieces of bark into two rooms, one of which served as a bedroom and a workshop, whilst the other was the reception-room, and also served as a kitchen. When the news spread abroad that a white man had arrived, the visits of the Papuans became very frequent. Most of them brought yams, maize, or tobacco, for which Venetian beads were given in payment. On September 13 the guides who had brought Signor D'Albertis from Andai left him to return home, taking messages to his companion Beccari, to endeavour to send up a new stock of provisions, which were running very short.

Established in his new quarters, Signor D'Albertis set to work on his collections of birds and insects, and succeeded in amassing a large number of interesting specimens. But his provisions quickly began to run short, leaving him only a small quantity of rice to subsist on together with the flesh of the birds prepared for his collections. Salt was not to be had, and powder and shot also began to fail, and endeavours to get a fresh supply of ammunition and provisions up from Andai did not succeed. In consequence of a quarrel between the Arfaks and the people of Dorey, in which one of the natives was killed, his friendly intercourse began to be interrupted. Neither women nor children brought him insects, and soon afterwards they refused to sell him yams and maize. The Corono informed him, through the interpreter, that they were expecting an attack at Atam, and intended to leave the village. This D'Albertis did not believe until they commenced destroying the plantations, when his position becoming critical from want of provisions, he arranged with the Corono to return to Andai at the end of the month.

On September 29, accordingly, D'Albertis left Atam at sunrise, accompanied by about forty persons, his health having been much improved by his sojourn in the mountain air. Returning by a shorter route, he avoided Putat, and on arriving, on October 1, at Andai, found, to his regret, that Signor Beccari had gone on to the former village, so that if he had passed through it he could have obtained a fresh supply of provisions.

During his month's residence at Atam, Signor D'Albertis obtained 122 specimens of birds, and a large collection of insects, besides some mammals and other specimens. The only part of these that have yet reached Europe is the series of birds, of which an account was given in a previous number of NATURE (vol. viii. p. 305). The mammals obtained are stated to embrace several species of *Cuscus*, one of which is believed to be new, two or three species of Tree-kangaroo (*Dendrolagus*), a *Pteropus*, a Squirrel, and several species of Mice and Bats. The Insect collection is rich in *Cetoniæ* and *Melolonthæ*.

Soon after his month's excursion to the Arfak mountains, Signor D'Albertis was compelled, by continued attacks of fever, to leave New Guinea and proceed to Sydney, in the Italian frigate *Vettore Pisano*. Dr. Bennett informs me that his health is now re-established, and that he will probably return to Europe in a few months.

This interesting narrative serves to show us that the dangers and difficulties of penetrating into the interior of New Guinea, though considerable, have been somewhat over-rated. Though Signor D'Albertis has been the first to publish an account of his adventures in this country, I believe that the naturalist Rosenberg, in the employment of the Leyden Museum, had already made an expedition into nearly the same district.* Where these two pioneers have found their way, others will doubtless

* Several of the new birds described by Dr. Schlegel, in his article on Rosenberg's collections (*Ned. Tigdschr.* iv. p. 33), were also obtained by D'Albertis, but the only locality assigned to them is "l'intérieur de la grande presq'île septentrionale de la Nouvelle-Guinée."

quickly follow, and we may thus hope to acquire, before long, a complete knowledge of one of the most wonderful floras and faunas of the world's surface.

P. L. S.

THE MOTION OF PROJECTILES

A Mathematical Treatise on the Motion of Projectiles, founded chiefly on the results of Experiments made with the author's Chronograph. By Francis Bashforth, B.D., Professor of applied Mathematics to the advanced class of Royal Artillery Officers, Woolwich, and late Fellow of St. John's College, Cambridge. (London: Asher and Co., 1873.)

WE are told in the Preface to this work that "the consideration of the motion of a projectile naturally divides itself into three parts—first, its motion in the bore of the gun; second, its motion through the air; and third, its motion during its penetration into a solid substance." The author directs his attention chiefly to the second of these parts. Galileo was the first person who determined with anything like accuracy the motion of a solid body moving through space under the action of gravity. Treating the vertical and horizontal motions as perfectly independent (which of course is in accordance with Newton's laws of motion), he showed that a particle moved in a parabola. In this theoretical investigation gravity is supposed to be constant, and to act in parallel directions, while the effect of the resistance of the air is totally disregarded. The parabolic motion is approximately true for bodies whose velocities are small, but the greater the velocity of a projectile, the more does its path deviate from a parabola, and, in the present days of large guns and heavy charges, we can at once see the importance of solving with the greatest possible accuracy the problem of the motion of a projectile through the air, considering the air as a resisting medium materially affecting the motion of the shot. Newton solved the problem of the motion of a body through a medium whose resistance varies as the first power of the velocity, and John Bernoulli extended it to the case of resistance varying as any power of the velocity.

Experiments, however, show that the resistance cannot be regarded as varying as any single power of the velocity, though, within certain limits, the third power gives pretty accurate results.

Mr. Bashforth has applied himself to the task of throwing Bernoulli's solution into a practical shape, so that by means of copious tables, of which his book contains more than 100 pages, such problems as the following may be solved:—"The 16-pounder muzzle-loading gun fires an ogival-headed shot 16 lb. in weight, and 3·54 inches in diameter. If the angle of projection be 2°, and the initial velocity 1,358 feet per second, find the trajectory and time of flight." "A Rodman shot weighing 452 lb. is fired with an initial velocity of 1,400 feet per second, at a target 500 yards off, find the striking velocity."

Experiments were made by Robins and Rumford last century to ascertain the pressure of fired gunpowder and several persons have attacked the problem during the present century. General Mayevski attempted to solve the problem by firing shot, into the back of which a rod was screwed, the rod running through an aperture in the breech of the gun, and carrying a knife edge which cut two thin wires at a given distance, the interval of time between the two breakages being measured as accurately as possible. Captain Rodman made use of the following arrangement:—A gun was mounted in a gun-pendulum, and a revolving cylinder was placed with its axis parallel to that of the gun. When the gun was fired, a tracing point on the gun drew a curve on the revolving cylinder, the shape of which curve determined the whole motion of the gun's recoil. Mr. Bashforth suggested that much greater exactness would be procured if the tracing-point were connected with the projectile. He managed to do this to some extent by firing a shot through a number of equi-distant vertical screens, made of very thin metal wires. By an ingenious arrangement, the time of the shot breaking a wire in each screen was registered by means of an electric current on a revolving cylinder, special care being taken that all the registrations should be made under the same circumstances, so as to eliminate what we might call the personal error on the different registrations. This gave the times of transit of the shot over the successive intervals between the screens: from them, the velocities at the different screens can be calculated with great exactness, and also the resistance of the air on the shot. Mr. Bashforth has made great numbers of experiments with shots of different shapes and sizes, fired with different charges of powder, and from them has with great labour calculated the tables above referred to, which are sufficient for the solution of the problems we have given above as examples of what Mr. Bashforth has been able to accomplish.

The work is one which is too mathematical to do full justice to in our columns, but we have no hesitation in recommending it to such artillerists as are not unacquainted with mathematical analysis.

OUR BOOK SHELF

Half-hours with the Microscope. By E. Lankester, M.D. (Hardwicke.)

THIS excellent and well-known little work would scarcely require to have special attention now drawn to it, if it were not that the present edition contains an additional chapter, which adds much to its value as a text-book for amateurs. Until now the subject of polarised light has been omitted, and as the many beautiful and striking results which can be obtained by its employment are among the most important and attractive in the whole field of microscopy, any work on the subject in which it is omitted must be necessarily incomplete. The author, evidently feeling this, has added a "Half-hour with Polarised Light," which he has entrusted to the hand of Mr. F. Kitton, who, in the short space allowed him, has explained the theory of this rather intricate subject in a clear and popular manner, and has described some of the most striking of the phenomena exemplified by it, such as the appearance of the slides of iodo-sulphate of quinine, asparagine and sulphate of copper in gelatin, together with the methods for arriving at them. The addition of this chapter has made this work as complete as it is useful to the commencing microscopist.

Proceedings of the Belfast Natural History and Philosophical Society. (Belfast, 1873.)

WE welcome with pleasure the first number of the Belfast Society's Proceedings, which includes a number of papers read during the session 1871-2, some of which are already known to our readers. We need only name the principal papers. There is, first, the Presidential Address of 1871, "On Motive Power," delivered by Mr. J. J. Murphy, who has also a short paper on "The Bernina Lakes;" then comes Prof. James Thomson's admirable paper, "Speculations on the Continuity of the Fluid State of Matter, and on Transitions between the Gaseous, the Liquid, and the Solid States." This is followed by two short papers, one by Dr. J. D. Everett on "The Reduction of Observations of Wet and Dry Bulb Thermometers," and another on "Recent Changes of Coast-level at Ballyholme Bay, Co. Down," by Mr. Robert Young, C.E., who has also an excellent paper on "The Duty of Preserving National Monuments." Mr. John Anderson contributes a paper on "The Geological Formation of County Down," the Rev. Dr. Macloskie a long paper on "The Silicified Wood of Lough Neagh;" and there are also one or two papers of antiquarian and social interest. Appended is an interesting obituary notice by the secretary, Mr. Taylor, of the late Mr. Robert Patterson, F.R.S., one of the founders of the Society, and who, amid the cares attendant on the carrying on of a large commercial establishment, managed to find time to prosecute to very good purpose the study of natural history, and even to write admirable zoological text-books, and take an active part in the promotion of science and of social progress. The first number is edited by Mr. Murphy and Dr. H. Burden, and we hope the Society will produce material enough to bring out an equally good number every year.

LETTERS TO THE EDITOR

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

Dr. Huizinga's Experiments

In a letter published in last week's Nature, in which Dr. Bastian comments on a short paper read by me at Bradford on certain experiments of Dr. Huizinga, he challenges me to deal with his "main proposition," which is "that Bacteria are capable of arising in fluids independently of living reproductive or ge rminal particles."

In so far as relates to the subject of my communication, I have done so by showing that in the case of Huizinga's liquid Bacteria can be prevented from arising by heating the liquid to a temperature somewhat above boiling.

I hope that Dr. Bastian will allow me to decline to enter on the general question, and will believe that in doing so I am not insensible either to the difficulties of the subject, or to the value and importance of his own experimental investigations.

Oct. 13 J. Burdon Sanderson

Experiments on the Development of Bacteria in Organic Infusions

The correspondence in your journal on this subject (relating chiefly to the statements of Dr. Bastian) in which I took a part some six or seven months since—renders it necessary, in justice to myself, and I may add, in justice to the memory of my friend, Dr. Pode, whose loss has prevented me from continuing a series of experiments on the nutrition of Bacteria, commenced in the spring—to give some account in your columns of experiments carried out by us, which demonstrate that Dr. Bastian's assertions as to infusions of turnip and turnip-cheese are devoid of foundation in fact. The paper in which our results are given in detail was sent in to the Royal Society at the end of last March and printed in May (Proceedings, No. 145). Since you are not able to afford space for the reproduction of that paper in full, I must beg to refer your readers, for details, to that publication of the Royal Society. Here I may be allowed to sketch briefly the results and their bearing on Dr. Bastian's statements. The following passage from that gentleman's "Beginnings of Life" (vol. i. p. 429) induced us to make experiments similar to those mentioned in it, with the view of testing the correctness of his conclusion as to matter of fact:—

"On the other hand, the labours of very many experimenters have now placed it beyond all question of doubt or cavil that living *Bacteria*, *Torulæ*, and other low forms of life will make their appearance and multiply within hermetically-sealed flasks (containing organic infusions) which had been previously heated to 212° F., even for one or two hours. This result is now so easily and surely obtainable, as to make it come within the domain of natural law." And in a note is added, "in a very large number of trials I have never had a single failure when an infusion of turnip has been employed; and from what I have more recently seen of the effects produced by the addition of a very minute fragment of cheese to such an infusion (see Appendix C, pp. xxxiv.-xxxviii), I fully believe that in 999 cases out of 1,000, if not in every case, a positive result could be obtained."

The extract which follows is from a paper by Dr. Bastian in Nature, vol. vii. p. 275, and is perhaps more remarkable than the preceding, because it is of later date and refers to a simple infusion of turnip.

"Taking such a fluid, therefore, in the form of a strong filtered infusion of turnip, we may place it after ebullition in a superheated flask, with the assurance that it contains no living organisms. Having ascertained also, by our previous experiments with the boiled saline fluids, that there is no danger of infection by *Bacteria* from the atmosphere, we may leave the rather narrow mouth of the flask open, as we did in these experiments. But when this is done, the previously clear turnip-infusion *invariably* becomes turbid in one or two days (the temperature being about 70° F.), owing to the presence of myriads of *Bacteria*." The italics are my own.

Dr. Pode and I give in our paper the details of 53 experiments, of which 11 were made with hay-infusion, the rest with turnip- or turnip-and-cheese infusion. We had some trouble at first in ascertaining some of the conditions under which Dr. Bastian experimented—since he does not state them in his book In the first place we ascertained through these columns the specific gravity of Dr. Bastian's turnip-infusion. We made a number of experiments after obtaining that information, which are recorded in our paper, and which invariably gave opposite results to those obtained by Dr. Bastian. At the beginning of this year we ascertained through Dr. Sanderson, in the columns of Nature, that Dr. Bastian made use of two-ounce retorts; and that particles of cheese visible to the naked eye were present in his infusions at the time of boiling. Dr. Sanderson also stated that Dr. Bastian attached importance to the peeling of the turnips used. With this additional information we made further experiments, which tend to explain the failure of Dr. Bastian to keep his infusions free from Bacterian contamination.

There are four points which require attention in these experiments, and which were attended to in our series, but we must suppose were not attended to by Dr. Bastian.

In the first place the infusions were examined by the microscope at the time of sealing the tubes, as well as subsequently. What we sought to determine was whether a change had occurred in the infusion. Spherical and other particles besides dead Bacteria occur in freshly-boiled infusions, which might lead to erroneous conclusions when seen subsequently, if their previous existence had not been ascertained.

Secondly, we employed small tubes, five inches in length and of half-inch bore. It appeared to us not at all improbable, from the results of some experiments made by us with retorts such as Dr. Bastian used, that a boiling for five or ten minutes, before closure, of an ounce of liquid in a vessel of that peculiar shape, might sometimes give a development of Bacteria, owing to the protective effect of "spluttering," and the large mass to be guarded.

Thirdly, in the majority of cases—though we had no reason to doubt the efficiency (as proved by the results) of the boiling for five minutes in one of our small tubes, *ceteris paribus*—yet, to ensure thorough exposure of every part of the tube and liquid to the boiling temperature, we submerged many of our tubes in boiling water for a quarter or a half an hour after their closure. This method we finally adopted as the most certain to ensure the destruction of Bacterian contamination; it is essentially the same as that subsequently adopted by Dr. Burdon-Sanderson in the experiments described in a letter in Nature, vol. viii. p. 141, the difference being that, "to make assurance doubly sure," Dr. Sanderson raises the temperature of the water in which his tubes are submerged above 100 C. by increasing the pressure under which ebullition is effected, beyond the normal atmospheric limit.

