THURSDAY, OCTOBER 21, 1875

BANCROFT'S "RACES OF THE PACIFIC STATES"

The Native Races of the Pacific States of North America. By Hubert Howe Bancroft. Vol. ii. Civilised Nations. Vol. iii. Myths and Languages. (London: Longmans and Co., 1875.)

THE publication of this great anthropological work goes on rapidly, and no doubt the two remaining volumes will be out in a few months. Every reader must be glad that the author departs more and more from his original plan of making his book a mere museum of compiled information, and now makes some attempt towards interpreting the mythical and religious puzzles of Mexico and Central America. The introductory essays on the philosophy of civilisation and religion may not be of startling originality, but at any rate they are the deliberately adopted conclusions of a writer with an unusually large knowledge of the facts. Mr. Bancroft has evidently come, like so many thinkers of this generation, under the genial influence of Emerson. To his mind, the world seems animated by a "Soul of Progress," individual men working on unknowingly, and often against their will, towards a mysterious end which is the goal of civilisation. The two apparently oppugnant agencies of good and evil tend together toward one end; "Night or day, love or crime, leads all souls to the good." At one stage of civilisation blind faith is essential to give strength to man's belief, till at another stage scepticism has to come in and destroy the scaffolding of superstition, leaving the mental fabric which has been reared by its means. War and tyranny do the work of consolidating nations and founding political institutions, till the time comes when, having done their work in promoting good, they may themselves be cast out for being evil. Institutions which were at first the essentials of civilisation become, as man advances, a drag on his progress, and have to be abolished. The union of Church and State, of superstition and despotism, a union still necessarily kept up in some of the more backward civilisations, was in barbarous ages a real means of moral and intellectual advance from a wilder and lower state. Thus we see in every phase of development the result of a social evolution, but where it is to end, whither it is tending, we cannot tell as yet, nor can we yet fully understand its guiding laws, for "like all other progressional phenomena, they wait not upon man; they are self-creative, and force themselves upon the mind age after age, slowly but surely, as the intellect is able to receive them."

One really stands in need of some such hopeful theory of social evolution, in reading the details of Mexican religion. The chapter on Public Festivals is a sickening catalogue of horrors. It begins mildly with the priests scarifying and mutilating themselves, especially by boring holes in their tongues to pass sticks through. Then comes the sacrifice of a number of sucking infants, who were carried in procession on gorgeous litters to be slain on the mountains and in the lake, some of the bodies being brought back as a delicacy for the priests and nobles. Then an account of a festival, where the human victims, having had their hearts cut out in the usual way on the sacrificial stone, were then flayed; their flesh was eaten at a banquet, and the lads of the colleges dressed up in their skins and went about singing, dancing, and asking for contributions: "those who refused to give anything received a stroke in the face from the dangling arm." A little later comes the feast of the Fire-god, where the priests carried captives naked and bound, on their shoulders up to the top of the temple, and pitched them into a huge fire of glowing coals, where they watched them writhe and crackle till it was time to rake the almost dead bodies out and cut them open; the proceedings ended with a dance and climbing a maypole. Even at the harvest festival, an occasion of jollity, when everybody danced and feasted, these sanguinary religionists brought out a criminal, put him between two immense stones balanced opposite each other, and let them fall together so as to smash him.

It is not easy, in the present condition of Sociology, to account for this monstrous development of cruelty in the Mexican religion. The people seem not to have been either wicked or hard-hearted in their private life, but to have been the same mild and rather stolid people that their descendants still remain. The Aztec criminal code was indeed of the severest, and even Draco might have scrupled to have a man beaten to death with clubs for getting drunk, or to make stealing a tobacco-pouch a capital crime. But there is nothing extraordinary in a barbarous government trying to stamp out even small offences by ferocious punishments. That these lose much of their effect by the public mind becoming too habituated to them, is a discovery which comes at a higher stage of statecraft. The state of civil society in ancient Mexico was on the whole like that of many other half-civilised communities. It was their religion which was exceptional, in the enormous frequency of human sacrifice combined with cannibalism, it being the ordinary motive for war to obtain a supply of captives for victims. The nearest parallel is to be found in nations of West Africa, where human sacrifice and cannibalism form a great part of the religious observances. The Dahoman custom of dividing the human victim, the blood for the fetish, the head for the king, the body for the people, reminds us of similar arrangements described by Mr. Bancroft in Central America. On the other hand, the religion of Mexico, unlike those of West Africa, was one in which asceticism and self-torture prevailed both among priests and people. They fasted long and severely in their religious rites, and were everlastingly drawing blood from their bodies with aloe-thorns and obsidian knives, piercing their tongues as a penance for evil speaking, and other parts of their bodies for appropriate sins. This religious ordinance is almost peculiar to the group of connected nations of Mexico and Central America, and thus has a certain ethnological interest. The Mexican combination of religious austerity and cruelty may be instructively compared with that which developed itself in mediæval Europe.

Mr. Bancroft is inclined to think that the civilisation of Mexico and Central America had sunk somewhat from its highest point at the time of the Spanish discovery. He believes in the high culture of the famous traditional Toltecs, who were of the same stock with their successors the Aztecs, both belonging to the wide Mexican race to which modern writers apply the old designation of Nahua (Nahuatl). But his description of the Aztec civilisation at the time of the Spanish Conquest scarcely suggests a state of decay. The handicrafts of the stonecutter, the weaver, and the goldsmith, the elaborate organisation of the priesthood and the army, of the colleges for training boys and girls, and of the guilds of merchants, were found by the Europeans in full vigour. The Mexicans not only had a system of picture-writing and kept their chronicles in it, but King Nezahualcoyotl is said to have made a law prescribing the penalty of death on historians who should record fictitious events. This same king made severe forest-laws to prevent the supply of wood in the country being exhausted, so that the people did not dare even to pick up the fallen wood. Such a state of things may indicate a certain stiffness and artificiality of law and custom, but hardly a fall from an earlier higher state. In any new discussion of the problem of American civilisation, for which these volumes afford the first ample collection of materials, we should prefer reasoning on Aztec life as Cortes saw it, to speculating on the institutions of the half mythical Toltecs of tradition.

In looking through the present volumes two observations suggest themselves. Mr. Bancroft has drawn up descriptions of the languages of the Pacific district which are of some use in defining the general structure of each, and justifying the class-arrangement which he adopts. But he only gives a few specimen words of each language, such as pronouns, numerals, incomplete parts of a verb, and perhaps a Lord's Prayer. We wish, considering the space he has spared for native myths, that he had found room for a series of concise grammars. The existing grammars and dictionaries of many of these languages, even such as Aztec and Maya, which are the spoken languages of large populations, are so scarce and costly as to be out of the reach of ordinary philologists. For instance, it is difficult to get sufficient information as to one of the most curious languages of Mexico, the Otomi, described by several writers as a real monosyllabic language imbedded among languages like the Aztec, whose formation is polysyllabic-agglutinative in the extreme. This is a most interesting phenomenon in philology, and we looked to Mr. Bancroft at least to settle the disputed point whether the Otomi tongue is really monosyllabic. There are plenty of polysyllables in it, such as *tayo*, dog ; *nxuyo*, bitch ; *mahetsi*, heaven ; *nuga*, I. But the question is whether the statement is fully borne out, that "in words compounded of more than one syllable, each syllable preserves its original meaning." In the first two instances this is evidently true, *ta-yo*, *nxu-yo* being decomposable as "male dog," "female dog." Whether the other two words can be analysed we do not know. So interesting is the Otomi tongue for its bearing on the theory of the monosyllabic origin of language, that it would be worth while to collect and reprint everything that is known about it. For one thing thanks are due to Mr. Bancroft, that he insists on the merely accidental character of such resemblances as exist between Otomi and Chinese. Naxera's baseless theory of a connection between these two languages had publicity given to it by Prescott, and is not yet forgotten.