A fourth point to which we gave attention was the possible preservative effect of "lumps" on Bacteria or their germs. No one would have supposed that Dr. Bastian neglected the precaution of removing large particles of cheese from his experimental infusion. We always strained our cheese emulsion very carefully, or else filtered it. Prof. Cohn found that an infusion made by boiling a pea in water developed Bacteria when the pea was left in it; but if the pea were removed, and the infusion subsequently reboiled, no Bacteria were developed. We found that lumps of cheese could really act as protective hiding-places for Bacterian contamination. In a retort—similar in every respect to Dr. Bastian's—this result was first obtained, though other retorts similarly treated were barren. Accordingly we prepared twelve tubes exactly alike, with the exception that in six the cheese was added as an emulsion, in the other six in the form of lumps. The tubes were closed, and submerged in boiling water for five minutes. Of the "emulsion"-tubes, one burst in the boiling, the other five were barren; of the "lumpy"-tubes, four developed Bacteria in quantity, two remained barren.

In the experiments recorded in NATURE, vol. viii. p. 141, by Dr. Sanderson, it is shown that even when "lumps" are avoided, and the infusion heated by submergence in boiling water, this may not prevent the development of Bacteria when a large bulk of material is employed. But boiling for such a length of time as one hour, or heating to 101° C., always gave him a barren infusion. Dr. Sanderson does not believe that there is a definite relation between the precise temperature to which the infusion is exposed and the destruction of Bacterian contamination, but that the *longer* heating, or the heating to a *higher* degree, will increase the *chance* that Bacteria or their germs are destroyed. Further, Dr. Sanderson's results agree with those of Dr. Pode and myself as to simple turnip infusion. With this infusion I understand that he has not found the same length or amount of heating necessary as with the turnip infusion to which a fragment of cheese has been added.

And now, I wish very briefly to point out where Dr. Bastian's statements are affected by these results. It is necessary that this should be clearly and simply put, because I find that many persons are under the impression that the investigation of the grounds of Dr. Bastian's statements has shown that there was some solid foundation for them. This is, however, in my opinion, not the case. It is *not* "beyond all question of doubt or cavil that living Bacteria, Torulæ, and other low forms of life will make their appearance and multiply within hermetically-sealed flasks (containing organic infusions) which had been previously heated to 212° F. even for one or two hours." On the contrary, no organic nor inorganic infusion has been contrived by Dr. Bastian nor by anyone else which will develop Bacteria, still less Torulæ, after exposure for one hour (or even less) to 212° F. This is the conclusion given by the impartial examination of the subject, indicated in the experiments above quoted.

Moreover, the statement in the second quotation from Dr. Bastian is abundantly contradicted by the experience of Dr. Sanderson, Dr. Pode, and myself. Such a turnip-infusion, placed as directed by Dr. Bastian, does *not* invariably become turbid in one or two days, owing to the presence of myriads of Bacteria. We have often kept such infusions free from Bacteria for many days, and I preserved one in a retort with its beak inclined downwards for more than six months, clear as crystal, but amply capable of sustaining the life of Bacteria, as was proved by its accidental contamination a week ago.

It is my opinion that the only *positive* addition to knowledge which this inquiry about the development of Bacteria in infusions has led to is, that when you have cheese-emulsion, or similar material present in an infusion, you must be a little more careful about heating it than when you have not, if you wish to destroy by the agency of heat the life of Bacteria or their germs contained in the infusion. How it is that cheese-emulsion helps the Bacterian contamination to escape destruction we do not know. Possibly in the same way as the larger lumps do. But that matter remains for inquiry when more is ascertained as to the natural history of the Bacteria. I think we may now feel fully satisfied that "archebiosis" or "abiogenesis" is not in any way rendered more probable than it was before by Dr. Bastian's experiments with organic infusions. Prof. Smith and Mr. Archer, of Dublin—eminent authorities in the study of the lower algæ—have criticised in detail and suggested explanations of some of the statements in the third part of "The Beginnings of Life," viz., statements relating to the transformation of various species of organisms into others. They show (the reader may consult Prof. Smith's paper in the October number of the *Quarterly Journal of Microscopical Science*, 1873) that the asserted "facts" of transmutations are *not* facts. It is abundantly demonstrated that the fundamental observations recorded by Dr. Bastian are erroneous, and that he has been mistaken.

Exeter College, Oxford, Sept. 26 E. RAY LANKESTER

Variations of Organs

MY father finds that in his letter, published in your number for September 25, he did not give with sufficient clearness his hypothetical explanation of how useless organs might diminish, and ultimately disappear. I therefore now send you, with his approval, the following further explanation of his meaning.

If one were to draw a vertical line on a wall, and were to measure the heights of several thousand men of the same race against this line, recording the height of each by driving in a pin, the pins would be densely clustered about a certain height, and the density of their distribution would diminish above and below. Quetelet experimentally verified that the density of the pins at any distance above the centre of the cluster was equal to that at a like distance below; he also found that the law of diminution of density on receding from the cluster was given by a certain mathematical expression, to which, however, I need here make no further reference. A similar law obtains, with reference to the circumference of the chest; and one may assume, with some confidence, that under normal conditions, the variation of any organ in the same species may be symmetrically grouped about a centre of greatest density, as above explained.

In what follows I shall, for the sake of brevity, speak of the horns of cattle, but it will be understood that my father considers a like argument as applicable to the variations of any organs of any species in size, weight, colour, capacity for performing a function, &c.

Supposing then that a race of cattle becomes exposed to unfavourable conditions, my father's hypothesis is that, whilst the larger proportion of the cattle have their horns developed in the same degree as though they had enjoyed favourable conditions, the remainder have their horns somewhat stunted. Now, if we had made a record of the length of horn in the same species under favourable conditions, we should, as in the case of the heights of men, have a central cluster, with a symmetrical distribution of the pins above and below the cluster. According to the hypothesis, the effect of the poor conditions may be represented by the removal of a certain proportion of the pins, taken at hazard, to places lower down, whilst the rest remain *in statû quo*. By this process the central cluster will be slightly displaced downwards, since its upper edge will be made slightly less dense, whilst its lower edge will become denser; and further, the density of distribution will diminish more rapidly above than below the new central cluster.

Now, if horns are useful organs, the cattle with shorter horns will be partially weeded out by natural selection, and will leave fewer offspring; and after many generations of the new conditions, the symmetry of distribution of the pins will be restored by the weeding out of some of those below the cluster, the central cluster itself remaining undisturbed.

If, on the other hand, horns are useless organs, the cattle with stunted horns have as good a chance of leaving offspring (who will inherit their peculiarity) as their long-horned brothers. Thus, after many generations under the poor conditions, with continual intercrossing of all the members, the symmetry of distribution will be again restored, but it will have come about through the general removal of *all* the pins downwards, and this will of course have shifted the central cluster.

If, then, the poor conditions produce a *continuous* tendency to a stunting of the nature above described, there will be two operations going on side by side—the one ever destroying the symmetry of distribution, and the other ever restoring it through the shifting of the cluster downwards.

Thus, supposing the hypothesis to be supported by facts (and my father intends to put this to the test of experiment next summer), there is a tendency for useless organs to diminish and finally disappear, besides those arising from disuse and the economy of nutrition.

Down, Beckenham, Oct. 4 GEORGE H. DARWIN

Oxford Physical Science Fellowships

I WRITE this letter that in future candidates for Oxford Fellowships in Physical Science may be aware that outsiders are ineligible.

In June last the Warden of Merton College informed me that the election to a Physics Fellowship would *not* be limited to graduates of Oxford, and would altogether depend on the result of the examination held at Merton on Oct. 7. Candidates had no other information than was afforded by the notice in your columns.

Although I found that great difficulties were thrown in the way of outsiders in their not being allowed an opportunity of examining the physical apparatus which was to be used in the examination, and with which Oxford men are well acquainted, I read for the examination, not having the slightest doubt about my eligibility after receiving the Warden's letter.

It is now nearly four months since I received the letter, and although the authorities must have been very well aware of the grave error which had been fallen into, I was not informed that a blunder had been committed until the morning of the examination. It is now found by the Warden, on consulting the registrar of the university, that only Oxford graduates can compete for these Fellowships.

Oxford, Oct. 8 JOHN PERRY

Simple Method of Studying Wave Motion

IT is difficult for a student to obtain a clear idea of the movement of the particles of a liquid or gas propagating a wave. To assist him models have been devised, but as a rule they are expensive and complicated. The following plan, based on the principle of the stroboscope, I have found extremely convenient. Take a piece of cardboard about 3 ft. long and 18 in. broad. Put this into the tin drum of a "zoetrope," pressing the card well against the interior of the drum, so that it stands up forming a cardboard cylinder. With a lead pencil mark where the inside fold of card comes, and you have the right size of the cardboard to form the cylinder. Divide now the length of the cardboard into 12 equal strips. On each strip paint dots representing the wave you want to study, taking care that each wave is represented $\frac{1}{12}$ behind its predecessor. Lastly, cut out 12 slits, about 8 in. by $\frac{1}{4}$ in., between each representation of the wave; restore the card to the drum of the zoetrope, and then turning the cylinder and observing through the slits, the wave is seen, as the cylinder revolves, to advance with its characteristic motion, while by stopping out all but one of the particles represented the exact character of its oscillation, whether circular, elliptical, or linear, is clearly seen.

Midland Institute, Birmingham C. J. WOODWARD

The Glacial Period

JUST one line in reply to Frank E. Nipher. I have read Tyndall's Lectures on Heat, and that some time before I addressed you on the subject of the Glacial Period. Plainly, it is against common sense to suppose that an increased outpour of solar energy would diminish the mean temperature of the air at the earth's surface to such an extent that glaciers at or near sea level should be found in Egypt, or even, I believe, in Central Hindustan, as was the case in the Glacial Period. All I can say is, that if the sun then were a hotter sun than the sun of our own age, he must have blundered at his work.

And now may I crave space for just another line on another subject? Could not our learned societies be induced to publish their mathematical contributions separately? I was compelled to take the whole of the first part of the Royal Society's Transactions of 1867, for the sake of Clerk-Maxwell's paper on Molecules. For this I paid a guinea—willingly, indeed; but had the paper been published alone, I should probably have had it for a much lower figure. Then there are Professor Stokes' and Sir W. Thomson's magnificent papers scattered up and down among the Transactions of the Royal and Cambridge Philosophical Societies; if these were gathered together and published apart, it would be a precious boon to persons like myself who are interested in physical mathematics. And pupils of the Ecole Invariantive would, no doubt, be as much gratified by an easier access to the numerous contributions of Professor Cayley to the Theory of Determinants. Is it impossible, or even inconvenient, to afford such facilities to students and amateurs?

Hampstead, N.W., Oct 3 J. H. RÖHRS

THE OWENS COLLEGE, MANCHESTER

IT is now upwards of twenty-two years since this college was opened—for the foundation of which in Manchester, John Owens, a merchant of that city, left 100,000*l.*—in a house that belonged to Mr. Cobden, in Quay Street, which was purchased and presented to the trustees by Mr. John Faulkner, the first chairman. The number of students during the first session was 64, which went on increasing year by year, until last session the day students numbered 327, and the evening students 513. A few years ago it was felt that the original house had become much too small, and that a new building ought to be erected adequate to the increased needs of the College. Accordingly, in 1866, a circular was prepared, setting forth the disadvantages of the then institution, and propounding an extension scheme which should include the additions to the College of a school of Engineering, a Medical School, and the Natural History Museum, which the Council of the Natural History Society recommended should be deposited in Owens College, "if it should appear that the scheme for enlargement was likely to be successfully carried out within a reasonable period." The trustees therefore appealed for funds which would enable them to lay the foundations of an institution which would virtually be the University of South Lancashire, and of the neighbouring parts of Cheshire and Yorkshire.

In 1867 an Extension Committee was formed for raising a fund, which "it was desirable should not be less than 100,000*l.*, and, if possible, 150,000*l.*," to carry into effect the proposed system of extension. 24,000*l.* was almost immediately subscribed. The engineers of Manchester and neighbourhood subscribed 10,000*l.* to found and endow a chair of Engineering Science, and for the provision of an apparatus and a library. An application to the Government for a grant, though never absolutely refused, was first temporarily shelved on the familiar plea that the subject was "under consideration," and on a change of Government it was ultimately forgotten. The success of the College is therefore a monument of voluntary effort. After the present site had been purchased, the sum of 12,000*l.* was subscribed towards the new Medical School. Principal Greenwood and Prof. Roscoe subsequently visited Germany, and obtained valuable information as to the schools of science in that country; and to the plans which the Professor of Chemistry especially brought home, the new College owes the perfect arrangements in its scientific lecture-rooms, and the handsomely fitted-up laboratories for chemical and physiological science; laboratories, we believe, which are not equalled by any in the kingdom, if, indeed, in Europe.

The foundation-stone of the buildings just completed was laid by the Duke of Devonshire in September 1870, and the same nobleman occupied the chair at the opening of the new building on the 7th instant.

As is well known, the "religious difficulty" has been entirely obviated, in the case of Owens College, by the will of the founder, which requires "that the students, professors, teachers, and other officers and persons connected with the said institution, shall not be required to make any declaration as to, or submit to any test whatsoever of, their religious opinions," and that "nothing shall be introduced into the matter or mode of education or instruction, in reference to any religious or theological subject, which shall be reasonably offensive to the conscience of any student, or of his relations, guardians, or friends under whose immediate care he shall be." It is no doubt partly owing to this that the Manchester

College can boast a body of teachers not surpassed in any respect by any university in the kingdom.

The college is rich in scholarships, fellowships, and prizes founded by Manchester men, and by means of these, and its admirable system of day and evening classes, affords facilities to all classes of obtaining a literary and scientific education, both general and professional, of the highest and most advanced kind. In most respects, indeed, it may be regarded as a model institution for the higher education.

Of the many excellent addresses given on the occasion, we have only space for a few extracts from those of Principal Greenwood and Sir Benjamin Brodie. We shall take another opportunity of referring to the address of Prof. Roscoe at the opening of the Chemical School.

Principal Greenwood said :—"I am addressing the assembled students of the new year ; and it is because I feel that you are even more concerned in the inquiry than are my colleagues and myself that I ask you to consider some of the relations which subsist between culture and practical life, not as matters of speculative interest, but as bearing closely on the aims and the temper with which you should take up the studies of this place. This inquiry might take either of two directions, according as we consider the debt due from society to the student, or the debt due from the student to society. It is not possible altogether to separate these inquiries ; but it is of the latter that I propose to speak more especially this morning, not only because in addressing students, as in addressing other men, it is more wholesome to speak of their obligations than of their claims, but also because in this place and on this day, there is little need to urge the duties of society to the student.

" . . . . For us the normal principles of education, in their whole range and mutual bearings, are of infinitely greater weight than the special questions which fix attention at the moment ; but our thoughts are in danger of being drawn away from these deeper truths, and our springs of action of being in that degree weakened or perverted. An illustration of this position may be seen in the history of the vigorous and successful efforts which, within a few years, have been made in favour of the claims of the natural sciences to a leading place in the curriculum of study. Men of genius and of public spirit have insisted on them with unanswerable arguments ; and I shall not be suspected by those who happen to be cognizant of the part which Owens College has taken in this matter with any inclination to call these claims in question. I wish, however, to point out that arguments are urged in their support of very unequal force ; and that while the able leaders of the crusade dwell most on the stronger among them, their followers are wont to recur too frequently to the weaker, and by raising them into undue prominence to run the risk of inducing—not the general public only, but what is in reality a more serious thing, of inducing you and us to hold pernicious views as to what education is and what are the appropriate motives for it. Of these arguments the weightiest is, I will venture to affirm, the most seldom heard. I mean the assertion that the natural and experimental sciences have a characteristic discipline for the mind. This position may in this place be taken for granted ; and it constitutes of itself an argument at once unanswerable and sufficient. But when we hear the further argument that physical sciences should hold a prominent place in education because their promotion contributes to the material advancement of the country, or because to possess a knowledge of them will give the learner a greater command of money and what money brings, we are then offered motives of a very different order. As collateral motives they have great value, I admit, for exaggeration on one side must not be met by exaggeration on the other, but a value subordinate to that of the former consideration. It is, of course, true that all good education, through whatever medium, tends to produce good and well-furnished citizens, and therefore promotes the general, including the material, well-being of a country ; and all good sound education tends to make men manly and self-reliant, and so trains their faculties as to enable them, among other things, to win with ease their share of material good. It is true too, that in choosing the subjects of study regard should be paid, in due degree, to the destination of the future life. But when the secondary and by nature inferior aim takes the first rank, the fatal consequence follows that the higher good is not even sought in the second place. The greater may include the less, but not the less the greater.

"Another instance of harm to the business of education from the passing controversies of the hour lies in the sudden development of the system of competitive examinations. To discuss the merits of this system in itself is altogether beside my object. I wish to refer only to its oblique influence on teachers and pupils, or rather (for each of these schemes would admit of long discussion) of its influence on the temper of the student. Can anything be more deplorable—if it were not deplorable it would be grotesque—than the change which this system threatens to bring about in the mutual relations of study and examination ? By the old theory the business of education was—first, the discipline of the intellect by means of the arts and sciences as instruments ; and, secondly, the storing of the mind with methodical knowledge gained in the process. Examinations were but the handmaid of the teaching, designed to test and measure the results of study, and so to correct its methods ; and if honours and more substantial rewards were conferred on those who took the foremost places, this was partly to stimulate the flagging, and enable the more promising wits to prolong their season of study, and partly that public or academical offices might be filled by the fittest occupants. . . . Now, however, men are almost tempted to think that the public service exists for the sake of the sharp-witted or the industrious, and not they for it. 'La carrière ouverte aux talens,' once the stirring motto of an indignant people, has become a circumlocutory and more decorous version of the frank maxim of ancient Pistol—

'The world's mine oyster,
Which I with sword will open.'

" . . . We are now prepared to answer the question which I wish to propose : What were the conditions under which for many centuries the theory of the higher education was this—that to all who sought it a common culture was provided in the first instance, and that from this, as from a trunk, three or four types of special or professional training branched off. And again, to what influences is it due that in the present day many are found to advocate the abandonment of this principle in favour of a method by which, the common groundwork being reduced to the narrowest limits, the special training is made to begin with the first years of college life or even at a still earlier date ? One answer to this question (but not the only answer) I have already indicated, viz., that according to the older theory 'a complete and generous education,' in the words of Milton, was 'that which fits a man to perform justly, skilfully, and magnanimously all the offices, both private and public, of peace and war ;' whilst the other theory holds that the aims and interests of the individual are to be chiefly kept in view. Now it is no doubt true that, as is sometimes urged, these rival theories may be so handled as in appearance to lead to the same result ; but in appearance only. It is true that the highest development of any community not only allows, but requires, that the best possible should be made of each of its members ; and it is not less true, if less obvious, that an enlightened selfishness might discover that in the long run it can serve itself best by serving others. But 'enlightened selfishness' has been a great many centuries in learning, in this region as in others, how 'to save by losing itself.' If then, as of course no one will seriously question, the older theory be sound, it will not be safe to leave the course of study wholly to the caprice of individuals. The experience or instinct of academic bodies has aimed at giving effect to this principle by requiring that students aspiring to academic honours, ahd to those diplomas which are the passports to the so-called learned professions, should pursue a course of studies uniform, or nearly uniform, up to a certain defined point. In our day, when university training is no longer sought only by those who seek to enter the great professions, and when, too, the narrow list of these liberal professions is from time to time receiving one and another sister, it is a principal academic problem to show that the old principles ought still to be insisted on in their essence, and yet that modifications must be made in detail, in order that they may be applied with safety. It is when we have to meet the reluctance—the natural reluctance—of students of this new order to submit to the yoke of academic traditions that we are brought face to face with the rival claims of society and the individual. I say the rival claims; but, in fact, they are not rivals, but complementary each of the other. I mean not only that each has its rights, which must not be ignored, but that each is necessary to the perfect development of the other; that unless due play is given to the special gifts and aspirations of its members, society cannot reach its highest form; and that, unless individual men remember that they exist for the sake of society at least as much as for themselves, they too will fall short of their proper standard, and will leave some of their noblest faculties wholly unused. . . .

"... The subject matter of the studies selected is, in fact, of less importance than the discipline imparted. This only is essential—that there should be such a selection made as will (1) draw out and strengthen the several powers of the mind, and (2) afford a basis so broad that on it may afterwards be erected the structure of professional study when the career is chosen. These conditions are met if the common groundwork includes (1) letters, to cultivate the taste and judgment, to give a good style in speech or writing, and to place the student on the threshold of the best literature of home or foreign growth; (2) mathematics, to discipline the reasoning faculty, to give the habit of concentrated thought, and to place in the student's hand a weapon indispensable for the thorough mastery of the physical branches; and (3) some branch of physical study, to develop the powers of observation and inductive reasoning, and to impart the method of this study, so that, should the student afterwards take up a profession based on some physical science, as medicine, engineering, or manufacturing art, he may be able with facility and pleasure to provide himself with the technical knowledge proper to his calling. It might be added, too, in defence of the claims of this third prime element of culture, that it is singularly fitted to counteract the faults alleged, not without reason, to be inherent in the other two. But I must not proceed further on this field. I have placed the justification of the adoption of a common groundwork of culture for all students on two direct and, as I believe, sufficient pleas. But, over and above these direct uses, there are at least two others, which I can only indicate; —(1) Grace and vigour are lent to social intercourse when men feel that they can trust to the possession by all of a certain general culture—that a common atmosphere, so to say, is shared by all, and that subtle criticisms, delicate shades of thought, apt illustrations, will not fall flat on the ears of one half of those who listen. Those who are familiar with the social history of the first half of this century will agree with me that this element of social life was far more generally present with cultivated men than it is now. (2) And, again, from the want of this common elementary culture, men are without that sympathy with the pursuits of others which tends so powerfully to soften the bitterness of controversy, and even to make fruitful discussion possible."

Sir Benjamin Brodie's speech is specially remarkable as giving the impression which a long connection with one of the older Universities has made upon a distinguished man, whose sympathies would naturally be with them. We have only space for the following extract:—

"The foundation of such universities as Oxford and Cambridge is lost in almost prehistoric time; and if I say that this is the foundation of an university, I say so from what appears to me to be a very good reason, for I believe that Owens College boasts all the essential constituents of an university; and I have no doubt that before long it will go forth into the world equipped as an university in every respect. I know that some persons take a very different view of universities from that which I do. Some consider that the university is merely a sort of better grammar-school, which differs from the ordinary grammar-school by having more and older students, and a somewhat wider range of study. I don't believe that any enlargement of the curriculum of a grammar-school will ever elevate it into an university. Some persons consider that an university is a body which grants degrees. I confess that the granting of degrees is an important and responsible function; yet of all the functions of an university it appears to me the very least. To claim that function as the distinguishing characteristic of an university is equivalent to saying that the man who puts a stamp on a sovereign is the maker of the coin. An university should not only be a teaching body, but from every point of view it should represent, further, and promote the interest of knowledge, not only by teaching, but by preserving knowledge through the foundation of libraries, museums, and collections, and by the labours of its professors in furthering and increasing knowledge. I fully believe that that was the idea which was present to those who were concerned in the foundation of Owens College—namely, that it is to be not merely a grammar-school, but a great organ for furthering knowledge. . . .

"We have heard many allusions to-day to the financial condition of Owens College, and I do not doubt that there are many here who, in considering this question, look perhaps, I will not say, with some degree of envy, but with a peculiar interest, upon the statistics relating to the pecuniary affairs of Oxford and Cambridge. These great universities differ from Owens College as *plus* differs from *minus*. These institutions—Oxford and Cambridge—are in that happy position that their Chancellors of the Exchequer have no taxes to raise, and have only to consider the appropriate mode of distributing their budgets. But yet, really, any envy which might be raised from this consideration might be entirely removed by a more close intimacy and acquaintance with the subject, for though undoubtedly money is a good thing, and money well used is better than money itself, yet in many cases these endowments of universities have been so connected and linked with inappropriate objects, that they have really done more harm than good. The question of University Reform has been debated for about 30 years without the end being gained as to how to distribute these revenues properly. These revenues are also inappropriate and sometimes mischievous, doing great evil to the old universities in consequence of their application to objects which, though appropriate 300 or 400 years ago, are now useless, or worse. Unhappily these objects do not coincide with those which deserve attention at the present day, and the consequence is that a great amount of time and a large amount of energy and talent have been wasted in removing evils which have grown up in connection with these endowments. I hope that this kind of work will never be necessary in connection with the University of Owens, and I think you may congratulate yourselves that you have to begin *de novo*, and that you have only to adapt your arrangements to the purposes you desire to be served. That is a much simpler thing to do than to adapt antique arrangements to purposes which they were not intended to serve. Another point in which there are some difficulties that the old universities have had to contend with comes before us in regard to those unfortunate arrangements which for so long a period connected them with a very unpopular party in the State. It is only recently that, by a prolonged series of efforts on the part of individuals, we gained the abolition of what were commonly termed university tests. I do not think I shall offend anybody by referring to that subject, because these tests may now be regarded with a curious, though somewhat painful, interest, like the thumbscrews and other instruments of torture of which we read in history; but in reality they constituted a very atrocious evil. We must all regret that they ever existed, not only on account of the labour and difficulty which they involved to those who took an active part in sweeping them out of the way, but also on account of the far worse amount of evil, in the shape of immorality and dishonesty, which they created. However, you at Owens College are happily free from all these evils. I earnestly hope, and fully believe indeed, that Owens College will ever preserve that union between freedom and science—freedom not only to think, but freedom of research and freedom of speech—which is absolutely necessary for the progress of science. I hope that nobody will ever meddle with your professors, and try to put an extinguisher upon their researches."

ON THE APPENDIX VERMIFORMIS AND THE EVOLUTION HYPOTHESIS

TOWARDS the close of the last meeting of the British Association at Bradford, a paper was read before the Biological Section, which calls for special comment, because of the unfavourable impression which it and much of the subsequent discussion must have left on non-scientific as well as scientific hearers, as well as on account of its scientific inaccuracy.

The paper referred to was by Prof. Struthers, who endeavoured to show that the appendix vermiformis of the human intestine may be considered as a good example of a useless and detrimental addition to the vital economy, and, such being the case, it must be apparent to all that evidence of design is not exhibited in the construction of the living body, and consequently the doctrine of special creation must be supplanted by that of evolution.

The general weakness of this argument must be apparent to many at first sight, but there are some points with reference to it which call for special remark. In the first place it may be shown, if it is assumed as true that the appendix vermiformis of the human cæcum is, as stated, useless and positively injurious, that the fact militates quite as much against the doctrine of the evolutionist, as it does against those of the teleological school. For if it is positively disadvantageous, on the Darwinian hypothesis, for the individuals of a species to possess an appendix vermiformis, it is a necessary deduction, that in a very short period either the species should die out, or be replaced by another in which the detrimental organ is absent. The human race and the anthropoid apes, however, seem quite able to hold their own, without the loss of their supplementary cæcum, consequently either the appendix vermiformis causes insignificant danger, or the evolution hypothesis is incorrect.

It is not difficult to demonstrate that it is the former of these two alternatives which fails, that the danger caused by the existence of the appendix vermiformis is much exaggerated, and that its uselessness is only an expression of ignorance on the part of those who make statements to that effect.

Some people have died from perforation of the appendix vermiformis, or the peritonitis which it induces; the number of recorded cases are comparatively few, and those which follow disease of the rudiment of the vitelline duct in the small intestine are much rarer, though Prof. Struthers seems to have seen several. This shows no doubt that there are disadvantages attending the possession of a complicated cæcum, or an unobliterated vitelline duct; but it shows too much for the argument on which we are considering its bearing, for there are many other organs, avowedly indispensable to the economy, which have caused death by their simple mechanical presence. A case was lately recorded before the Zoological Society, in which a kangaroo met its death from strangulation of a loop of the small intestine by the coiling round it of the uncomplicated, but long cæcum; are we from this to infer that the cæcum is so dangerous an addition to the organism, that it would be better if it did not exist? Such can hardly be correct. Again, in man, if the testes do not descend into the scrotum, impotency is the result, can we therefore infer that the abdominal rings would be better away, because some die of strangulated inguinal hernia? It would be as logical to wish to dispense with the head, because some have been killed by wounds on the scalp.

Again, it can scarcely be said in the present state of our physiological knowledge, that the appendix vermiformis is useless, and a remnant of a fœtal structure. Leaving sexual structures out of the question, as subject to different laws, it is quite contrary to evolutionary doctrine that useless rudiments of embryonic organs should be retained in after life; for the individuals encumbered with the unnecessary remains of a former different *régime* could scarcely be expected to succeed in the struggle for existence against less trammelled and consequently more advantageously circumstanced members of its own or any other class. If also the appendix vermiformis were a rudiment of a fœtal organ, it is not easy to see how it is that it is retained in man and the anthropoid apes, whilst it is not found in the lower monkeys, the Ungulata, and other animals which possess a cæcum (the wombat excepted), and are therefore similarly situated in early life. On the other hand, the voice of the evolution hypothesis clearly states that, with the exception above mentioned, the appendix vermiformis must bring positive advantage to its possessors; for it is only developed in the most elaborated and the highest of those creatures which are the result of its unceasing and most beautiful routine, and there is no reason why its action should cease at this point where it is most called for, and where the struggle is most acute.