The collection of cosmogonic traditions in the third volume is remarkable, and may lead us to expect valuable results to science when the creation-myths of all tribes and nations of the world shall be put together and carefully analysed. Many of them are of course mere products of childish fancy. In Central California the story is that in the beginning the world was dark, so that men and beasts and birds were always stumbling and dashing against one another. The Hawk happening to fly in the face of the Coyote (Prairie-wolf), they mutually apologised, and set to improve things. The Coyote made balls of reeds and gave them with some pieces of flint to the Hawk, who flew up into the sky with them and set them alight. The sun-ball still glows red and fierce, but the moon-ball was damp, and has always burnt in a feeble, uncertain way. The Southern Californians, on the other hand, believe that the sun and moon were the first man and woman ; women, descendants of the moon, are fair but fickle, for as she changes so they all change, say these savage philosophers. Such mythical fancies, of which there are numbers in this one district, fall within the province of the pure mythologist. But it is an interesting question whether, among the legends of catastrophes which altered the face of the earth and destroyed its inhabitants, there may be any dim recollections of actual events, recognisable by the antiquary or the naturalist. To take another example from California, the natives about Lake Tahoe ascribe its origin to a great natural convulsion. Their story is that their ancestors were once numerous and rich, but a stronger people rose up who defeated and enslaved them. Then the Great Spirit sent an immense wave across the continent from the sea, which engulfed both oppressors and oppressed, all but a small remnant. Those who remained of the ruling caste made the people build a great temple for refuge in case of another flood, and on the top of this the masters worshipped a perpetual fire. Soon, however, the earth was troubled again, this time with strong convulsions and thunders. The masters took refuge in their great tower, shutting out the slaves, who fled to the Humboldt River, and paddled for their lives, for the land was tossing like a troubled sea, casting up fire, smoke, and ashes. The Sierra was mounded up from the bosom of the earth, while the place where the great fort stood sank, leaving only the dome at the top exposed above the waters of Lake Tahoe.

Such is the local story, remarkable for its good descriptions of an earthquake-wave, an eruption, and a volcanic upheaval and subsidence. Whether it is founded on some fragmentary reminiscences of a real local catastrophe is a question which we leave to be answered by some geologist who has examined the district.

HUXLEY AND MARTIN'S "ELEMENTARY BIOLOGY"

A Course of Practical Instruction in Elementary Biology. By T. H. Huxley, LL.D., Sec. R. S., assisted by H. N. Martin, B.A., D.Sc. (London : Macmillan and Co., 1875.)

IN the preface to this work, Prof. Huxley tells that the object of his book is to serve as a laboratory guide to those who are inclined to study the principles of Biology as a single science, and not as one divided, except for the sake of convenience, into the two "disciplines," Zoology and Botany. To accomplish this end a certain number of readily obtainable plants and animals have been selected for minute description, in which the most important types of vegetable and animal organisation are capable of being demonstrated. With reference to each species selected, an account of its anatomy is given, which is followed by laboratory instructions as to the manipulatory detail necessary for its complete verification. The types selected include Yeast, Protococcus, the Proteus Animalcule, Bacteria, Moulds, Stoneworts, the Bracken Fern, the Bean Plant, the Bell Animalcule, the freshwater Polype and Mussel, the Crayfish and Lobster, and the Frog. As an illustration of the form in which the laboratory directions are given, the following quotation from a portion of the dissection of the Frog will serve as a fair example:—

"DISSECTION OF THE VISCERA IN THE VENTRAL CAVITY.

"1. Lay a frog, which has been killed with chloroform, on its back, and pin it out on a layer of paraffin or beeswax, under water; divide the skin along the abdominal median line from the pelvis to the front of the lower jaw; next make a transverse incision at each end of the longitudinal one, and then throw outwards the two flaps of skin thus marked out. The following points may now be noted:—

"*a.* A great vein (*musculo-cutaneous*) on the under surface of each flap of skin, about the level of the shoulder.

"*b.* Some of the muscles of the abdominal wall, covered by a thin aponeurosis; through this latter can be seen—

"*α.* The *rectus abdominis*, running from pelvis to sternum, close to the middle line, and divided into a number of bellies by transverse tendinous intersections.

"*β.* Other muscles outside the rectus on each side.

"*c.* The *pectoral region*: part of its hard parts in the middle line, only covered by tendinous tissue; external to this, muscles running towards the shoulder-joint.

"*d.* The *muscles of the throat*: small and with a general direction from the lower jaw towards the sternum and shoulder-girdle.

"2. Raise the tissues of the body-wall with a pair of forceps, and carefully divide them, a little to the right of the median line," &c.

From what has been said above it is evident that there are two features in this volume of Prof. Huxley's which call for special notice on account of their novelty. The first of these is that Botany and Zoology are taught in combination, as parts of the science of living organisations—Biology. The second is that the subject is taught practically; in other words, with full information on how to observe the features described.

Most amateur students of so-called science, or collectors, run in a single groove of thought. They learn to recognise specific differences in those groups of animals, fossils, or plants which they honour with their patronage; they discover minute variations in individual specimens, and frequently attempt to load nomenclature with fresh names, which may or may not have to be swamped in the mass of synonyms—already but too large—according to their knowledge of the literature of the subject they affect. In the scale of scientific investigators these stand lowest. They do good; their work is indispensable; the mental effort required for its production is, however, small, and is generally associated with a want of power to grasp general principles which is frequently quite surprising. The opportunity of seeing, or, better still, possessing "type" specimens is their highest gratification; and their opinion on any point involving more than generic differences is unreliable.

A second class of student advances further. Collection of familiar forms is not the object kept in view by them. They study the literature of their subject, having previously received a sound educational foundation. They do not make fresh and independent observations themselves, but delight in verifying those of others. New facts they absorb; and by engrafting them upon their previous ideas, modify the latter—generally prematurely—in a direction which they prophesy to be the science of the future. They draw extreme deductions on insufficient evidence, and are apt to fall whilst attempting to substantiate them. These are not to be trusted in the definition of a sub-kingdom.

A third class investigate on their own account. They study the works of others; and by thoroughly digesting the new and old facts at their disposal, are in a position to modify generally accepted views on important questions by the publication of arguments as cogent as they are reliable. These original investigators have their independent views on the most general principles.

Such being the case, we may employ the scale of biological relationships as a rough standard of the mental capacities of working students. It leads us to look upon everything which tends to inclusiveness as an advance in the right direction, and everything in the opposite direction as retrograde. All biologists must therefore thank Prof. Huxley for having introduced into the preliminary training of students of Natural History the conception of the complete unity of plant- and animal-life, and of the comparative insignificance of the gulf between the two.

Prof. Huxley teaches Biology *practically*. The pupil has to see with his own eyes all that he reads about; and what is more, he has to find what he is to see. Practical education is a praiseworthy characteristic of the present age. Numbers of laboratories, in this country and on the Continent, have been recently established for the teaching of Physics, Physiology, and lastly Biology. That this practical phase must be generally adopted in scientific education becomes more certain as the scientific training itself becomes more and more a part of the preliminary education. The tendency in recent times to estimate classics at a lower value as a discipline than formerly, is one which necessitates the introduction of a substitute; of a means by which a training in the method of work shall be the mental exercise, whilst mere facts shall not have the prominence generally given them in the scientific lecture-room. As a training, practical biology offers all the requirements, at the same time that it leaves those who have pursued it, after they have finished their education, in a position peculiarly favourable for the prosecution of original investigation on their own account. From this view of the subject we have also therefore to thank Prof. Huxley for having added Biology to the list of those sciences which are taught practically as well as theoretically.

It has also special advantages in this direction. No expensive outlay is necessary for the purchase of apparatus; a well-lighted room, together with a microscope, scalpels, forceps, and scissors, being nearly all that is essential to a biological laboratory. These can be procured by anyone; and the student when thus equipped with Huxley and Martin's "Practical Biology" in his hands, need only look around for some of the most easily obtainable animals, upon getting which he can start work in good earnest.

In the descriptive portion of the work there is one point to which we cannot help referring, which is in connection with the circulation of the blood. It is an explanation, originally given by Brücke, we believe, of the manner in which the mixed arterial and venous blood in the single ventricle of the frog is distributed in such a manner that the venous blood mostly enters the lungs. "It fills (during the systole) the conus arteriosus, and, finding least resistance in the short and wide pulmonary vessels, passes along the left side of the median valve into them. But as they become distended *and less resistance is offered elsewhere*, the next portion passes on the right side of the longitudinal valve into the aortic arches." The words italicised by us are those which it is difficult to comprehend, for it is evident that if the pulmonary artery offers less resistance at the commencement of the systole, it will do so all through the revolution in proportion to the relative calibre of its capillaries and those of the system generally; and then there is no reason why the valve should flap back.

OUR BOOK SHELF

Rotomahana, and the Boiling Springs of New Zealand. A Photographic Series of Sixteen Views, by D. L. Mundy. With descriptive notes by Ferdinand von Hochstetter, Professor of the Polytechnic Institution of Vienna. (London: Sampson Low and Co., 1875.)