There is another aspect in which we think the whole subject should be regarded. Prof. Struthers' remarks all have an anti-teleological tendency; in other words, they are little more than hits at a theory which has had its day, and which, if left alone, will die a quiet and natural death. Why make this death a painful one, and attempt to develop an unplesant party feeling between those who, from the capacities of their brains and their previous education, have been led to adopt the one or the other? Such discussions, as acknowledged by most who are competent to form a correct opinion, do very little, or nothing, towards the advancement of science, and tend to lower it very much in the estimation of the non-scientific world. The true theory will ultimately predominate, without doubt, but it will do so from its own intrinsic value, and not from attacks on the deepest feelings of its opponents, especially when they are based on a false interpretation of its deductions. To quote the words of one of the greatest of our physiologists, it can only bring ignominy on the body of scientific workers if they are supposed to countenance an argument such as that of Prof. Struthers, which assumes that because one or two individuals have died from the impactation of cherry-stones in the appendix vermiformis, therefore there is no God!

THE COMMON FROG*

II.

BEFORE passing on to an enumeration of the subordinate groups of the sub-kingdom Vertebrata, we may first revert to our subject, the Frog, and make further acquaintance with it.

The common frog of this country belongs to the genus *Rana*, and it is the species *Temporaria*, therefore its scientific name is *Rana temporaria*. It is common in Ireland, as well as in England and Scotland, and is indeed the most widely distributed species of the frog-order, being found throughout the temperate regions of both the Old and New Worlds. It is found over nearly the whole of Europe; in Africa north of the Sahara, and in Egypt; in Northern Asia, including Japan and Chusan, and it is also spread over North America. It is not found in the northern half of Scandinavia, nor in Iceland.

Except in winter, the common frog is generally in England so familiar an object, that any description of it might seem superfluous. The purpose in view, however, renders it needful at least to recall certain external structural characters both of the adult and the immature condition.

The head and body of the frog together forms an elongated oval mass, somewhat pointed at each end, of which mass the head constitutes rather more than one-third. This mass is more or less flattened both above and below, except at the commencement of the hinder third of the back, where there is a more or less marked prominence, which indicates the junction of the haunch bones with the spine. In front of this the only marked projections are those of the eyeballs.

The short arms project outward on each side just behind the head, and each ends in a small hand with four fingers, the second of which is the shortest, and the third the longest. When the arm is turned backwards this third finger barely attains (if it can do so at all) the hinder end of the body.

The hind limbs proceed from quite the hinder end of the body, there being no vestige of a tail. The thigh is very muscular, and the leg has a good "calf." The foot is exceedingly long, and what is very remarkable, is so jointed that the toes can be sharply bent upwards on its thick and undivided part. The latter thus seems to form a third segment of the hind limb following the thigh and the leg, the limb having four segments instead of three as in ourselves, and in almost all beasts, birds, and reptiles.

The foot ends in five toes connected by a web. Of these the fourth is the longest, the first the shortest. On the inner margin of the sole of the foot, at the root of the first toe, is a small, hard prominence, called a "tarsal tubercle." When the hind limb is turned forward, the knee reaches nearly to the armpit; the ankle-joint is about on a line with the end of the snout, and both parts of the foot beyond it. These two parts of the foot together are much longer than the whole fore limb, and exceed two-thirds of the length of the whole mass of the head and body.

When the animal is viewed in profile, the point of the muzzle is seen to be very little in advance of the opening of the mouth. The latter is straight. It is also very wide, extending back even beyond the hinder margin of the eye. Just above the hinder angle of the gape, and behind the eye, is a rounded surface of smooth, tightly-stretched skin. This is called the "tympanum," and directly covers in the drum of the ear.

When the mouth is opened, if the finger be drawn along the inner margin of the upper jaw, a series of minute teeth may be detected. Towards the front of the palate are a pair of small holes (which are the inner openings of the nostrils), and between these are two juxtaposed little groups of other minute teeth. There are no teeth whatever in the lower jaw. At the hinder end of each side of the palate is another small hole. These latter two apertures are each the opening of a canal leading from the mouth to the cavity of the ear within the drum. The tongue is seen to be large, flat, and fleshy. It is tied down to the jaw in front, but free for more than its hinder half, with the processes developed from its free hinder margin.

The skin of the frog is naked and smooth, without a trace of scales, or other appendages. Its colour on the upper surface is more or less yellowish, or reddish brown, with irregular black, brown, or grey patches. Similar patches form transverse bands upon the legs. Beneath the colour is pale yellowish, often with a few spots, paler than those of the back. There is constantly a brownish black subtriangular patch placed behind the eye, and extending over the tympanum down towards the shoulder. The frog breathes partly by swallowing air (aided by a mechanism to be described hereafter), partly by the direct respiratory action of the skin. It feeds exclusively upon living animals, such as insects and slugs, which it catches by suddenly throwing forwards beyond the mouth, the free hinder half of the tongue (furnished with an adhesive secretion), and then retracting it with its prey in a most rapid manner.

In winter the frog passes into that torpid state known as *hibernation*, as is the case with our bats, hedgehogs, and some other beasts. Its season of torpidity is generally passed by it buried in mud and at the bottom of water, and great numbers of individuals may be dug up in winter all clustered together.

In spring the frogs again congregate for the purpose of oviposition in the month of March, at which period their well-known croaking makes itself heard, and though in itself unme-

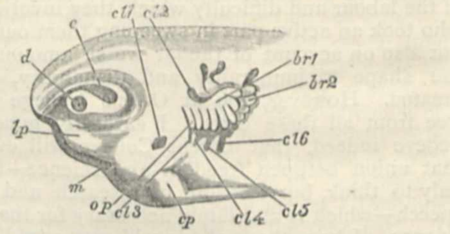

Fig. 3.—View of left side of head of Embryo Tadpole (after Parker). br^1 and br^2, first and second external branchiæ; cl^1—cl^6, the six viceral clefts; *cp*, the left "holder"; *d*, the olfactory organ; *e*, the eye; *lp*, th left lip; *m*, the aperture of the mouth; *op*, the hinder margin of the rudimentary operculum.

lodious, possesses a certain charm through its association with the vernal outburst of nature.

When first laid, the frog's eggs are little round dark bodies enclosed in no solid shell or case, but in a small glutinous enve-

Fig. 4.—The Edible Frog (*Rana esculenta*).

lope. The latter quickly swells in the water so much that the "spawn" comes to have the appearance of a great mass of jelly through which dark specks (the yolks of the egg) are scattered. Each egg, when microscopically examined, may be seen to undergo a process of yolk sub-division and cleavage till a mulberry-like mass is formed. Upon this soon appears the "primitive groove," which forms a canal and develops beneath it a "chorda dorsalis" according to the process which has been already stated to be common to the whole of the Vertebrata.

Gradually the embryo assumes the form of a young tadpole, and is provided with a pair of little "holders" (or organs for

* Continued from p. 471.

adhesion) just behind the mouth, with six openings on each side of the neck (Fig. 3, cl^1–cl^6), and with a pair of rudimentary external gills (Fig. 3, br^1 and br^2). These openings are termed "visceral clefts," which lead from the exterior into the throat, as already described. The solid pillars (or intervals) between the clefts, *i.e.*, the "visceral arches," become furnished with gills,* or *branchiæ*, and are therefore called "branchial arches." The eggs are hatched towards the end of April, and the tadpole emerges in the stage represented at Fig. 2, 1. It has a relatively large head, a rounded body, and a long tail, by lateral undulations of which the little creature swims about. From behind the head, on each side, jut forth external branchiæ as a small plume-like structure, but no limbs are visible.

As the tadpole grows the external plumose gills at first greatly enlarge (Fig. 2, 2 and 2*a*), but afterwards become gradually absorbed, and are succeeded by short gill-filaments, which are

Fig. 5.—A, *Pachybatrachus robustus*, nat. size; B, interior of the mouth of ditto.

developed along each of the branchial arches. These latter filaments do not appear externally, and indeed a membrane, termed the operculum (Fig. 3, *op*), is developed from the front of each series of branchial apertures, and which, extending backwards by degrees, ultimately covers over and conceals them.

Little by little the limbs bud forth and grow, the hind ones being the first visible because the fore limbs are for a time concealed by the opercular membrane. As the legs grow, the tail becomes absorbed (Fig. 2, 7), not falling off, as some suppose. The gills also disappear, and the branchial apertures close, that on the right side first becoming obsolete by adherence of the operculum to the skin of the body.

As the gills diminish and cease to serve the purposes of respiration, lungs at the same time become developed in an inverse ratio, and the tadpoles absolutely require to come to the surface to breathe.

The process, from the hatching to the acquisition of the miniature form of the adult, may be accelerated or retarded by elevation or depression of the temperature. The frog more than doubles its bulk in its first summer.* The young tadpole has at first a very small mouth placed beneath the head and not at its anterior termination; it is also for a time provided with a sort of beak formed of two little horny jaws.

The food of the tadpole, quite unlike that of the adult, consists largely (especially in its earlier stages) of vegetable substances.

Having now made acquaintance with the Frog considered absolutely, or by itself, and also clearly seen that it is a member of the Vertebrate Sub-kingdom, we may enumerate the principal primary sub-divisions (Classes) of that Sub-kingdom, and enumerate such of the next smaller groups (Orders) as more or less nearly concern the subject of this work—the Frog.

The Vertebrata are divided into five great Classes:—(I.), *Mammalia* (Man and Beasts); (II.), *Aves* (Birds); (III.), *Reptilia* (Reptiles, *i.e.* Crocodiles, Lizards, Serpents, and Tortoises); (IV.), *Batrachia* (Amphibians, *i.e.* Frogs, Toads, Efts, &c.); and (V.), *Pisces* (Fishes).

Of these five classes Birds and Reptiles are classed together in a larger group called *Sauropsida*, because they present so many structural resemblances. Similarly Amphibians and Fishes are grouped together, and to their united mass the common term *Ichthyopsida* is applied.

Fig. 6.—The Common Toad (*Bufo vulgaris*)

The orders into which the two classes, Mammalia and Aves (beasts and birds), are divided, may here be neglected, as we shall have little to say respecting them in the following pages. There are, however, about twelve orders of beasts, and probably some fourteen of birds.

The class of Fishes has been subdivided into five Orders.

1. Elasmobranchii (the sharks and rays, or highly organised cartilaginous fishes).
2. Ganoidei, an important order, containing many extinct forms, and a few very varied existing ones, such as the mud-fish (Lepidosiren), ceratodus, and the sturgeon.
3. Teleostei, the ordinary or bony fishes, such as the carp, sole, perch, &c., and containing a remarkable group called Siluroids, as also the curious little sea-horse—Hippocampus.
4. Marsipobranchii (the lamprey and myxine, or lowly organised cartilaginous fishes).
5. Pharyngobranchii (the amphioxus, or lancelet).

Reptiles are arranged in nine different orders, five of which are now entirely extinct. They are of living forms:—

1. Crocodilia (crocodiles).
2. Sauria (lizards, the Amphisbenæ, the little Flying-dragon, &c.)
3. Ophidia (serpents).
4. Chelonia (tortoises and turtles).

Of extinct kinds there are:—

5. Ichthyosauria; 6, Plesiosauria; 7, Dicynodontia; 8, Pterosauria; and 9, Dinosauria.

The remaining class, Batrachia, will require more lengthy consideration, both as a whole and as regards the four orders which compose it, and which are called respectively, 1, Anoura; 2, Urodela; 3, Ophiomorpha; and 4, Labyrinthodonta.

It will require such consideration, because it is the class to which the Frog itself belongs.

* Gills (or branchiæ) are delicate processes of skin richly supplied with minute blood-vessels, wherein the blood becomes exposed to the purifying action of the air dissolved in the water.

* Parker, Phil. Trans., 1871, p. 172.

The Frog belongs to the Batrachian order *Anoura*, to the family *Ranidæ*, and to the genus *Rana*.

The order Anoura, to which all frogs and toads belong, is a remarkably homogeneous one, consisting as it does of a multitude of species, all differing from each other by comparatively trifling characters.

Altogether there are about 600 species of frogs and toads, arranged in about 130 different genera.

ST. GEORGE MIVART

(*To be continued.*)

JEAN CHACORNAC *

THIS eminent French astronomer died on the 6th of last September, having been born at Lyon, June 21, 1823. Chacornac is chiefly known for his discoveries among the planetoids whose orbits are contained between those of Mars and Jupiter. In his earlier years he devoted himself to commerce, but having, in 1851, made the acquaintance of M. Valz, Director of the Marseilles Observatory, Chacornac became an enthusiastic student of astronomy, devoting himself to research in connection with the solar spots and to the assiduous exploration of the heavens. On his discovery of a new comet on May 15, 1852, he made up his mind to abandon commerce and devote himself entirely to astronomy.

In 1852, M. Valz, following the example of Mr. Hind, had drawn some charts of the region of the heavens in which the small planets were likely to be met with, and on Chacornac taking the above decision, Valz entrusted to him the construction of the "Atlas écliptique." Chacornac commenced his observations on the region of the small planets on June 1, 1852, and on September 20 he discovered Massalia, and on April 6, 1853, Phocæa, and that with an equatorial telescope of only thirteen centimetres aperture.

The poor resources which were at the disposal of the Marseilles Observatory did not permit of M. Valz's undertaking the publication of the ecliptic charts; and for this purpose he addressed the Academy of Sciences, which had appointed a commission to examine the question. M. Le Verrier, who at this time sought to reform the *personnel* of the Paris Observatory, called to his aid M. Chacornac, who, on March 4, 1854, was appointed Adjoint Astronomer.

At the Observatory of Paris, Chacornac had at his disposal an equatorial of 7 in. aperture, equal to that of Mr. Hind; he set down in his charts stars up to the 13th magnitude, and the limits which they embraced were at the same time somewhat extended. The publication commenced very soon after, and from 1854 to 1863, thirty-six charts, of which some contained not less than 3,000 stars, were put into the hands of astronomers.

During the construction of these charts, Chacornac discovered many small planets—Amphitrite (March 3, 1854), Polymnia (October 28, 1854), Circe (April 6, 1855), Lydia (January 12, 1856), Lætitia (February 8, 1856), Olympia (September 12, 1860). At the same time he observed all the comets which were then visible and defined, with the telescope of Foucault, of 80 centimetres, many spiral nebulæ, previously studied by Herschel. The drawings of M. Chacornac are among the most careful we possess, and appear to show that nebulæ of this kind undergo in time slight variations of form.

This collection of remarkable works brought to the Astronomer of the Paris Observatory many academic and honorary rewards: thus, he obtained the Lalande Prize in 1852, 53, 54, 55, 56, 60, and 1863, became titular astronomer February 22, 1857, and Chevalier of the Legion of Honour, August 15, 1857.

His labours, however, and their attendant anxieties, told upon his health. After going to Spain, where he went to observe the total eclipse of the sun of July 18, 1860, the ecliptic charts were issued less frequently, and in June, 1863, he quitted the Observatory to retire to Ville Urbanne, in the suburbs of Lyon.

In his country retirement, M. Chacornac, whose spirit had preserved all its activity, constructed with his own hands a telescope of three metres focus, by means of which, until within the last few months, he assiduously observed the solar spots and their manifold transformations. In the description of their incessant changes he sought new proofs of the gaseous nature of the sun, an idea which he was one of the first to announce.

* From an article in *La Revue Scientifique*, by M. G. Rayet, Chief Astronomer of the Meteorological Service at the Paris Observatory.

SCIENCE LECTURES AT CAMBRIDGE

THE following Lectures in Natural Sciences will be given at Trinity, St. John's, and Sidney Sussex Colleges during Michaelmas Term, 1873:—

On General Physics and Mechanics. By Mr. Trotter, Trinity, in Lecture Room No. 11 (Monday, Wednesday, Friday, at 11, commencing Wednesday, Oct. 15).

On Elementary Organic Chemistry. By Mr. Main, St. John's (Tuesday, Thursday, Saturday, at 12, in St. John's College Laboratory, commencing Thursday, Oct. 16). Instruction in Practical Chemistry will also be given.

On Palæontology (the Protozoa and Cœlenterata). By Mr. Bonney, St. John's (Tuesday and Thursday at 9, commencing Thursday, Oct. 16).

On Geology for the Natural Sciences Tripos. Preliminary matter and Petrology. By Mr. Bonney, St. John's (Monday, Wednesday, and Friday, at 10, commencing Wednesday, Oct. 15.) A Course on Physical Geology will be given in the Lent Term, and on Stratigraphical Geology in the Easter Term.

Papers will be given to Questionists every Saturday at 11, but the first paper will be set on Wednesday, Oct. 15, at 11, when arrangements will be made for further instruction should it be required.

On Botany, for the Natural Sciences Tripos. By Mr. Hicks, Sidney (Tuesday, Thursday, Saturday, at 11, in Lecture Room No. 1, beginning on Thursday, Oct. 16). The Lectures during this term will be on the Morphology of Phanerogamia.

A Course of Practical Physiology and Histology. By the Trinity Prælector in Physiology (Dr. Michael Foster) at the New Museums. Lectures on Tuesday, Thursday, Saturday, at 12, commencing Saturday, Oct. 25.

This course is intended for those who have gone through a course of Elementary Biology similar to that given last Easter Term.

THE AMERICAN ASSOCIATION

THE Portland Meeting of the American Association for the Advancement of Science was in almost every respect an exceptional success. Its general attendance was very large, and there was an unusual number of the older members, whose presence insures consideration of the more important topics, and gives dignity and force to the discussions. An especial effort had been made to exclude all inferior communications. A regulation had been adopted, compelling the presentation of an abstract of each paper before it was read; and the examining committee in determining from abstracts what papers should be read, exercised in general a rigorous but wise discretion. It will not be the case after this, as after previous meetings, that a considerable proportion of the communications actually read will have to be ignored in the printed proceedings. But even under such restrictions, the number of papers actually read was unusually large, and there were but few instances, as compared with previous years, of the pernicious practice of reading papers by title only—a practice which, if pushed to its logical conclusion, would result in the destruction of the meetings.

The discussions were kept well in hand, wandering but little from the subject, and being, though frequently brilliant, notably brief. There was in them almost an entire absence of any display of feeling, except an occasional expression of kindly regards between opponents whose differences did not extend beyond the debate; in fact, the cordiality of the meeting was one of its prominent features.

The newspaper press sent correspondents from distant cities—New York, Boston, and Chicago being well represented. The *New York Tribune* announced that its reports would be re-published in an extra, and determined to make that extra cover, with at least a fair extract, every communication read and accepted at the meeting, and the discussions elicited. The practical difficulties in the way of such an undertaking are considerable. All the sub-sections of the Association carry on their proceedings in separate rooms simultaneously. Many of the communications are technical, abstruse, and difficult to report, and have not been reduced to writing; it being the custom of some authors to delay preparation of MSS. for the official report till some months after the close of the meeting. Notwithstanding these obstacles and the expense involved in overcoming them, the extra was brought out with all the completeness proposed; thus anticipating the usual official publication by almost a year. It is a sheet of eight pages, and gives also an illustrated series of letters upon Deep Sea Dredging, as practised by the United States Commission of Fish and Fisheries, the whole containing as much reading-matter as would make a large duodecimo volume. The extra is sold for ten cents, this price including postage.

NOTES

SIR SAMUEL and Lady Baker arrived in London on Thursday evening last. The young African, a lad of about fifteen or sixteen years of age, in whom Lady Baker is said to take much interest, accompanied the party. Both Sir Samuel and Lady Baker looked well, and seemed in excellent spirits.

FOR the Biological Fellowship examination at Magdalen College, Oxford, there are five candidates, of which we are surprised to hear that three are graduates of the University of Cambridge. The election takes place on Saturday next.

MR. EDWARD BAGNALL POULTON, from Mr. Watson's School, Reading, has been elected to an open Physical Science Scholarship of 80*l*. per annum, in Jesus College, Oxford.

MISS POGSON, daughter of the Government Astronomer at Madras, has been appointed Assistant Astronomer.

THE American aëronaut, Mr. Samuel A. King, intends during September to make an extended balloon voyage from Buffalo, New York. For this purpose he is building a large balloon to replace the "Mammoth," which was destroyed by the recent great fire in Boston. It is Mr. King's purpose to make the longest overland voyage, if circumstances favour, ever yet accomplished. It is no part of his plan to go out over the ocean, nor to explore the sea, but he expects to be able to settle something about the upper currents when he comes down. His voyage is undertaken wholly in the interest of science, and, in view of the extraordinary degree of attention now being drawn to the subject of meteorology, the results will be regarded as of much more than ordinary importance. From a communication made by Mr. King in 1871 to the Washington Philosophical Society, it appeared that out of 170 aërial voyages made by him during the past twenty-five years, about twenty-five per cent. showed that the currents of the atmosphere were moving to the north-eastward; a second twenty-five per cent. gave westerly currents; and a third gave north-westerly currents. The remaining forty voyages were about equally distributed among northerly, southerly, and easterly currents. Mr. King's experience, therefore, agrees with that of most European aëronauts, who have repeatedly testified that there is no constant westerly current of air prevailing at any altitude above the earth's surface which they have been able to reach in their balloons.

CANADA is doing its part toward the exploration of the Great West. Besides the surveying parties out on the route of the Pacific Railroad, it has special parties in the field in connection with the Geological Survey and the Boundary Commission. Mr. Selwyn, F.G.S., Director of the Survey, and Mr. R. Bell, F.G.S., are at work on the great regions watered by the North Saskatchewan, and Mr. Richardson on the other side of the Rocky Mountains in British Columbia. Mr. G. M. Dawson, Associate of the School of Mines, Geologist of the Boundary Commission, has just completed a survey of the Lake of the Woods and its neighbourhood, and is now exploring the plains westward of Pembina. All these parties are provided with the means of making collections in the botany and zoology of the regions explored.

MR. J. A. HARVIE BROWN has sent us a reprint of an article by him which appeared in the *Scottish Naturalist* for July, advocating the establishment of a British Naturalist's Agency, on the model of the "American Naturalist's Agency," established at Salem, Mass. U.S. The American Agency has flourished and brought forth abundant and good fruit, and in an incredibly short space of time has become the acknowledged medium for the sale of the proceedings of all the learned societies in America, and through which advertisers on all natural history subjects make known their wants. The main purpose of the Agency is to facilitate the circulation of papers and pamphlets on Natural History, which, from the want of such an Agency, many who wish to possess them find it difficult to obtain, and which are often not even known beyond a narrow local circle. The Agency also undertake to publish new and republish old standard works in Natural History, and perform several other eminently useful offices which can only be sufficiently performed by some such central organisation. The very existence of such an Agency would create a demand for scientific knowledge. Such an Agency in this country would undoubtedly prove a great boon to naturalists, provided it were ably conducted, and fully acknowledged and supported by the leading scientific societies. Scientific circles in time, we believe, would be enlarged, and not be confined to the metropolis, or nearly so. There are plenty of good men out of London, Edinburgh, Glasgow, and the large towns who have no opportunities of reading, being removed from the principal scientific libraries. Not one individual, nor indeed any one society, could set such an undertaking afloat, but if all the leading societies would jointly discuss its merits and demerits, and at length bring it carefully and repeatedly before the notice of the British Association, there is every likelihood that it would become a complete success. To arrive at this first step it is necessary to ventilate the suggestion, and this cannot be better done than by bringing it before the notice of the local societies, and asking each to assist in bringing it finally before a higher court. Parties interested and desirous of seeing such a scheme successful may communicate with Dr. F. Buchanan White, editor of *Scottish Naturalist*, Perth, or with John Harvie Brown, Dunipace House, Falkirk.

ON Monday last a meeting was held at the Mansion House with the view of promoting technical education in the City. The meeting was immediately held in connection with the distribution of prizes by the Turners' Company, for the best specimens of workmanship in the turning of articles in ivory and stone. It is creditable to this Company that it has by this means been endeavouring to promote technical education for some years past, and if all the other City Companies took the trouble to follow the Turners' example, and encourage the introduction into the various trades and handicrafts with which they are connected of a scientific method of workmanship founded upon scientific knowledge of material and on sound scientific theory, we believe they would be doing eminent service that would be fruitful of the best results to the trade and commerce and manufactures of the kingdom.

MR. T. W. BURR writes us that he has, since 1853, been in the habit of using a sidereal dial similar to that described by Captain Mayne, in NATURE, vol. viii. p. 366.

THE death of Prof. John Lewis Russell is announced as having taken place at Salem, U.S., on the 7th of June, in the sixty-fifth year of his age. Prof. Russell was well known as an ardent student of botany, and especially in the department of New England cryptogams, in which he was a recognised authority. He took much interest in the scientific societies of Salem, having been connected more or less with their foundation and administration during the active years of his life.

PROF. AGASSIZ has recently lost one of his most valuable assistants in the death of Dr. G. A. Maack, on the 6th of August last, in the thirty-third year of his age. He was connected with the Cambridge Museum for several years, during which time he was detailed by his chief to act as geologist of the Darien Isthmus exploring party, under Commander Selfridge, and also prosecuted similar researches in Brazil and elsewhere in South America. He was specially charged with the osteological collection of the Cambridge Museum, which he managed with great ability.

THE death is announced of Mr. George Ormerod, of Sedbury Park, Gloucestershire, F.R.S., F.S.A., D.C.L., &c., a well-known antiquary. He was eighty-seven years of age.

THE *Journal of Botany* records the death of Dr. J. Lindsay Stewart, late Conservator of forests in the Punjaub, who had rendered great service to the cause of forest administration in India, by the commencement of the large and now flourishing plantations in the plains of the Punjaub, and who was also a copious writer on Indian botany.

"CONTRIBUTIONS to our knowledge of the Meteorology of the Antarctic Regions," published by the Meteorological Committee, will be of value both to meteorologists and to future Antarctic navigators. The work has been executed by Mr. R. Strachan, and the materials which form the paper have been extracted from the Meteorological Registers kept in the Antarctic Regions, on board H.M.S. *Erebus* and *Terror*, during the months December 1840—March 1841, December 1841—March 1842, December 1842—March 1843, and on board H.M. sloop *Pagoda* during January-March 1845.

As a result of the inquiry into the recent typhoid epidemic, we are glad to see that the Dairy Reform Company have secured the co-operation of Prof. Corfield, M.D., Prof. Voelcker, Ph.D., and Prof. Wanklyn, to carry out the precautions which have been adopted. A medical and veterinary examination of the employés and stock on each farm is made every week, and reports are forwarded to the Company's chief office in Orchard Street, where they are open to the inspection of customers from 10 A.M. to 4 P.M., on week days. Orders of admission to all their establishments have been given to the medical officers of health for the following districts:—St. James's, Marylebone, Kensington, St. George's, Paddington, Chelsea, and St. Pancras.

WITH reference to our note in last week's number concerning the *Leeds Daily News*, we are glad to be able to say that the *Leeds Mercury* and the *Yorkshire Post and Leeds Intelligencer* also report the transactions of the Leeds Naturalists' Field Club.

MESSRS. CHURCHILL have in the press and will publish during the ensuing season the following works of interest to scientific men:—"On Food, Physiologically, Dietetically, and Therapeutically considered," by F. W. Pavy, M.D., F.R.S.; a third and enlarged edition of Dr. Lionel Beale's "Protoplasm, Dissentient Demonstrative, and Speculative," with 16 plates; a second edition of "The Thanatophidia of India," by J. Fayrer, M.D., C.S.I.; a new illustrated work on "Medicinal Plants,' by Robert Bentley, F.L.S., and Henry Trimen, M.B., F.L.S. This work will include full botanical descriptions and an account of the properties and uses of the principal plants employed in medicine, especial attention being paid to those which are officinal in the British and United States Pharmacopœias. The plants which supply food and substances required by the sick and convalescent will be also included. Each species will be illustrated by a coloured plate drawn from nature. This work will be published in monthly parts, of which we may expect the first very shortly. A translation by Arthur E. J. Barker, of Frey's "Manual of the Histology and Histo-Chemistry of Man," a treatise on the elements of structure and composition of the human body; the book will be largely illustrated with engravings on wood, and specially revised by the author. "The Microscope and its Revelations," by Dr. W. B. Carpenter, F.R.S.; a new edition with upwards of 500 engravings." "Experimental Investigations of the Action of Medicines;" being a handbook of Practical Pharmacology, with engravings, by T. Lauder Brunton, M.D., one of the lecturers at St. Bartholomew's Hospital; "The Student's Guide to Zoology," with engravings on wood, by Andrew Wilson, Lecturer on Zoology at Edinburgh and author of "Elements of Zoology;" "On Long, Short, and Weak Sight, and their Treatment by the Scientific use of Spectacles," by J. Soelberg Wells, F.R.C.S., fourth edition, with engravings.

MESSRS. BLACKWOOD will shortly publish, "Economic Geology, or Geology in its relation to the Arts and Manufactures," by David Page, LL.D.; and an "Advanced Text-Book of Botany," for the use of Students, by Dr. Robert Brown, F.R.G.S., with numerous Illustrations.

MESSRS. STRAHAN & CO. announce, as nearly ready, "The Great Ice Age and its Relation to the Antiquity of Man," by James Geikie, F.R.S.E., of H.M. Geological Survey. This work will be copiously illustrated.

THE third session of the Newcastle College of Science commenced on Tuesday, presided over by the Dean of Durham. Prof. Herschel delivered an address. The necessity for shortly providing more accommodation was considered, and it was understood that an effort was about to be made to raise funds for a new college. The very rev. chairman also mentioned that a College of Agriculture was about to be founded in Central Northumberland in connection with the University of Durham.