THE autotype illustrations which form the main feature of this handsome volume are triumphs of the photographic art, and reflect the highest credit upon their author, Mr. Mundy. The photographs are on a scale quite large enough to give one a satisfactory idea of the main features of the various scenes intended to be portrayed; and by the judicious introduction into most of the views of the human figure, a good idea of the scale of the photographs is at once afforded.

The remarkable region illustrated by Mr. Mundy's series of photographs lies just about the centre of the North Island of New Zealand, in the south of the province of Auckland. The culminating or rather originating point of the phenomena described, Prof. Hochstetter regards as the still active volcano Tongariro, in the north of the province of Wellington. From this volcano three lines of volcanic action are supposed to proceed in a north-easterly direction by Lake Taupo to Lakes Rotorua, Rotoiti, and Rotomahana respectively, the last-mentioned line proceeding inwards as far as the marine volcano Whakari, in the Bay of Plenty; this line also, near its source, includes the hot springs at the head of Lake Taupo, about forty miles to the north of Tongariro. Another line, which follows to some length the outflow of the river Waikato from Lake Taupo, is marked by the hot springs and steam jets of Otumaheke and Orakeikorako, on the river's banks, and those of the Pairoa mountain range. The third line of action forming eruptions of this kind is exhibited in the hot springs of Rotorua and the solfataras of Rotoiti, which terminate these specimens of volcanic action on land, being situated near the sea-coast. While all along these three lines evidences of volcanic action are visible in the shape of hot springs, solfataras, geysers, mud-lakes, &c., the chief interest centres in Rotomahana, where the most beautiful and marvellous effects of this action are displayed. Though on a much smaller scale, the phenomena greatly resemble those which are seen in such profusion in the Yellowstone region of North America.

Mr. Mundy devotes most of his photographic views to the illustration of the phenomena to be witnessed in and around Rotomahana. This is one of the smallest lakes in the region, being scarcely a mile in length and a quarter of a mile in breadth; it is 1,088 feet above the sea, and the temperature of the lake itself varies from 60° to 100° Fahr. On the margin of the lake are many boiling springs, and around it are a great variety of phenomena similar to those which are witnessed in Iceland and in North America. It is impossible in a few words to give any adequate idea of these phenomena, and we must therefore refer our readers to Mr. Mundy's beautiful illustrations, and Prof. Hochstetter's brief but clear descriptions. One of the photographs gives a fine view of Lake Rotorua, about twelve miles north of Rotomahana, and the last four are devoted to the illustration of Lake Taupo and the phenomena to be seen in its neighbourhood. Rotomahana, we may state, is about forty-five miles N.N.E. of Lake Taupo, and about double that distance from Mount Tongariro.

Lake Taupo lies at a height of 1,250 feet above the sea, and no bottom has been found at a depth of 200 fathoms. Prof. Hochstetter conjectures that its waters, which have only one visible outlet, the Waikato, but many tributary streams, has a subterranean outlet to the north. It is this, he believes, which gives rise to the curious phenomena which abound in the region to which Mr. Mundy's photographs refer; the water, after being heated by underground volcanic fires, generates high-pressure steam that forces its way to the surface, bearing the characteristics of the rocks with which it has come into contact: the New Zealand springs, we should say, are divided into two distinct classes, the one alkaline, and the other acid. Whatever may be the value of Prof. Hochstetter's explanation of the phenomena, there is no doubt about the value of Mr. Mundy's illustrations of a district which seems to be all that now remains of a once extensive active volcanic region. While as a collection of well-executed views of great interest the work deserves a wide circulation, to the student of geology it is of great value, as affording a far more satisfactory idea of an important feature of the physical geography of New Zealand than any mere description can convey.

Elementary Lessons in Botanical Geography. By J. G. Baker, F.L.S., Assistant Curator of the Herbarium at Kew. (London: L. Reeve and Co., 1875.)

A WANT has long been felt of a small text-book for the use of lecturers and students dealing with the distribution of plants on the face of the globe. A work of this kind necessarily contains a large amount of detail and a formidable array of plant-names. These features of the present little volume are less objectionable when its special purpose is borne in mind, viz., the instruction of gardeners; the various chapters into which it is divided being in fact the substance of a series of lectures delivered to the gardeners at Kew. A reference to these details would be out of place in a short notice; and the best idea will be conveyed by giving the author's final summing up, viz:—That each species has originated from a single centre; that species have originated in different parts of the world, and that the flora of any given tract depends largely on its geographical position; that a large portion of the present genera (or types which agree in structure down to minute detail) were in existence before the end of the Secondary period, and have passed through the very great changes in climate and the relative positions of sea and land that have occurred during the Tertiary period; and that species (or types which accord not in structure only, but in vegetative characters—such as shape of leaves and arrangement of flowers) were dispersed in broad outline as at present, before present islands were insulated and the present general dispersion of sea and land worked out. The reader will find in the volume a very large amount of information on these subjects compressed into a small space.

LETTERS TO THE EDITOR

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

Ocean Circulation

HAVING carefully read Mr. Croll's papers in the *Philosophical Magazine* for September and October, I find in them the full confirmation of my statement that his "crucial-test" argument is based on the assumption of an equilibrium between the Equatorial and the North Atlantic columns; the words "to be in equilibrium" or "in order to equilibrium" being used over and over again to fix this as the essential condition of the computation by which the North Atlantic column is made out to be 3½ feet higher than the Equatorial.

No reference to other passages in Mr. Croll's writings can countervail this fact. I pointed out at Bristol the fallacy it involves, which was at once recognised by Sir William Thomson, General Strachey, and other competent authorities. This fallacy becomes obvious in the following parallel case:—

The specific gravity of Ægean water being to that of Black Sea water as (say) 1029 to 1013, a column of Black Sea water 1,029 feet high would be required to balance a column of Ægean water 1,013 feet high; therefore (on Mr. Croll's assumption of an equilibrium) the level of the Black Sea must be above that of the Ægean in the proportion of 16 feet to 1,013 feet of depth. But that there is *not* an equilibrium between the two columns, is conclusively proved by the deep inflow of Ægean water which always accompanies the surface-outflow of Black Sea water, showing the Ægean column to be the heavier.

Now Mr. Croll has obviously no more right to assume an equilibrium between the North Atlantic and the Equatorial columns, and thereby to deduce from their relative temperatures the higher level of the former, and the consequent impossibility of the thermal circulation as making the poleward upper flow run uphill, than he would have to deduce the excess of level of the Black Sea from its lower salinity, and to assert that an inward underflow of Ægean water is impossible, as tending to raise that level yet higher.

But there is yet another serious error in Mr. Croll's computation, which, even admitting his fundamental assumption, completely invalidates his conclusion. He has entirely omitted the consideration of the *inferior salinity* of the Equatorial column; which, as it shows itself alike at the surface and at the bottom, may be fairly taken as characterising its entire height. This will make a difference *in the opposite direction* of about one foot in 1,026; sufficient, therefore, if the excess in the North Atlantic column extends to a depth of no more than 600 fathoms, to neutralise the whole 3½ feet of elevation which Mr. Croll deduces from relative temperatures.

Mr. Croll is unable to see what the "viscosity" of water has to do with the question. Just this—that it affects his whole doctrine of "gradients." The nearer water is to a "perfect fluid," the less is the gradient required to give it horizontal motion.

If a viscous fluid be drawn from the bottom of one end, A, of a long trough A—B, its level at B will be lowered more slowly than at A, and will remain appreciably higher so long as the outflow continues. But in the case of a "perfect fluid" and a slow outflow, the level will practically fall simultaneously along the whole length of the trough A—B. I am quite aware that, *mathematically* speaking, the level must be always lower at A than at B; since there can be no movement of any particle from B towards A, unless room has been previously made for it. But if the time required for the replacement of each particle by the one next adjacent to it be infinitely small, the excess of reduction at A will also be infinitely small.

Now, according to the authorities I previously cited, water approaches so nearly to the condition of a "perfect fluid," that very small differences in its density will suffice (if constantly renewed) to maintain a vertical circulation, *without any appreciable difference in level*. And my position is, that the void created by the slow descent of water chilled by the surface-cold of the Polar area will be so speedily replaced by the inflow of water from the circumpolar area, and this again by inflow from the temperate region, as to produce a continual upper-flow of equatorial water towards the pole, without the gradient which Mr. Croll persistently asserts to be necessary.

I now leave it in the hands, not of Mr. Croll, but of competent authorities in Physics, to decide (1) whether his "crucial test" has the value he himself assigns to it, and (2) whether his doctrine of "gradients" can stand examination by the light now thrown upon it by Mr. Froude's researches. Until some physicist of equal weight with Sir George Airy and Sir William Thomson shall pronounce the doctrine I advocate to be untenable, I shall continue to believe, with Lenz, Arago, and Pouillet, that it is the only one which can account for the phenomena of Deep-sea temperature.