THE annual distribution of prizes to the successful competitors in the Guildford Science and Art classes, awarded by the Government Department of Science and Art, took place on the evening of October 1, at the Town Hall. In addition to the Guildford prizes those won by the students of St. John's, Woking, were also distributed, as well as the Night Art Class of the Guildfold Working Men's Institute. The number of students has continued steadily to increase upon former years, 62 having attended the classes during the last winter session. Of these, 35 came up for examination in May, and 23 passed. Several of these obtained very advanced success in more than one subject, so that the total number of successful candidates in the seven subjects taught amounts this year to 49, including four outside candidates, leaving an increase of 13 from last year. Mr. Ethelbert Dowlen, one of the pupils, has been awarded the "Queen's Silver Medal" in botany, and besides numerous other prizes and certificates, he also obtained the "Queen's Gold Medal" for geology at St. John's College, Woking. Altogether these classes seem to have been highly successful, and we hope they will continue to be increasingly so. The classes will be re-opened for instruction on Tuesday, 27th inst., and will be continued every Monday and Wednesday evening for Physical Geography, and on Tuesdays and Fridays, from 6 to 9 P.M., in the other subjects. A class will be held on Saturdays for ladies, in Botany, at a convenient time, commencing from the 11th inst. at 11 A.M. Proposed Subjects :—1, Mathematics (1st, 2nd, and 3rd stage), or theoretic mechanics ; 2, sound, light, and heat ; 3, magnetism and electricity ; 4, chemistry, inorganic ; 5, animal physiology ; 6, elementary botany ; 7, biology ; 8, physical geography. The fees are very moderate.

THE volume of Artizans' Reports upon the Vienna Exhibition, published by the Society for the Promotion of Scientific Industry, Manchester, will be published about the 20th of this month. There are thirty-six reports, which are said to be of a very high-class character.

WE are glad to see, from the Report of the Chester Society of Natural Science, that that Society, which has concluded its second year, continues to increase in prosperity so far as numbers are concerned—the number of members being now 454. Among these are not a few working members ; and the secretary gives excellent advice in counselling each member to devote himself to a special subject, as thus only can the interest of the Society and the advance of science be best promoted. During the past year two societies of natural science have been founded in the neighbourhood of Chester—one at Wrexham, the other at Whitechurch. The Chester Society does its work by means of field excursions, general lectures, and sectional meetings.

THE forthcoming number of Petermann's *Mittheilungen* will contain a detailed account of Captain Hall's *Polaris* Arctic expedition, with its scientific results. It will be accompanied by a carefully constructed map showing the course of the *Polaris* from the 80th degree northwards, her course southward from Aug. 15 to Oct. 15, 1872, the course along which the floe containing the nineteen persons drifted after they were separated from the ship on the night of Oct. 15, 1872, until they were picked up off the coast of Labrador six months afterwards, the distance drifted each day, along with the state of the weather, and the places where seals, &c. were obtained, being indicated ; and lastly, the course taken by the men who were picked up in Melville Bay last June.

SHORTLY before his death the late Colonel J. W. Foster completed the manuscript of a work upon the prehistoric races of the United States, which has just made its appearance from the press of S. C. Griggs and Co., of Chicago. This contains an excellent summary of the present state of our knowledge of the aborigines of North America, as illustrated by the remains found in mounds, shell heaps, and ancient mines, as well as by their crania.

THE City of London College, Leadenhall Street, to judge from the programme we have received, offers excellent opportunities to young men engaged during the day for obtaining a good education, literary and scientific, and for intellectual improvement in various ways.

THE *Times of India* says that a scientific geographical survey of native Sikkim is in contemplation by the authorities.

THE *Geological Magazine* announces the death of Prof. Dr. Kemp of Darmstadt, a distinguished zoologist and palæontologist, whose name is well known in connection with the discovery of the *Dinotherium*.

HERR SCHLOENBACH, proprietor of certain salt works at Lieberhall, in Hanover, has instituted a foundation of 12,000 florins, the interest of which is to be devoted to assist geologists who may undertake journeys of exploration beyond the Austro-Hungarian empire. This is intended as a memorial tribute to his son, a young German geologist of much promise, recently deceased.

THE additions to the Zoological Society's Gardens during the last week include an Arctic Fox (*Canis lagopus*) and an Iceland Gull (*Larus leucopterus*), European, presented by Mr. B. L. Smith ; a Black-handed Spider-monkey (*Ateles melanochir*) from South America, presented by Mr. B. Went ; an African Civet Cat (*Viverra civetta*), presented by Lady Cust ; a Macaque Monkey (*Macacus cynomolgus*) from Africa, presented by Capt. Denison ; a Raccoon (*Procyon lotor*) from North America, and a Vulpine Phalanger (*Phalangista vulpina*) from Australia, presented by Miss Breach.

THE BRITISH ASSOCIATION

SECTIONAL PROCEEDINGS

SECTION A.—MATHEMATICS

On the Introduction of the Decimal Point into Arithmetic, by J. W. L. Glaisher, B.A.

The following is an extract from Peacock's excellent History of Arithmetic, in the "Encyclopædia Metropolitana," which forms the standard (not to say the only) work on the subject. Speaking of Stevinus's "Arithmétique," Peacock writes : "We find no traces, however, of decimal arithmetic in this work, and the first notice of *decimal*, properly so called, is to be found in a short tract, which is put at the end of his 'Arithmétique,' in the collection of his works by Albert Girard, entitled 'La Disme.' It was first published in Flemish, about the year 1590, and afterwards translated into barbarous French by Simon of Bruges. . . . Whatever advantages, however, this admirable invention, combined as it still was with the addition of the exponents, possessed above the ordinary methods of calculation in the case of abstract or concrete fractions, it does not appear that they were readily perceived or adopted by his contemporaries. . . . The last and final improvement in this *Decimal Arithmetic*, of assimilating the notation of integers and *decimal* fractions, by placing a *point* or *comma* between them, and omitting the exponents altogether, is unquestionably due to the illustrious Napier, and is not one of the least of the many precious benefits which he conferred upon the science of calculation. No notice whatever is taken of them in the 'Mirifici Logarithmorum Canonis Descriptio,' nor in its accompanying tables, which was published in 1614. In a short abstract, however, of the theory of these logarithms, with a short table of the logarithms of natural numbers, which was published by Wright, 1616, we find a few examples of decimals expressed with reference to the decimal point ; but they are first distinctly noticed in the 'Rabdologia,' which was published in 1617. In an 'Admonitio pro decimali Arithmetica,' he mentions in terms of the highest praise the invention of Stevinus, and explains his notation ; and without noticing his own simplification of it, he exhibits it in the following example, in which it is required to divide 861094 by 432. . . . The quotient is 1993,273, or $1993,2'7''3'''$, the form under which he afterwards writes it, in partial conformity with the practice of Stevinus. The same form is adopted in an example of abbreviated multiplication, which subsequently occurs. . . . The preceding statement will sufficiently explain the reason why no notice is taken of *decimals* in the elaborate explanations which are given by Napier, Briggs, and Kepler, of the theory and construction of logarithms ; and indeed we find no mention of them in any English author between 1619 and 1631. In that year the 'Logarithmicall Arithmetike,' was published by Gellibrand, and other friends of Briggs, who died the year before, with a much more detailed and popular explanation of the doctrine of logarithms than was to be found in the 'Arithmetica Logarithmica.' It is there said . . . From this period we may consider the decimal arithmetic as fully established, inasmuch as the explanation of it began to form an essential part of all books of practical Arithmetic. The simple method of marking the separation of the decimals and integers by a comma, of which Napier has given a solitary example, was not however generally adopted." . . .

De Morgan ("Arithmetical Books," 1847, p. xxiii.) writes: "Dr. Peacock mentions Napier as being the person to whom the introduction [of the decimal point] is unquestionably due; a position which I must dispute upon additional evidence. The inventor of the single decimal distinction, be it point or line, as in 123·456, or 123 | 456, is the person who first made this distinction a permanent language; not using it *merely as a rest in the process*, to be useful in pointing out afterwards how another process is to come on, or language is to be applied, but making it his final and permanent indication as well of the way of pointing out where the integers end and the fractions begin, as of the manner in which that distinction modifies operations. Now first I submit that Napier did not do this; secondly, that if he did do this, Richard Witt did it before him."

De Morgan then states that he has not seen Wright's translation of 1616, but he proceeds to examine Napier's claim as resting on the two examples in the "Rabdologia," in the first of which a comma is used, but only in one place. After this examination he proceeds, "I cannot trace the decimal point in this: but if required to do so, I can see it more distinctly in Witt, who published four years before Napier. But I can hardly admit him to have arrived at the notation of the decimal point. . . ."*

I agree with De Morgan in all that he has stated in the above extracts, and do not think that the single instance of the comma used in the course of work, and replaced immediately afterwards by exponential marks, is a sufficient ground for assigning to Napier the invention of the decimal point, or even affords a presumption that he made use of it at all in the expression of results.

Still one of the objects of this paper is to claim (provisionally of course, till evidence of any earlier use is produced, if such there be) the invention of the decimal point for Napier, but not on account of anything contained in the "Rabdologia." The mathematical works published by Napier in his life-time (he died in 1617) were his "Mirifici Logarithmorum Canonis Descriptio," 1614, containing the first announcement of the invention of logarithms, and the "Rabdologia," 1617, giving an account of his almost equally remarkable (as it was thought at the time) invention of numbering rods or "bones." In 1619, two years after his death, the "Mirifici Logarithmorum Canonis Constructio," containing the method of construction of the canon of logarithms was published, edited by his son, and in this work the decimal point is systematically used in a manner identical with that in which we employ it at the present day. I can find no traces of the decimal point in Wright's translation of the "Descriptio," 1616; and, as De Morgan says, the use of the decimal separator is not apparent in Witt. The earliest work, therefore, in which a decimal separator was employed seems to be Napier's posthumous work, the "Constructio" (1619), where the following definition of the point occurs on p. 6. "In numeris periodo sic in se distinctis, quicquid post periodum notatur fractio est, cujus denominator est unitas cum tot cyphris post se, quot sunt figuræ post periodum. Ut 10000000·04 valet idem, quod $10000000\frac{4}{100}$. Item 25·803, idem quod $25\frac{803}{1000}$. Item 9999998·0005021, idem valet quod $9999998\frac{5021}{10000000}$, et sic de cæteris." On p. 8 we have 10·502 multiplied by 3·216, and the result found to be 33·774432; and on pp. 23 and 24 occur decimals not attached to integers, viz. ·4999712 and ·0004950. These show that Napier was in possession of all the conventions and attributes that enable the decimal point to complete so symmetrically our system of notation, viz. (1), he saw that a point or separatrix was quite enough to separate integers from decimals, and that no signs to indicate primes, seconds, &c., were required; (2), he used ciphers after the decimal point and preceding the first significant figure, and (3), he had no objection to a decimal standing by itself without any integer. Napier thus had complete command over decimal fractions and understood perfectly the nature of the decimal point, and I believe (except perhaps Briggs) he is the first person of whom this can be said. When I first read the "Constructio," I felt some doubt as to whether Napier really appreciated the value of the decimal point in all its bearings, as he seemed to have regarded it to some extent as a mark to separate figures that were to be rejected from those that were to be retained; but a careful examination has led me to believe that his views on the subject were pretty nearly identical with those of a modern arithmetician. There are perhaps 200 decimal points in the book, affording abundant evidence on the subject.

The claim of Napier to the invention of the decimal point is not here noticed for the first time, as both Delambre ("Hist. de l'Astron. mod. t. i. p. 497) and Hutton allude to the decimal fractions in the "Constructio" (though the latter claims priority for Pitiscus), and Mr. Mark Napier ("Memoirs of John Napier," p. 454) devotes a good deal of space to it.

Briggs also used decimals, but in a form not quite so convenient as Napier; thus, he writes 63·0957379 as $63\underline{0957379}$, viz., he prints a bar under the decimals: this notation first appears without any explanation, in his "Lucubrationes" appended to the "Constructio."* Briggs used this notation all his life (he died in 1631), and he explains it in the "Arithmetica Logarithmica" of 1624. Oughtred's symbol first used (as far as I know), in his "Arithmeticæ in numeris"...Clavis, 1631, differed only from Briggs's in the insertion of a vertical bar to separate the decimals from the integers more completely, thus: 63 | $\underline{0957379}$. Oughtred's and Briggs's notation are essentially the same, the improvement of the former being no doubt due to the uncertainty that sometimes might be felt as to which was the first figure above Briggs's line.

From an inspection of MSS. of Briggs and Oughtred (the Birch MSS. contain a letter of Briggs's to Pell, and the Royal Society has a Peter Ramus with many of his MS. notes, while the Cambridge University copy of the "Constructio" is annotated in MS. by Oughtred), it is apparent that in writing, Briggs and Oughtred both made the separating rectangle in exactly the same way, viz., they wrote it 63 |$\underline{0957379}$, the upright mark usually being just high enough to fix distinctly what two figures it was intended to separate, and rarely took the trouble to continue the horizontal bar to the end of the decimals, if there were many. Thus Oughtred was a follower of Briggs, and only made an improvement in the *printed* notation. It is clear that in writing Briggs's rectangle was pretty nearly as convenient as Napier's point, and there is every probability that Briggs appreciated all the properties of the "separatrix" as clearly as Napier; but in his 8 pp. of "Lucubrationes" he has left much less to judge by than has Napier. In 1624, as we can see from his "Arithmetica Logarithmetica," he had full command over decimal arithmetic in its present form (except that he used the rectangular "separatrix" instead of the point). Gunter was a follower of Napier, and employed the point (but see De Morgan). In his "Description and Use of the Sector" (1623), he uses the point throughout pretty much as we do at present (*e.g.* p. 41 of the "First Booke of the Crosse-staffe": "As 4·50 unto 1·00 : so 1·000 unto 0·222"), except that he calls the decimals *parts* in the text. In Roe's "Tabulæ Logarithmicæ, or Two Tables of Logarithme" (1633), the explanatory portion of which was written by Wingate, decimal points are used everywhere; thus we have (p. 29): "As 1 is to ·079578 : so is the square of the circumference to the superficial content," and he takes the case of circumference 88·75, and obtains by multiplication (performed by logarithms) 626·8 for the result. Wingate refers for explanation on the decimal point to his arithmetic, but I have not seen any edition of this work that was published previously to Roe's tables (Watt gives one, 1630). In his "Construction and Use of the Line of Proportion" (1628), Wingate also uses decimals and decimal points.

On the whole, therefore, it appears that both Napier and Briggs saw that a mere separator to distinguish integers from decimals was quite sufficient, without any exponential marks being attached to the latter; but that Napier used a simple point for the purpose, while Briggs employed a bent or curved line, for which in print he substituted merely a horizontal bar

* In an essay "On some points in the History of Arithmetic" (Companion to the Almanac for 1851), De Morgan has further discussed the invention of the decimal point, but in the same spirit as regards Napier. He seems never to have seen Napier's "Constructio" of 1619, and the work is very rare. The only copy I have been able to see is that in the Cambridge University Library.

* A curious blunder is made in Bartholomew Vincent's reprint of the "Constructio," Lyons, 1620 (of which there is a copy in the Royal Society's library). The printer, unaware that the position of Briggs's subscript bars had any meaning, has disposed them symmetrically under all the figures.

subscript to the decimals; that Gunter and Wingate followed Napier, while Oughtred adopted Briggs's method and made an improvement in the mode of *printing* it. Napier has left so many instances of the decimal point as to render it pretty certain that he thoroughly appreciated its use; and there is every reason to believe that Briggs had, in 1619, an equal command over his separator, although there are not enough printed instances of that date to prove it so conclusively as in Napier's case (there is no instance in the "Lucubrationes" in which a quantity begins with a decimal point, and there could not well be one). Napier did not use the decimal point in the "Descriptio" (1614), nor in his book of arithmetic first printed under the editorship of Mr. Mark Napier in 1839, and there is only the single doubtful case in the "Rabdologia," 1617, so that there is reason to believe that he did not regard it as generally applicable in ordinary arithmetic. The only previous publication of Briggs's that I have seen was his "Chilias," 1617, which contains no letterpress at all. The fact that Napier and Briggs use different separating notations is an argument against either having been indebted to the other, as whoever adopted the other's views would probably have accepted his separator too. It is doubtful whether, if Napier had written an ordinary arithmetic at the close of his life he would have used his decimal point. Wingate employed the decimal point with much more boldness, and regarded it much more in the light of a permanent symbol of arithmetic than did (or could) Napier. The Napierian point and the Briggian separator differ but little in writing, and as far as MS. work is concerned it is quite easy to see why many should have considered the latter preferable, for it was clear and interfered with no existing mark. A point is the simplest separator possible, but it had already another use in language. In all the editions of Oughtred's "Clavis" (which work held its ground till the beginning of the last century) the rectangular separator was used, and it is not unlikely that it was ultimately given up for the same reason as that which I believe will lead to the abandonment of the similar sign now used in certain English books to denote factorials, viz., because it was troublesome to *print*. But be this as it may, it is not a little remarkable that the first separator used (or more strictly, one of the first two) should have been that which was finally adopted after a long period of disuse. All through the seventeenth century exponential works [seem to have been common, on which see the accounts in Sir Jonas Moore's "Moor's Arithmetick," London, 1660, p. 10; and Samuel Jeake's "Compleat Body of Arithmetick," London, 1701 (written in 1674), p. 208, which are unfortunately too long to quote in this abstract. In his account Peacock is inaccurate in saying that the "Logarithmicall Arithmetike" was published by Gellibrand and others, the mistake having arisen, no doubt, from a confusion with the "Trigonometria Britannica," 1633; and in any case the reference is not a good one, as the "Arithmetike" of 1631 shows (for reasons which must be passed over here) a less knowledge of decimal arithmetic than do any of the chief logarithmic works of this period. Also Briggs died in 1631, not 1630.

There is no doubt, whatever, that decimal fractions were first introduced by Stevinus in his tract, "La Disme." De Morgan ("Arithmetical Books," p. 27) is quite right in his inference that it appeared in French in 1585, attached to the "Pratique d'Arithmétique." A copy of this work (1585) with "La Disme" appended, is now in the British Museum. On the title-page of the "Disme" are the words "Premierement descripte en Flameng, et maintenant conuertie en François, par Simon Stevin de Bruges." These words appearing also in Albert Girard's collected edition of Stevinus's works (1634) no doubt gave rise to De Morgan's inference that "the method of decimal fractions was announced before 1585 in Dutch." The Cambridge University Library possesses a 1585 copy, entitled "De Thiende... Beschreven door Simon Stevin van Brugghe....Tot Leyden. By Christoffel Plantijn, M.D. LXXXV." (privilege, dated December 20, 1584), and there seems every reason to believe, in the absenc of any evidence to the contrary, that this was the first edition of this celebrated tract. Peacock's statement that "it was first published in Flemish about the year 1590, and afterwards translated into barbarous French by Simon of Bruges" is also, I suspect, founded on no other evidence than the sentence on the title-page of the "Disme," which appears also in Girard. De Morgan rightly remarks that Simon of Bruges is Stevinus himself, but he cannot tell whence Peacock derived the date 1590. It is probable that it was merely a rough estimate obtained by considering the dates of the other works of Stevinus.

Stevinus's method involved the use of his cumbrous exponents. Thus he wrote 27·847 as 27(0)8(1)4(2)7(3)* and read it 27 commencements, 8 primes, 4 seconds, 7 thirds; and the question chiefly noticed in this abstract is the consideration of who first saw that by a simple notation the exponents might be omitted, and introduced this abbreviation into arithmetic.

Napier's "Rabdologia" was translated into several languages soon after its appearance, and I have taken some pains to examine the different ways in which the translators treated the example which Peacock regarded as the first use of the decimal point, as we can thereby infer something with regard to the state of decimal arithmetic in the different countries. Napier (1617) wrote 1993,273 in the work, and 1993,2′7″3‴ in the text. In Locatello's translation (Verona, 1623) this is just reversed, viz. there is 1993.2′7″3‴ in the work, and 1993,273 in the text. The Lyons edition (1626) has 1993,273 in the work, and 1993,2(1)7(2)3(3)† in the text, while De Decker's edition (Gouda, 1626) has 1993,273 in the work, and in the text 1993(0)2(1)7(2)3(3), the last being exactly as Stevinus would have written it. Ursinus's "Rhabdologia," Berlin, 1623, is not an exact translation, and the example in question does not occur there.

SANITARY PROGRESS ‡

SANITARY science is a thing of yesterday, comparatively speaking; but sanitary art, the art of preserving the health, whether of individuals or of communities, has been studied and practised for ages. Sanitary science is the latest and highest development of medicine. I say it is the highest branch of medical science because of the extreme importance of its objects, and I may also add of its results. It is the study of the causes of diseases, and it points out the means of preventing them; and I am sure you are all agreed that "prevention is better than cure;" as Rollet of Lyons well said, "Medicine cures individuals, hygiene saves the masses." But while we contrast hygiene (another name for sanitary science) with curative medicine, we must not forget that it is altogether a medical science, and that its great lights have been all medical men (mind, I am not speaking of the art now, but of the science), and this is necessarily so, and always must be so. I have said that sanitary science is the study of the causes of diseases, of the modes in which they originate, and in which they spread from one person or place to another. It is therefore only those who are acquainted with disease, that are competent to deal with it all, and these are those who have made medical science generally their special subject. You sometimes hear it said that medical men don't know much about diseases. Just think what this means; disease has been studied by earnest men in all its various forms for thousands of years; experiences have been recorded, comparisons made; the effects of remedies noted from generation to generation, and yet we are asked to believe that medical men don't know anything about diseases; the thing is absurd on the face of it.

Sanitary science is, then, a medical science, and the most intimate acquaintance with diseases is necessary for its prosecution —I mean for its advancement as a science. Sanitary investigations can only be scientifically conducted by medical men, just as pianos can only be played by musicians. This science is also the latest development of medical science. We must understand simple things before we can study complex ones. It is little use for a boy to study higher algebra until he has mastered the rule of three; and so pathology, or the study of diseased actions, becomes more and more advanced as physiology—the study of normal healthy actions—is more scientifically pursued; while the study of sanitary matters in a scientific way has only become possible of later years from the great advances made in the study of pathology, physiology, and chemistry; but being possible, it has made such rapid strides, and evolved such startling facts with regard to the causes of diseases, that it has become the popular subject of the day. Everyone thinks that he is competent to speak about it, and everyone who wants to make an effective discourse must needs take upon himself to expound

* Stevinus enclosed the exponent-numbers in complete circles, which have been replaced above, for convenience of printing, by parentheses.

† These parentheses are printed instead of the circles which appear in these works as in Stevinus.

‡ Abstract of the Inaugural Lecture delivered at the Town Hall, Birmingham, Thursday evening, Oct. 9, 1873, by Prof. Corfield, M.D. Oxon.

some, to him, new view of sanitary matters; this is very mischievous. A man may do more harm by giving the weight of his authority to erroneous views respecting the method to be employed for the prevention of diseases than he has done good during the whole of his life in any other way. None but those who have made a special study of this subject have a right to speak on it, or at any rate have a right to influence the public mind with regard to it. The amount of good which may be done by the exposition of correct views on sanitary matters is incalculable; the amount of evil done by the enunciation of erroneous views, backed by apparent authority, fearful.

But if sanitary science is a thing of yesterday, such is not the case with the observation of sanitary facts, nor with the practice of sanitary art; and, while it is true that sanitary science is essentially and entirely a medical study, and is necessarily so, it is equally true that the practice of the art of preserving the health is not only possible to all, but is a duty which devolves upon all. In all ages we have had writers on this subject. From all countries we may learn useful lessons about it. From the times of Hippocrates, Galen, and Celsus, we have had records of the results of observations on the methods of preserving the health; from the time of Moses we have had lawgivers imposing salutary conditions of existence upon unwilling, because ignorant populations. We look upon the immense engineering works undertaken and carried out by the Romans to supply their towns with pure water with astonishment, when we turn round and see our own towns supplied from polluted rivers, or, worse still, from shallow wells dug in the soil upon which they themselves stand, wells supplied in most cases chiefly by the foul water which has percolated from the surface of the ground. We have found out in later times that one of the main conditions of the health of communities depends on the purity of the drinking water, and we see that the Roman engineers, by having to go to a considerable distance for water in order to get it to a sufficient height in their cities, accidentally, as it were, fulfilled one of the most important of sanitary requirements.

"Knowledge is power," and as we come to know more of the conditions which favour the spread of diseases, as we do daily, it is our own fault if we neglect to use the power which that knowledge gives us. There are two conditions of insalubrity which are pre-eminent. I hardly know which to place first. The one is overcrowding, and the other the accumulation of refuse matters in and about dwellings. These conditions were those which especially favoured the spread of the fearful plagues of the middle ages; as a result of over-crowding we have a deteriorated condition of the air, from the diminution of the amount of its most essential constituent, oxygen; and, worse still, we have it rendered foul by the exhalation of decomposing organic matters from the bodies of the persons breathing it. Such a state of air is especially favourable to the multiplication of the poisons of diseases; such a state of the air is also brought about by the non-removal of refuse matters from the vicinity of habitations. Dr. Laycock tells us that the plague in York in each of its visitations, and also the cholera, broke out in the same abominably filthy place; and in cholera epidemics it has been repeatedly noticed that those parts of towns which are most filthy and most over-crowded, always suffer worst.

But the danger is not only from special epidemic diseases. Such insanitary conditions induce a lowered vitality of the inhabitants, who become prone to attacks of diseases of all sorts; and then we have sickness, inability to work, and consequent inability to earn bread and to pay rents, and so the evil recoils from the tenants upon the landlords. One witness says, "Rent is the best got from healthy houses." Another, "Sickness at all times forms an excuse for the poorer part not paying their rent, and a reasonable excuse."

I consider that one of the most important conclusions that the study of sanitary science has forced upon us lately is the conclusion that the immediate removal of refuse matters is one of the first necessities of the healthy existence of a community. There are those who would have you believe that refuse matters may be rendered innocuous in one way or another, so that they may be kept with safety in and near to houses. Don't listen to them; the principle is wrong—radically wrong. Depend upon it that the true method is to get rid of such matters at once, and in the simplest possible way, and that is the cheapest plan in the end. Show me a town where refuse matters are kept—no matter how they are treated—and I will show you a town where the standard of vitality is low; I will show you a town with a high death-rate, especially among children.

To take the other side of the question, look at London. There you have a population of 3¼ millions, with the lowest death-rate of any very large collected population in the world, with one of the lowest death-rates among the large towns of even our own country. Why is this? I say unhesitatingly, and without fear of contradiction, that with all allowances made for the excellent position of London, it is mainly due to the fact that the principle there, however incompletely it may be carried out, is the immediate removal of all refuse matters; in London, the water-carriage system, by which the foul water containing a very large proportion of the refuse matters of the population, is removed by gravitation in sewers, is carried out far more perfectly than in any other large town, and this system is daily being rendered more perfect there; it is the right system based upon a true principle, and its results are most salutary. When you have got rid of refuse matters, then see what you can do with them; and here arises a very curious consideration. Sewers, in most instances, were not originally built as sewers, but as drains; a sewer is a conduit for the removal of fouled water; a drain is a channel for the removal of mere superfluous water, the object being to dry the soil. The pattern of all our old sewers, the Cloaca Maxima at Rome, was originally a drain; it was constructed by Tarquinius Priscus, the fifth King of Rome, 600 years B.C., to drain the marshy ground between the Palatine and Capitoline hills, and it was so well constructed that it drains that ground at this moment. Pliny wondered that it had endured 700 years unaffected by earthquakes, by inundations of the Tiber, by masses which had rolled into its channel, and by the weight of the ruins which had fallen over it. What would he say could he see it now, as any of you may who choose to go to Rome, still discharging, after more than 2,400 years, its dirty water into the Tiber? But the convenience of the great drain for the disposal of refuse matters soon became apparent, and so it was turned into a sewer, and has been one ever since.

Well, what are we to do with the refuse sewer water, when we have got it out of our towns? This is one of the greatest questions of the day. Drains, of course, were naturally made to discharge into rivers, their proper place, so long as they were only drains; but when they come to be used as sewers, this will not do; in the first place the rivers are fouled, and in the next the manure is lost. I shall be able to show you in the course of the lecture that the only way known by which sewer water can be either purified or utilised, is by turning it, with suitable precautions, on to land, that this may be done, not only without injury to the health of the neighburhood, but with great benefit in many ways.

We have spoken of drains to dry the soil; what is the necessity of this? Every farmer knows that crops will not flourish on undrained land; neither can human beings; a damp house is a synonym for an unhealthy house, you all know that; but it is only within the last few years, as the result of a most important sanitary research, made by Dr. Buchanan, that we have come to know as a scientific fact, beyond all dispute, that the drying of the soil of a town reduces the number of deaths from consumption in a most extraordinary manner; in some towns the number of deaths under this head has been reduced by one-third or even by one-half, in this way.

To mention some other special diseases which have been successfully combatted of late years, look at scurvy, that terrible malady which formerly decimated our navies! We know now that that disease may be prevented by the use of limejuice as part of the daily food, and we are no longer afraid of it. (Some illustrations of the ravages of this disease were given.)