That the temperature of the upper stratum of the ocean is often affected by the Wind-circulation, and is especially thus modified in the North Atlantic, I have repeatedly pointed out. And it is scarcely fair in Mr. Croll, therefore, to continue speaking of the "wind-theory" and the "gravitation-theory" of Ocean Circulation as if they were antagonistic, instead of being not only compatible, but mutually complementary—the wind-circulation being *horizontal*, and the thermal circulation *vertical*.

As, however, Mr. Croll has now advanced so far as to admit that "physicists may differ from him in regard to whether or not the present difference of temperature between the ocean in equatorial and polar regions is sufficient to produce circulation," I am not without hope that in another year or two he may come to accept the Thermal-circulation as a "great fact;" and that he may then make good use of his knowledge and ability in elucidating the shares which are taken by the Wind-circulation and the Thermal-circulation respectively, in the distribution of terrestrial heat.

WILLIAM B. CARPENTER

The Sliding Seat

MOST problems in animal mechanics are of so complicated a character as to be generally referred to direct experiment rather than to mathematical analysis.

In Mr. Wagstaffe's remarks (vol. xii. p. 369) on the analogy which exists between the movements at the sterno-clavicular articulation in rowing, and those permitted by the sliding seat, we have an argument in favour of the latter arrangement. But when the subject is regarded from the point of view assumed by a practical oarsman, the question of actual advantage still remains unanswered.

There are certain preliminaries which must be considered before we can commence to solve the problem, leading to its subdivision into several distinct problems, some of which will prove interesting to the anatomist, some to the mechanician, some to the physiologist. In the following remarks I shall attempt to indicate the preliminaries referred to.

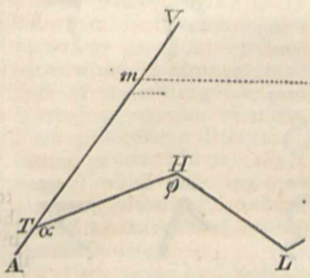


FIG. 1.

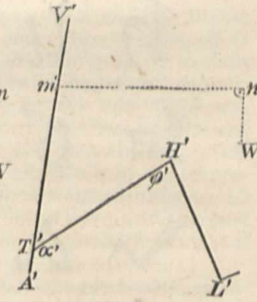


FIG. 2.

Fig. 1 represents the position of the vertebral axis, V A, the thigh, T H, and the leg, H L, when the point A or the seat is fixed.

Fig. 2 exhibits the same parts when A' is movable. In both there is the same position for the outstretched arms, that is, $m\,n = m'\,n'$.

It is clear that in 1 the weight, W, will be raised by such forces as tend to move V A towards the vertical position; while in 2 the same result is obtained by changing V' A' without alteration of the angle of inclination. We thus see that the angles α and ϕ will vary in definite inverse ratio, while the variation of ϕ' has almost entirely to be considered in 2. It is this which constitutes the chief difference between the sliding and the fixed seat, and which accounts for the sense of fatigue experienced in the legs in the former system.

If we examine the problems which arise from the consideration of Fig. 1 we shall find that in using the term "fixed seat" we are speaking incorrectly; that is to say, as far as there exists a force to hold A in position we have none but friction; and that practically the position of A with regard to L is determined by muscular action.

Thus in Fig. 2 the seat is really more fixed than in Fig. 1, or there is less muscular action round T′ than round T.

The advantages of the system 2 over 1 are however not simply mechanical, but the constancy of the angle α' affords greater space for the respiratory movements, and thus physiologically there is an explanation for the difference in disturbance of circulation and respiration generally experienced when comparing the two systems. R. J. LEE

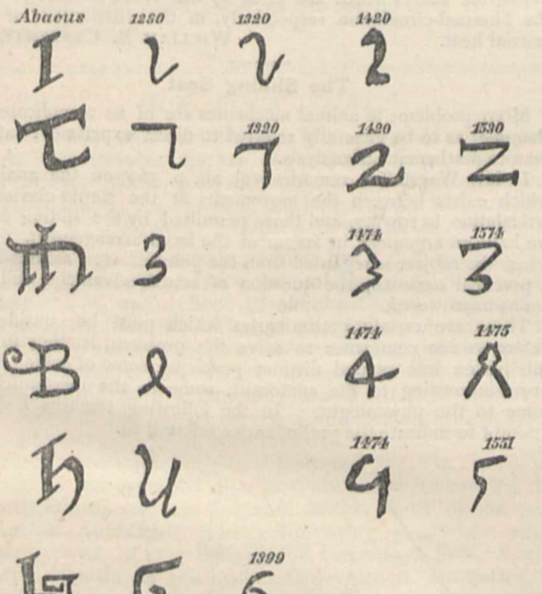
St. George's Hospital

History of the Numerals

ON reading the letter on the "Origin of the Numerals" (vol. xii. p. 476) I was reminded of some portions of their history which I had before noted down, and which are essential to any consideration of their origin.

The earliest forms which I have seen are those of the Abacus (Jour. Archæol. Assoc., vol. ii.), from which our later forms are mainly, if not entirely, derived. The intermediate forms are to be seen in arithmetical treatises and calendars of the thirteenth to sixteenth century, and on sundry quadrants, &c., of the fourteenth to sixteenth century, in the British Museum.

In the following table the earliest form of each letter and of



each variation is entered, with the corresponding date; the years 1280, 1320, 1420, and 1450 are only approximately stated.

Now, with respect to the primitive forms suggested by Mr. Donnisthorpe, the 2 would seem to have been two strokes at right angles (not parallel), the lower stroke of our form being only a *tail*, like that of many *medial* forms of Hebrew letters. The 3 may have been originally three vertical strokes, which were set horizontal in early times; the flat top, however, does not appear till 1574, and then only in English examples apparently. The 4 of the Abacus seems to have been deserted for cross lines connected, which are always placed diagonal till about 1474, when the first turn to the present position occurs: perhaps four strokes were intended, as we call cross-roads "four roads meet." 5 seems to have been inverted from the Abacus, and then about 1550 the straight tail was curved towards the previous figure, and the head elongated to lead to the next mark. It often occurs as a perfect though very straightened S in the sixteenth century, as it is now made in Belgium and other countries. Its form in 1280 reminds one of the Roman V written as U. 6 in the Abacus consists of six strokes; but this, from their cumbrous collocation, is probably merely a scribe's fancy. 7 has been apparently inverted (like 5) from the Abacus; its transitions are easily traced, but its origin is not so clear; some might see a trace in the Greek Z = 7. 8 has always been very near its present form, and the two squares is an explanation the character of which can only be objected to on the grounds of its inapplicability elsewhere. 9 has always had a straight tail, though it has been inverted since the Abacus form (as 5 and 7 seem changed): its origin might be looked for in the Greek θ possibly, as that letter has varied more in form than any other; or, more likely, in the Arabic Ta, or Tha (= 9), which in the Abacus it closely resembles; and it is even more similar to the Syriac Teth, a twin form to that of the Arabic. Perhaps the ancient Arabic alphabet (in its nearer approximation to its Hebrew- and Samaritan-like original) would show the origin of more of these forms, and even the simple 1 is exactly the Arabic *Elif* = 1, for their alphabetic origin is rendered highly probable from the fact that the numerical systems of the Greeks and of the Semitic nations (from whom our *Arabic* numerals probably came) were in very early times derived from the alphabet; not, like the Egyptian and Roman systems, wholly separate arrangements.

The apparent, though historically untrue, applicability of the line + line origin of all the forms of our numerals, is an interesting example of the fallibility of any theory which only looks to present conditions, apart from past facts and history.

Bromley, Kent W. M. FLINDERS PETRIE

Scarcity of Birds

I QUITE agree with Mr. Barrington, who writes in NATURE (vol. xii. p. 213) concerning the scarcity of birds. I find, by comparing my last year's ornithological diary with the present year's one, that I have only found about three-fourths of the number of Blackbirds' (*Turdus merula*), Thrushes' (*Turdus musicus*), Blue Titmouses' (*Parus cæruleus*), Pied Wagtails' (*Motacilla alba*), Greenfinches' (*Coccothraustes cloris*), Linnets' (*Linota cannabina*) nests that I found last year. The Hirundinidæ have been far less plentiful than usual; but the Goldfinch (*Carduelis elegans*) was the rarest bird here this summer. I did not succeed in finding a single nest, although our yearly average is fifteen. Other birds, as the Charadriidæ and the Mussel Thrush (*Turdus viscivorus*), have been very plentiful, and I found the Mountain Linnet's (*Linota montium*) nest for the first time I have ever met with it on the lowland south of the Humber. Will not the hard frost of last winter account for the scarcity of our native birds in some measure? ADRIAN PEACOCK

Bottesford Manor, Brigg.

OUR ASTRONOMICAL COLUMN

μ CASSIOPEÆ AND VICINITY.—Smyth (Cycle ii. p. 25) has the following remark with respect to stars near μ Cassiopeæ:—"Just 18′ south of μ is a star which, though of the 6th magnitude, is not in Piazzi. It is followed nearly on the parallel, about 11^s off, by a 9th magnitude, and both are remarkable from being red, of a decided but not deep tint." There is no star of the 6th magnitude near this position at the present time, nor so far as we know is there any record of such an object having been visible since the epoch of Smyth's observations, 1832·71.

It may, however, prove to be a variable star of long period, like the 8th magnitude orange-coloured star remarked by the same observer near Procyon in the autumn of 1833, the existence of which is supported by the observation of Mr. Isaac Fletcher, as described in Smyth's *Sidereal Chromatics* and elsewhere, and we believe by the experience of the Rev. T. W. Webb. There is now a star of the 9th magnitude, following μ Cassiopeæ, 17s·2 and 15′ 38″ south; this is clearly Argelander's star + 53°, No. 228 of the "Durchmusterung," there estimated 9·5, a considerably fainter object than an average 9th magnitude in Bessel's scale; its place would appear to correspond better with that of Smyth's star following his 6th magnitude, nearly on the parallel, than with that of the missing one. Probably this small star may be variable also; its place for the beginning of the present year is R.A. oh. 59m. 58·3s.; N.P.D., 35° 41′ 27″.

Smyth thought his 6th magnitude star, omitted by Piazzi, might have had "something to do with the mistakes of Flamsteed respecting μ, alluded to by Mr. Baily." These mistakes seem rather to have originated in the confusion of the stars θ and μ, and although Baily doubted if the place of the latter, which he gives from Halley's edition of 1712, could be depended upon, it will be found to agree very well with that of μ carried back from the position in the Greenwich Catalogue of 1860, with Mädler's proper motions.

Should any reader of this column have had the curiosity to look for Smyth's reddish stars, perhaps he will communicate the result of his examination of their neighbourhood.

THE DOUBLE STAR Σ 2120.—Mr. J. M. Wilson has favoured us with the following measures of this star, made at the Temple Observatory, Rugby, by himself and assistants:—

1872·48	Pos.	262°·9	Obs.	4	Dist.	3″·78	Obs.	2
73·50	,,	261°·7	,,	6	,,	3″·65	,,	2
74·62	,,	258°·5	,,	4	,,	4″·2	,,	2

Comparing these measures with the formulæ for rectilinear motion already given in NATURE, the following differences are shown:—

1872·48	Pos. $(c - o)$	− 0°·4	Dist. $(c - o)$	+ 0″·65
73·50	,,	− 0°·3	,,	+ 0″·91
74·62	,,	+ 1°·8	,,	+ 0″·51

Mr. Wilson has had a suspicion of variation in the magnitude of the companion, but thinks this may be owing to atmospheric circumstances.

THE MINOR PLANETS.—It is notified from Berlin, in M. Leverrier's *Bulletin International*, that the small planet detected by M. Perrotin at the Observatory of Toulouse, on the evening of Sept. 21, in R.A. 23h. 16m. 8s. and N.P.D. 95° 12′, is a new one, and will therefore be No. 149. The brighter members of this group now near opposition are Bellona, Clotho, and Thyra. Clotho will be between the 8th and 9th magnitude; the calculated places are, for Greenwich midnight, as follows:—

			h. m. s.			° ′
Oct. 23	...	R.A.	3 34 47	...	N.P.D.	90 36·0
,, 27	...	,,	3 32 50	...	,,	91 17·0
,, 31	...	,,	3 30 30	...	,,	91 55·8
Nov. 4	...	,,	3 27 51	...	,,	92 31·6
,, 8	...	,,	3 25 0	...	,,	93 3·4

TRANSIT OF COMET 1826 (V.) OVER THE SUN'S DISC.—It was remarked by Gambart that the comet discovered by Pons on the 22nd of October, 1826, the "comet in Bootes," as it was called at the time, must pass over the sun's disc on the morning of November 18, and he was at some pains in correcting the elements of the orbit, with the view of deciding whether the comet had left the disc, before it was examined by himself and Flaugergues, the only two observers who were at stations partially free from cloud on the morning of the transit. A letter from Gambart addressed to Sir John Herschel, at that time president of the Royal Astronomical Society, conveying an intimation of the expected phenomenon, arrived in London on the evening previous to the transit, and, as stated in vol. iii. of the Memoirs of the Society, "the news of so rare a phenomenon was immediately spread, and few astronomers in or near the metropolis failed to be prepared for it;" the sun, however, was totally obscured at rising, and for the whole day, by clouds and rain. A dense fog appears to have prevailed very generally over the continent of Europe, so that, as mentioned above, Gambart at Marseilles and Flaugergues at Viviers alone obtained a view of the disc during the interval in which it was expected the transit would take place.

The following particulars of the transit founded upon a new calculation from the corrected elements of Gambart, closely representing the observations between Oct. 26 and Dec. 11, may possess interest for the astronomical reader.

The comet's true geocentric positions, for Greenwich mean time, were:—

			R.A. ° ′ ″		N.P.D. ° ′ ″
Nov. 17.	17h.	...	233 7 5	...	108 51 48
,,	19h.	...	233 7 52	...	109 11 50
,,	21h.	...	233 8 38	...	109 31 26

Whence, correcting for aberration and taking the sun's places from Carlini's tables, the following differences of R.A. and N.P.D. of comet and sun's centre result:—

	h.		′ ″		′ ″
Nov. 17.	17	Diff. R.A.	+ 5 31	Diff. N.P.D.	− 16 48
,,	18	,,	+ 3 19	,,	− 7 19
,,	19	,,	+ 1 7	,,	+ 2 2
,,	20	,,	− 1 6	,,	+ 11 17
,,	21	,,	− 3 19	,,	+ 20 26

And as referred to the centre of the earth, we find:—

		h. m.		
Ingress	Nov. 17 at	16 59·9	at 19°	from sun's N. point towards E.
Egress	,,	20 22·5	at 184°	,, ,, ,,

At Marseilles, the egress would take place at 20h. 59m. apparent time, the equation of time being 14m. 43s. additive to mean time.

As is well known, neither Gambart nor Flaugergues were successful in detecting this comet upon the sun's disc, but though visible at one time to the naked eye, it was not of any considerable degree of brightness.

*FAYE ON THE LAWS OF STORMS**

Mechanical Theory of Whirling Movements.—Before we enter on the mechanics of these phenomena, it is necessary to clear the way by the removal of certain ideas which constantly recur to the mind of the reader, and by distracting his attention render any clear unbiassed perception of the subject altogether impossible. This preliminary discussion will embrace the three following points: the part played by electricity in the formation of whirlwinds and cyclones, the significance to be attached to the indications of the barometer, and the part played by currents of aspiration in the modern theory of the trade winds.

1. Part played by Electricity.—Certain physicists, dissatisfied with the views we are about to refute, and struck with the electrical phenomena which so often accompany hurricanes, typhoons, &c., have supposed that electricity is the determining cause. We shall perhaps give a clear idea of this theory by reverting to the electrical explanation of hail, the phenomena of hail being intimately bound up with that of whirling movements. It is well known that hailstones are composed of layers of ice alternately opaque and transparent; in breaking them we see in their texture the evidence of successive and alternate

* Continued from p. 501.

actions to which they have been subjected. Hence, it is argued, they must have been suspended in the air by some force to allow time for these alternate actions to take effect. Is the force in question not that of electricity? Let us suppose two clouds, superimposed the one above the other, to be charged with opposite electricities; if the crystals of ice which are often to be met with in the upper regions of the atmosphere happen to be in the interval between the two clouds, they will be attracted by the nearest, and thereafter repelled as soon as they have received by contact the electricity with which it is charged. Instantly being attracted by the other cloud, they rush towards it and are immediately charged with the opposite electricity; and this alternate play, during which the hailstones receive successive accretions from the vapour abstracted from the clouds and congealed by the cold of the original hailstone or of the space intervening, will go on till the hailstones acquire a weight too great for them to be any longer suspended, or till an electric discharge has destroyed the opposite electricities which have accumulated on the surfaces of the clouds. At this instant the hailstones fall to the ground by the simple effect of their own weight.