Look at small-pox, beyond all exception the most fearful epidemic disease with which the world was ever afflicted! We know how to prevent it, and we have recently had a very severe lesson from not applying that knowledge. It is to the immortal credit of England that Jenner, the discoverer of vaccination, was an Englishman; there are certain people, and they have actually formed a society, who are trying to get compulsory vaccination done away with in this country. Let me tell you that if there is one fact established in preventive medicine it is that vaccination affords a protection from small-pox; let me tell you that this statement is founded upon an induction such as has been brought to bear upon no other subject in medical science; and, let me add, that those persons who bring isolated facts as arguments against a statement so supported, show that they have no idea of the nature of an inductive argument at all. An unvaccinated person is a danger to the community, and ought not to be allowed o go at large, and so far from persons being merely fined for not allowing their children to be vaccinated, and then permitted to keep them unvaccinated, the children ought to be vaccinated by the public vaccinator, even in spite of their parents, who should not be allowed to risk their children's lives through their own obstinacy and ignorance; and not only their children's lives, but those of the persons around them. The recent epidemic of small-pox showed us several important things—it showed us what we knew before, that small-pox is far more fatal to unvaccinated than to vaccinated persons; it showed us that while small-pox is especially fatal to unvaccinated children, it is less fatal to vaccinated children than to other persons; thus demonstrating the necessity of re-vaccination, and it showed us that re-vaccination once performed is actually a better protection against small-pox than a previous attack of small-pox is. You know that it is not common for a person to have small-pox twice. Well, it is much less common for a person to have small-pox after he has been successfully re-vaccinated, and if he has it is almost certain to be a very mild attack. Out of nearly 15,000 cases of small-pox admitted into various London hospitals during the late epidemic, only four presented proof of having been re-vaccinated.

Let us pass on to typhoid fever. Here is a disease of the very existence of which, as distinct from certain other diseases, we have only known in recent times, but yet a disease about which, thanks to the researches of men now among us, one of whom it especially becomes me, as his pupil to mention, Sir William Jenner, we really seem to know more than about almost any other disease; a disease which we deliberately hunt down to its source, and stop just as we could stop the supply of stone from a quarry or of rifles from an armoury; a disease, the haunts and habits of which we know with such accuracy that we are able to go into a house and say, "Alter this, and alter that, or you will very likely get typhoid fever here," a disease the ways of which we know so well, that, when there has been a case of it caused by local defects in a house, we can almost predict what alterations are required without going to the place. Surely the results obtained from the study of this disease are some of the most striking results of sanitary progress in our day. I find that the idea has become widely spread that the recent epidemic of typhoid fever in London was due to the distribution of milk from a sewage farm; this was not so, and I regard it most in the light of a special providence that none of the milk sent out from that establishment came from a sewage farm: had it been so, such a fact, combined with the prejudice and ignorance which exists upon the matter, would have dealt a severe blow to the progress of one of the greatest sanitary improvements of the day. The cause of that epidemic is known with absolute certainty, the very channel by which the poison got into the dairy well having been recently unearthed.

I must allude, for an instant, to the recent sanitary legislation; it has been found fault with by many on account of matters of detail; but consider the fact that the result of it is that the country has spent a large sum of money in the employment of medical officers of health and sanitary inspectors, and that such men now exist, and you will see that in it we may find great cause for rejoicing when looking to the future of sanitary progress. In a lecture on the "History of Hygiene," which I delivered some three or four years ago at University College, London, I said, "From its very nature, hygiene interests all classes of society; but it is to those who are worst off—the poorest and most wretched—that it must direct its first attention. Civilisation has its evils as well as its advantages, as Bouchardat has well remarked; and one of the greatest of them is the over-crowding of people in the great centres of population, with the misery and disease which are the results of it. It is to better constructed houses for the working classes, to a free supply of good water, and to satisfactory sewerage arrangements, that we must look for an amelioration in these respects; and I would hasten to add, to a wider spread among those classes of such an education as shall lead them to appreciate the means used for the improvement of their condition, and to lend a helping hand for the furtherance of those means."

I feel that I cannot do better in conclusion than congratulate this town on having, through the munificence of one of its citizens, been the first to appreciate the importance of the education of the people in these subjects, and on having such an institution as this in which so much useful knowledge is imparted to the people, and congratulate myself on having the privilege of such an opportunity of spreading broadcast the great truths of sanitary science. The time is fast coming which was looked forward to by Dr. Parkes when he wrote:—"Let us hope that matters of such great moment may not always be considered as of less importance than the languages of extinct nations, or the unimportant facts of a dead history."

SCIENTIFIC SERIALS

THE current *Ibis* commences with the latter part of Mr. Brooke's notes on the ornithology of Sardinia, special attention being drawn to *Otis tetrax*, which is moderately common; *Phœnicopterus roseus*, which occurs in large flocks during the winter and even up to June; the presence of *P. erithacus* is doubtful. *Fulica nigrosa* was not seen, though included in both Cara's and Salvadori's lists. In the museum there are several specimens o *Phalacrocorax desmarestii*, and *P. carbo* is extremely common. *Larus andouini* is found, though very rarely.—Captain F. W. Hutton, in a note on *Rallus modestus* of New Zealand, gives evidence to show that Dr. Buller is in error when he considers *R. modestus* to be *R. dieffenbachii*, in an immature state of plumage, as the proportions of the chicks are different, and the bill of the latter more slender.—Messrs. Salvin and Elliot in continuation of their notes on the *Trochilidæ*, discuss the genus *Thalurania*, which is exclusively tropical, and consists of eleven species and five sections.—In notes on Chinese ornithology, Mr. R. Swinhoe draws special attention to *Ceryle rudis* at Ningpo, *Gallinago solitaria*, *Endrominas veredus*, and other land as well as water-birds found at Shanghai.—Mr. Sclater supplements Mr. Salvin's list of the birds of Nicaragua, with additions from a recent small collection made by Mr. Belt, adding seventeen species, mostly well known through Central America.—Mr. E. L. Layard gives notes of the birds observed in Para; and Mr. Sclater describes and figures two new species named by him *Picolaptes layardi*, and *Thamnophilus simplex*.—Captain J. H. Lloyd on the birds in the province of Kattiawar in West India, commences the detailed account with an interesting comment on the general ornithological description of the region.

THE *Monthly Microscopical Journal* for October, commences with a description, by Mr. F. H. Welch, of the thread-worm *Filaria immitis*, occasionally infesting the vascular system of the dog, with remarks on the same, relative to Haematozoa in general, and the Filaria in the human blood. The specimens described were obtained from the right ventricle and pulmonary artery of a dog, from Shanghai, the male, female, and young being described. The left ventricle also contained some of the young.—Dr. Royston-Pigott fully illustrates a paper entitled "Researches in Solar Spectra, applied to test residuary aberration in microscopes and telescopes; and the construction of a compensating eye-piece, being a sequel to the paper on a searcher for aplanatic images."—Dr. Rutherford describes a new freezing microtome in which the freezing box and escape tube are much larger than in his older instrument, and the indicator is improved.—Mr. Ch. Stodder, in a letter, points out that it is inaccurate to suppose that the nominal price of American objectives is directly comparable with that of English makers, as the value of money in the two countries is so different, and duty has to be paid on entering the former.

Annali di Chimica applicata alla Medicina, July number, 1873. —We notice in this journal, besides a number of formulæ for pharmaceutical preparations and other details interesting to the druggist, a paper by A. Gubler, on experiments with new and old opium alkaloids, which deals, amongst others, with apomorphia.—There is also a translation of Mr. Simon's memorandum on the diffusion of cholera, and other papers from native and foreign sources. In the *Rendiconto delle sessioni dell' Academia delle scienze dell' Istituto di Bologna*, 1872–1873," are given briefly (in about 189 pages) abstracts of the papers read before the Society, together with other matter of the usual nature.

Reale Istituto Lombardo di scienze e Lettre Rendiconti, Fascicolo xiii.," July 1873.—This number contains several critical literary, historical, and philosophical papers, including one on Kant's philosophy, by C. Cantoni.—In the scientific section there is a paper by Prof. Cavalleri on improvements in the helioscope, and a portion of a paper by P. Cantoni on electrical adherence, which is illustrated with several tables of data. —Fascicolo xiv. contains a paper on the capacity of the nasal fossa, by P Mantegazza, and one on cholera by G. Strambio.—C. Lombroso details some experiments on the tonic action of maize (*guasto*) affected with the *Pencillum glaucum*. The author maintains that the maize in this state acts injuriously. G. Sangalli, who replies to the paper, maintains that the effects are due to another cause.—New comet discovered at the Royal Observatory of Milan, by G. Tempel; communicated by G. V. Schiaparelli.—The continuation of P. Cantoni's paper on electrical adherence is given.—The other papers are on the propagation of the corpuscle cornalia, by C. Gibell, and a letter on a purulent disease of one hemisphere of the brain, by L. Porta.

SOCIETIES AND ACADEMIES

PHILADELPHIA

Academy of Natural Sciences, June 3.—Dr. Ruschenberger in the chair.—"Fertilisation of *Pedicularis canadensis*." Mr. Thomas Meehan drew attention to the structure of the flower of *Pedicularis canadensis*, in which it was evident self-impregnation was impossible, and there seemed to be no special arrangements for fertilisation by distinct agency, as there were in so many allied plants. In this case the stamens were included in the closely compressed arch of the corolla, and, with the anthers, were directed retrorsely to the pistil, which at an early stage, and long before the maturity of the pollen, was protruded beyond the corolla, rendering self-fertilisation almost impossible in this flower. But the flowers were always abundantly fertile, and though the arrangements were such as seemingly to afford no chance even for insects to aid in the fertilisation, it was also probable that in some way it was accomplished by them. Both last season and this he had devoted some time to watching the plant, but failed to find any clue to the process. A species of *Bombus* seemed to have the plant especially under its charge, visiting the flowers in great numbers; but they bored through the corolla on the outside of the tube for the saccharine matter, and the anthers or pollen did not seem to be in the least disturbed by this. Still it was so highly probable that in some way some insect aided in the cross-fertilisation of these flowers, that it might serve a useful purpose to direct attention to it, as others with time and opportunity might discover what he had failed to find.

RIGA

Society of Naturalists, April 16—M. Tank communicated some observations on honeydew, which he thinks is an immediate excretion of the leaves due to cooling.—M. Behrmann gave reasons for doubting the supposition that certain fires which occurred almost daily from October to December last year, in a village of the Orel Government, arose from phosphuretted hydrogen out of the marshy ground.

April 23.—M. Petzholdt read a paper on the composition and formation of Imatra stones. Various hypotheses of formation have been given—the gyratory, the stalactitic, the geological, the vegetable, the animal, &c. Parrot supposed the stones to be petrified, shell-less molluscs. M. Petzholdt formulates his view thus:—In a slimy layer of fine sand, mud, and carbonate of lime, are formed, through mutual attraction of particles of the latter, several ball-heaps of lime. Next, dry deposition of the whole at a later epoch. Disturbance of the stratum by water, setting free the hard spherical masses (Imatra stones).

April 30.—M. Pfeiffer showed a small headless chick with large legs, found dead with another, which was alive in the same egg. The two were connected by a fibre. After separation the living chick throve normally.

May 21.—M. Glasenapp gave a note on blackened wood in certain trees blown down in a storm. The blackening is attributed to a kind of fungus which formed on the north side of the trees while yet standing.—M. Gottfriedt read a paper on enclosure of diamonds in xanthophyllite; the supposed diamonds he finds to be merely hollow spaces, erosion figures. —M. Teich gave an account of an excursion to North-West of Kurland.—The *Correspondenz Blatt*, No. 9, contains a description of the snakes of the Baltic Provinces, of which there are three species—*Vipera verus*, *Tropidonotus natrix*, and *Coronella laevis*.

GOTTINGEN

Royal Academy of Sciences, Aug. 6.—Dr. Paul du Bois-Reymond communicated a paper on the representation of functions by Fourier's series.

Aug. 13.—M. Waitz compared some points in the Annales Sithiensis, relative to Pippin and Charlemagne, with other annals of the time.—M. Ewald gave a paper on the passage, Ezek. xlv. 12: "Twenty shekels, five-and-twenty shekels, ten-and-five shekels shall be your maneh." The maneh, it is known, originally contained 60 shekels (which these numbers make up), and this enumeration, he thinks, was in order to exactness and certainty, not because there were coins of these several values. The Septuagint version (rightly read) makes the maneh 50 shekels, and it is known there was such a maneh. The author advances a theory, on which the passage affords evidence of both manehs having been known in the first half of the sixth century B.C.—Dr. Voss communicated a note on the geometry of focal surfaces of congruences.

Aug. 20.—M. Minnigerode gave a long paper on a new method of solving Pell's Equation $t^2 D\mu = 1$.

PARIS

Academy of Sciences, October 6.—M. Bertrand in the chair.—The following papers were read:—Note on the means used to obtain a constant temperature in rooms and on the methods of moderating it during the heat of summer, by General Morin.—On new propyl compounds, by M. A. Cahours. The author described several ethers of the propyl series.—Certain considerations on the yellow elastic tissue and its immediate organic analysis, by M. Chevreul.—Treatment of carbuncle and malignant pustule by carbolic acid and ammonic carbolate, by M. Déclat.—Statistical tables of the losses of German armies in France during the war of 1870-1, by Capt. D. H. Leclerc.—The subcutaneous infarctus of cholera, by M. Bouchut.—On the improvement in healthfulness caused by the growth of *Eucalyptus globulus* in marshes, by M. Gimbert.—Studies on the *Phylloxera*, by M. Max Cornu.—On the action on the vine of the carbonic disulphide used to destroy the *Phylloxera*, by M. Lecocq de Boisbaudran.—On the size and variations of the sun's diameter, by S. Respighi. The author in his letter criticised Secchi's statements as to the difference between the nautical almanac diameter and his own observations by monochromatic light. He regarded Secchi's observations as erroneous.—On the theory of the thrust of earthworks, by M. J. Curie.—On the condensation of gases and liquids by carbon, by M. Melsens. The author noticed the thermal phenomena produced by the contact of the liquids with carbon, &c.—On the production of certain borates in the dry way, by M. Ditte.—Researches on tribromacetic acid, by M. H. Gal.—On the development of *Batrachians*. This was a note on the embryos of *Hylodes martinensis*, by M. Bavay.

PAMPHLETS RECEIVED

ENGLISH.—Synopsis of all the Mosses known to inhabit Ireland: David Moore, Ph.D.—Lobley's Geologist's Excursion to the Malvern District.—Proceedings of the Belfast Natural History Society for 1871–2.—Leyton Astronomical Observations.—Report, Chester Society of Natural Science.—Law of Elliptic Motion deduced from the Laws of Gravitation and Compound Rotation: G. Hamilton.—Milk, Typhoid Fever and Sewage: Alfred Smee.—Contributions to the Knowledge of the Meteorology of the Antarctic Regions.—A new Method of obtaining the Differentials of Functions; Profs. Rice and Johnson.—Count Rumford, How he Banished Beggary from Bavaria: T. L. Nichols, M.D.—A Scamper across Europe: T. L. Nichols, M.D.

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