To the same cause the formation of waterspouts has been attributed. Let us suppose a low cloud highly charged with electricity and producing by induction on the water of the sea a powerful accumulation of statical electricity of the opposite sign on its surface. The mutual attraction of these two electricities, the cloud on the one hand, the sea on the other, while powerless to produce contact, will nevertheless give rise to two opposing protuberances in the oppositely electrified bodies. At that point the electricities will acquire a tension the greater as the protuberances continue to assume forms more elongated. As the attractive action goes on increasing, these two protuberances will gradually approach each other between the sky and the earth, and will ultimately unite, the protuberance descending from the sky passing over a greater space than the other. Then, by the conductor thus quickly formed of water and an elongated fragment of cloud, the electricity of the upper regions will escape into the ground, exerting a destructive action over all obstacles in its way. It is also to be noted that the instant when the waterspout is thus completed, thunder ceases to roll in the clouds, the reason being that the electricity has found a silent mode of escape. M. Peltier, the accomplished physicist to whom science is indebted for many ingenious researches on atmospheric electricity, endeavoured to reproduce in miniature the phenomenon thus described; but in bringing a highly electrified conductor close to the surface of a sheet of water, he was unable to show any other sensible mechanical effect than a more rapid evaporation.

We shall not, however, insist on the electrical theory of waterspouts. The theory is now rejected, equally with the electrical theory of hail, because if a few waterspouts have exhibited traces of an electrical action, the greater part of the observed facts show nothing of it. Waterspouts and typhoons are mechanical phenomena, in which electricity plays not the principal part, but a part altogether subordinate. There was a time when the tendency was to explain everything in meteorology by electricity. Whenever any question became obscure, electricity was resorted to as a convenient explanation, and any difficult point was considered as cleared up by an adroit appeal to some laboratory experiment—such as the explanation of the theory of hail from the dance executed by pith-balls between two brass plates. It came, however, to be recognised that, in seeking to identify meteorological phenomena with laboratory experiments, the risk was run of losing sight of the real circumstances of nature and putting in their stead those of the laboratory. The clouds of Volta are real plates of brass, and the spark of the induced conductors, as they are brought near each other, always forgets to manifest itself when the two fragments of waterspouts unite together.

2. Barometer.—The question of the barometer is more difficult. The diminution of pressure which precedes and accompanies cyclones has always been considered as a proof of aspiration. It is certain that the continual lowering of the barometric column—a lowering the maximum of which occurs in the very centre of the hurricane—is a phenomenon so constant as to serve as an infallible warning to sailors. In certain seas and at certain times of the year, the sailor ought to keep his eye on the barometer as much as the compass. But what is the significance of this diminution of pressure? Does it prove that the air over our heads is rarefied? If a vertical column of air was rarefied, the equilibrium would be re-established not at its lower part only, that is to say at the expense of the lower stratum; to effect this, a solid envelope would be necessary to isolate the column through its entire length, leaving only a free opening at its base. But the column, on the contrary, being everywhere in communication with the atmosphere, the equilibrium would be quickly restored by a simultaneous afflux of the strata at all heights, and not merely by the afflux of the lower stratum alone. This, however, is not how things take place. The diminution of the barometer does not indicate a vacuum in the upper regions, but is the result of a movement. Involuntarily, when we speak of the barometer, we always regard pressure in the statical condition, as if the atmosphere was constantly in equilibrium, whilst in reality it is in continual motion. If there was reason to believe that the different layers of air do not mix in crossing each other, it could not be denied that the aqueous vapour in its continual ascent from the ground and the sea does not traverse the successive strata on its way to the more elevated regions of the atmosphere, to be there condensed into minute crystals of ice. And when under the action of other causes, the whole strata of the atmosphere flow almost horizontally, like vast rivers, between strata absolutely immoveable, producing everywhere condensation of vapour and heavy rains, it is doubtful if even the statical principle of the equality of pressure could in every sense be employed; the barometric pressure and its variations ought no longer to be interpreted from the statical point of view only, especially if it arises from gyratory movements on a vast scale. There is here a question belonging to the dynamics of fluids which mathematicians have not yet explained; but in the meantime we ought not to forget the essential distinction between dynamical and statical pressure so as to suppose that every rapid fall of the barometer indicates a sudden rarefaction of air overhead, and consequently aspiration from above downwards.

3. Trade Winds.—The question of the trade winds is connected with the preceding subject. If the air be considered only by itself, it will arrange itself in a state of equilibrium, in homogeneous layers of varying densities, which decrease with the height. These layers will be bounded by ideal level surfaces enveloping the globe, and which may here be regarded as spheres. If the action of the sun, whose heat-rays are specially absorbed by the lowest strata and by the aqueous vapour, is felt more energetically over the torrid zone than in higher latitudes, the inferior strata will expand, and pressing upwards will raise the upper strata to a higher level. The equilibrium being thus disturbed, it will tend to re-establish itself by a general flow towards the coldest regions after the manner of ocean currents, or like immense rivers which have for their beds level surfaces, of which we are about to speak.

On the other hand, the temperate and cold zones receiving this overplus of air, their lower strata taking a movement inverse to the above, set in towards the large space of the equatorial regions where the density of the air is less; and leaving out of view the effects of the earth's rotation, which diverts these currents from the direction of the meridians, we have there the true cause of the trade winds of the high regions, of which the lower trade winds are only the counterpart and the result. The lower trade winds are ordinarily attributed to an equatorial rarefaction and to the indraught which results from it. On this account, the indraught being direct and ceasing with the day, the lower trade winds ought to show, just as sea and land breezes, an alternation from day to night, of which there exists no trace. In considering the trade winds, on the contrary, as the indirect result of the draining effected in the region of the upper strata, we see that the intermediate mass plays the part of the air receiver of a hydraulic machine, which, by annihilating differences of velocity, produces a steady flow, but which placed under the direct action of the motive power would have been intermittent.

The theory of indraught or aspiration represents, on the contrary, vast regular currents of the atmosphere as shown by Fig. 12. We here see at the equator a sort of

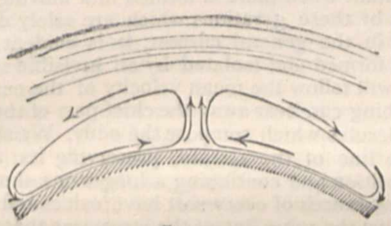


Fig. 12.

chimney towards which the air is drawn, and up which it ascends, and thereafter takes a course to north and to south. The proof that matters do not take place altogether in this way, and that the expansion of the air on all sides in the zone most highly heated by the sun does not there upset the order and the statical superposition of the strata, is astronomical refraction, whose laws are the same at the equator as in temperate regions; there is in addition the perfect regularity and the smallness of the barometric oscillations—conditions little compatible with those of a colossal updraught, or even with the behaviour of the trade winds, which no one has ever seen at the confines of the zone of calms begin to assume a vertical direction.

If we have at length succeeded in dispelling the idea of vertical aspiration from which has been deduced the direct cause of all aërial currents and all tempests, and the idea of electricity considered as the chief agent in the mechanics of the atmosphere, and lastly the confounding, so frequently, of statical pressure in a fluid mass in repose with dynamical pressure in a medium traversed throughout by movements the most capricious, we shall have no difficulty in accepting the following considerations, for the subject being in this way simplified, the result is a simple question of pure mechanics.

Vortices or Eddies with their Axes vertical to the Current of Water.—If the question exclusively concerned pure mechanics or mathematics, we should be stopped at the very threshold of the inquiry, because mechanics does not yet embrace the study of gyratory movements in liquids or fluids. We have not up to the present moment succeeded in submitting to analysis exact problems of hydrodynamics, unless in very special cases in which we may consider fluids as composed of elements of volume containing always the same molecules, of such sort that their masses are invariable and that the molecules situated at the surface or on any of the sides will always remain at the surface or at the same side. Besides, the trajectories of the liquid filaments ought never to present those re-entering or spiral-like curves which we, however, so frequently remark. If we set out with these restrictive hypotheses, the question cannot be attacked by analysis. In other words, we are forced absolutely to exclude all that relates to the movements with which we are now dealing.

But where analysis is still powerless, experiment and observation remain for our guidance. Whirling movements make their appearance not only in gases; they are equally found in liquids, where they are more manageable, since they can be followed by the eye and even produced at pleasure. We shall therefore commence with the movements which are observed in liquids after we have drawn a vital distinction between the different whirling movements with which we are dealing. Air and water present in fact very complicated gyrations, some ebullient transitory, and without any stability of figure, others' perfectly regular and persistent. They are distinguished by a very simple geometrical figure: the second class have their axis always vertical; the others turn round axes diversely inclined. A moment's reflection will enable us to account for the difference. In the case of a horizontal gyration the spires keep clear of the surrounding layers past which they whirl, or only very slightly graze them in their course. In the first case all motion of the layers disappears; that of the surface even no more exists; because at the surface of separation between the water and the air the eddying spires issue from the liquid mass and cut through or carry away to the interior the air placed above so as to produce the phenomena of spray, froth, foam, and emulsion.

Let us then confine ourselves to whirling movements round a vertical axis, which the student of hydraulics knows and observes, and which can be reproduced at will and studied experimentally. These are, in truth, regular persistent movements which obey laws very simple and precise. The general law which embraces all these phenomena is as follows:—When there exists in a current of water differences of velocity between the filaments in lateral juxtaposition, there tends to be generated, by reason of these inequalities, a regular gyratory movement round a vertical axis. The spires described by the molecules are sensibly circular, with their centres about the axis. These are, speaking more exactly, the spires of a helix, slightly conical and descending, so that in following a molecule in its movements it is seen to turn rapidly in a circle round the axis, which it imperceptibly approaches, descending with a velocity very much less than the linear velocity of rotation. Evidently the centrifugal force which results from this gyratory movement must be everywhere counterbalanced by the pressure of the surrounding liquid; there is then inside these eddying spires, at least at their upper orifice, a slight lowering of the pressure which discloses itself at the surface of the liquid by a feeble conical depression centered about the axis of rotation.

The two following characteristic properties are demonstrated by analysis:—(1) The entire whirl may be regarded as separated from the surrounding fluid, which remains immoveable, by a surface of revolution whose meridian curve has its concavity turned downwards. In other words, the exterior figure of the whirling mass is in the form of an inverted cone pointing downwards. (2) The angular velocity of a molecule increases in proportion as it approaches the axis; it is inversely proportional to the square of its distance from the vertical axis. Hence the linear velocity increases in simple inverse proportion to its distance from the axis. If we consider how great the breadth of the whirling cone in the current of the water occasionally is, relatively to the size of the lower orifice, we shall understand how a gyration which appears sluggish at the surface and at the circumference becomes violent at the base of the funnel-shaped eddy.

These two laws, it must be here observed, are applicable not only to liquids but also to gases. They are easily verified by the experiment of throwing a little dust into water in which an eddy has been formed, when the funnel-shaped figure and circulatory movement of the entire mass and the increase of velocity towards the centre will be at once seen.

The descending movement of these whirls may be examined by the preceding analysis, but observation has long since placed the matter beyond doubt. Everyone knows how much eddies in the current of a river are dreaded by bathers; when a swimmer has the misfortune to be caught in one he is drawn down by a rapid rotation even to the bottom of the water. There, the expert swimmer, knowing how to reserve his strength in place of expending it in useless efforts, extricates himself by resting on the bottom, and, disengaging himself from the eddy, rises quickly to the surface. Not only may men be thus engulphed, but masses of floating ice, or even small vessels, are drawn to the bottom by whirlpools, and thereafter are extricated and rise to the surface only by the obstacle afforded by the bottom, and by the contraction downwards, more and more marked, of the whirling mass of water.

These phenomena can be artificially produced in a large mass of still water, at a part where a rapid movement of gyration is communicated by a suitable mechanical appliance.* If we strew dust on the surface, in order to render the phenomena visible, it is seen that gyration is propagated in the form of a cone from above downwards, even to the bottom of the vessel, drawing the dust along with it. Count Xavier de Maistre, who has published in the *Bibliothèque Universelle de Genève* some interesting experiments on this subject, has shown that a layer of oil placed over the water of the funnel-shaped eddy is drawn towards the bottom by a gyratory movement; then, when it comes in contact with the obstacle presented by the base, the oil reascends in globules all round the eddy which it has quitted. There is thus here a double vertical movement—the first regularly descending along the spires of a conical helix, the second ascending and exhibiting in its ascent no geometrical figure, but rising to the surface irregularly *round about* the eddy. It is natural that the liquid thus drawn to the bottom should thereafter ascend more or less, not, be it noted, in the eddy down which it had been carried, but outside it, through the surrounding liquid.

This gyratory movement, which thus concentrates towards the point of the eddy the sum of the moving forces which the funnel-shaped whirl embraces in its vast expanse, ought to produce at its base a certain amount of mechanical work, and observation confirms this idea. The powerful whirlpools of our rivers plough up their beds and thus expend on the soil the force which they have acquired near the surface at the expense of the inequalities of velocity of the general current. And as all currents of water possessing some little depth present like inequalities of velocity among their lateral filaments, on account of the friction of the water against the banks, numerous whirlpools are constantly found whose action consists in finally absorbing these inequalities and regulating the flow of the water, so that the general velocity of the river is perceptibly reduced.

Vortices or Eddies with Vertical Axes in Gases.—All these phenomena are found in gaseous masses traversed by horizontal currents. In currents of this sort, inequalities of velocity will equally give rise to whirling movements round a vertical axis, and, as may be constantly observed, these gyrations will still assume the figure of a truncated cone in an inverted position, which becomes visible when any circumstance occurs to interfere with the transparency of the air. Equally as in the case of water, the gyration of a molecule will be the more rapid the nearer it approaches the centre. The analysis which confirms, or rather explains these phenomena is as applicable to gases as to liquids. Need it be said that waterspouts, from their appearance alone, range themselves in this category? The mechanical identity of whirls formed whether in liquids or in gases is found in all the details—such as the descending movement of waterspouts whose point is seen gradually approaching the earth, and in the abrading force which whirlwinds thus exert on the ground in breaking and beating down objects which obstruct their course—acting thus like a plate fixed perpendicularly at the end of a vertical axis whirling rapidly round. This action evidently ceases when the lower orifice of the waterspout rises a little; it recommences with energy each time that the whirling cone is lowered so as to be brought into contact with any opposing object.

We have only further to prove another characteristic of eddies in a stream of water not less general, in order to complete the study of the analogous phenomena in fluids. At the instant when there is formed in a moving mass of water one of these gyrations which are solely due to inequalities in the general current, it is evident that the eddy thus formed and isolated by an invisible sheath, so to speak, will follow the mean velocity of the current, because nothing can bear away the chief part of the velocity to the molecules which compose the eddy. We shall see it follow the line of the stream, preserving its axis in a vertical position and continuing a longer or a shorter time, or until resistances of every sort have exhausted its force. It will follow the same line of the stream as that taken by a floating object without losing its circular form, and without ceasing to act on the bottom, if it extend so far down, as long as its store of energy is inexhausted.

A distinction must be made between these travelling eddies and the great eddies in deep still water which are ceaselessly formed and re-formed at a post fixed at the turning of narrows of a river. When in such places the current makes itself felt it incessantly bears away with it the spires thus formed; the phenomenon is unceasingly renewed, giving rise to those stationary eddies in rivers which have no analogy to those of the atmosphere, and which appeared to play an important part in deepening the beds of rivers.

(*To be continued.*)

* These experiments must not be confounded with the experiment of water poured into a vessel to which a movement of rotation round a vertical axis has been communicated. In this case the free surface becomes hollow whilst the water rises along the sides of the vessel. A condition of equilibrium is soon established totally different from the dynamical phenomena we are here discussing. Thus the central depression is parabolical and not conical, and the angular velocity of the fluid molecules is constant, whereas it varies in the movements of eddies in the inverse proportion of he distance from the axis of rotation.

THE LARGE REFLECTOR OF THE PARIS OBSERVATORY

M. WALLON, the French Minister of Public Instruction, presided on the 7th inst. at the sitting of the Council of the Observatory, and at the end of the *séance* he made an official inspection of the large refractor. On the 9th the representatives of many of the Parisian papers were present at the Observatory by invitation of M. Leverrier; the weather, unfortunately, was very tempestuous.

The telescope was left under its iron house, but every detail was carefully explained by M. Leverrier, assisted by M. Wolff, the chief astronomer for physical observations. M. Leverrier praised very highly the skill displayed by the constructors, MM. Eichens and Martin.

The weight of the moveable part is nine tons; the mirror is 120 centimetres in diameter, with a focal distance of 6·80 metres. The weight of the mirror is only half a ton, instead of four tons, which would be necessary for a metallic one; its cost amounts to 2,000*l*.

The telescope is suspended like a refractor in an ordinary equatorial. The ocular is placed in front.

On the 8th minute stars were observed by M. Wolff with a magnifying power of 500, which has been found to answer excellently. An ocular multiplying 1,200 times, and perhaps another, 2,400, will be constructed. A micrometer is being made.

The seeker is in front, and can be rotated with the ocular and the small plane mirror round the axis of the tube by a very simple process. The reason of this arrangement is to facilitate the use of the large iron winding staircase. This enormous metallic structure is moved by special machinery on two circular iron rails. It is always placed on the same side of the tube as the counterpoise, which would render observations impossible if the ocular and seeker were not rotated round the axis of the tube. The height of the iron staircase is about twelve metres, and its weight six tons. The observations are made in open air, and when the weather is propitious the cabin protecting the apparatus is removed by machinery. It is an iron casement (weight twelve tons), moveable on rails. In less than a quarter of an hour the telescope can be directed on any object, however minute.

The clock is finished, but not adjusted. The machinery for moving in right ascension is finished and works admirably. The handle and screws for minute motions in declination are finished and working most nicely. So does the gear for connecting and disconnecting the tube with the clock.

The cost of the reflector is 8,000*l*. It was built in six years, but the work was interrupted several times, first by the dismissal of M. Leverrier, secondly by the war and the Commune.

M. Leverrier is justly proud of having completed the large refractor, to which a very few details only are wanting—the adjustment of the clock, the handles for slight equatorial motions, and the machinery for large declination motions. He asked M. Wallon to give orders for the construction of the large refractor, and it was granted at once. A sum of 8,000*l*. has been already voted by the National Assembly for that purpose. It will be seventeen metres in length, and the construction will be completed in three years, if the work is not interrupted by any political or other commotion.

LIEUT. WEYPRECHT ON ARCTIC EXPLORATION

We have already (vol. xii. p. 460) referred to Lieut. Weyprecht's paper on the Principles of Arctic Exploration, read at the German Scientific and Medical Association. A full report of the paper has now come to hand. Lieut. Weyprecht rightly maintains that the polar regions offer, in certain important respects, greater advantages than any other part of the globe for the observations of natural phenomena—magnetism, the aurora, meteorology, geology, zoology, and botany. He shows that hitherto immense sums have been spent and much hardship suffered for the mere purpose of extending geographical and topographical knowledge, while strictly scientific observations were regarded as holding only a secondary place. While admitting the importance of geographical discovery, he maintains that the main purpose of future Arctic expeditions should be the extension of our knowledge of the various natural phenomena which may be studied with so great advantage in these regions.

After showing in some detail the kind of observations which would yield valuable results, Lieut. Weyprecht lays down the following general propositions :—1. Arctic exploration is of the highest importance to a knowledge of the laws of nature. 2. Geographical discovery in these regions is of superior importance only in so far as it extends the field for scientific investigation in its strict sense. 3. Minute Arctic topography is of secondary importance. 4. The geographical pole has for science no greater significance than any other point in high latitude. 5. Observation-stations are to be selected without reference to the latitude, on account of the advantages they offer for the investigation of the phenomena to be studied. 6. Interrupted series of observations have only a relative value.

Suppose that stations were established at Novaya Zemlya, 76° ; Spitzbergen, 80° ; West or East Greenland, 76°-80° ; N. America east of Behring Strait, 70° ; Siberia at the mouth of the Lena, 70°, there would thus be a girdle of observatories around the entire Arctic region. A station in the neighbourhood of the centre of magnetic intensity is much to be desired. By means of the stations already existing in the neighbourhood of the polar circle, a connection would be established with our own region. The cost of one geographical exploring expedition would supply the means of keeping up these stations for a year. The object of these expeditions would be, with similar instruments and according to similar instructions, to record simultaneous observations as far as possible throughout a year. In the first line would be placed the various branches of Physics and Meteorology, as also Botany, Zoology, and Geology ; and first in the second line, detailed geographical exploration. Were it possible to establish stations for simultaneous observation in the Antarctic regions, results of much higher value might be expected. Were the cost of these yearly expeditions divided among various countries, it would fall very lightly upon each.

While we think the curiosity of a healthy kind which seeks to know the configuration of the entire surface of our globe, we are sure every man of science will admit the value of Lieut. Weyprecht's propositions. There has, without doubt, been hitherto too much weight attached to merely reaching a high latitude, and too little provision made for strictly scientific observation. Lieut. Weyprecht's suggestions deserve the serious consideration of all civilised countries ; were they adopted as a ground for action, a new era in polar exploration would be begun, and results of far higher value than any hitherto obtained might with certainty be expected.

NOTES

It is rather disappointing that Capt. Young's Arctic Expedition in the *Pandora*, which arrived at Portsmouth on Saturday, should have returned home prematurely without accomplishing any part of the work for which it was organised—the discovery of additional Franklin relics and the complete navigation of the North-west Passage. Under the circumstances, however, Capt. Young has adopted the wisest possible course. Better that the expedition should spend a comfortable winter at home, and set out early next year to renew the attempt in which they have just been baffled. Disco was reached on August 7, Upernivik on the 13th, and Cape York on the 16th, after a splendid passage through the much-dreaded Melville Bay. Carey Islands were visited to deposit letters for the *Alert* and *Discovery* and to obtain a despatch from Capt. Nares, as previously agreed on. The despatch, however, was not discovered till the return voyage. From Carey Islands the *Pandora* proceeded up Lancaster Sound to Beechey Island, which was reached on the 26th. Here Capt. Young inspected "Northumberland House," which was built as a storehouse by the *North Star* (Capt. Saunders) in 1850. It was found that the house had been broken into by bears, and many of the stores damaged, but those in casks and barrels had sustained scarcely any injury. The yacht *Mary* and two lifeboats left by Sir John Ross were in such good condition that, with a few repairs, they could still be made seaworthy. After putting the stores in order, Capt. Young proceeded up Peel Strait for the purpose of reaching King William Land. After considerable manœuvring with the ice, and some difficulties arising from the uselessness of the compasses so near the magnetic pole, La Roquette Island, near Bellot Strait, was reached on August 30. The ground thus far gone over was pretty well known from the explorations of previous expeditions, and Capt. Young was close to his former encampments when travelling from the *Fox* in 1859. But now an impenetrable pack of ice across the channel barred all further progress, and after vainly trying to find a passage, Capt. Young prudently determined to retreat, which he did on Sept. 3. Carey Islands were reached on Sept. 11, and Capt. Nares' record discovered. The *Pandora* arrived at Disco on the 20th, passed Cape Farewell on Oct. 2, and, as we have said, reached Portsmouth on Saturday. Both on the outward and return voyage very rough weather was encountered, although after leaving Disco until Bellot Strait was reached, the weather was on the whole very favourable. The following is Capt. Nares' record referred to:—"H.M.S. *Alert*, at Carey Islands, 3 A.M., 27th July, 1875.—*Alert* and *Discovery* arrived here at midnight, and will leave at 6 A.M. for Smith's Sound, after depositing a depot of provisions and a boat. We left Upernivik on the evening of the 22nd inst., and Brown Islands on the evening of the 23rd. Passing through the middle ice during a calm, we arrived at Cape York on the 25th inst. The season is a very open one, and we have every prospect of attaining a high latitude. All are well on board each ship." Thus the latest news from our Arctic Expedition is entirely favourable.

Two long letters from Mr. Stanley, the leader of the *Daily Telegraph* and *New York Herald* African Expedition, appear in the *Telegraph* of Friday and Monday last. As might be expected, they are full of interest, and contain many geographical details, too summarily stated, however, to be condensed intelligibly, or appreciated without a special map. Such a map Mr. Stanley seems to have sent home, and we hope it will be published as soon as practicable. Both letters are written from the "village of Kagehyi, district of Uchambi, country of Usukuma, on the Victoria Niyanza" (so he spells the name), dated March 1 and May 15 respectively. An intervening letter has not come to hand. The lake was reached after a march of 720 miles from the coast, in 103 days. That the expedition has had to encounter more than the usual difficulties and hardships of African exploration may be inferred from the fact that Stanley has lost considerably more than half his men, including two of his white companions, Frederick Barker and Edward Pocock. Disease carried off the greater number, though many were lost in a fierce fight with the Waturu, a people of the Leewumbu Valley. The principal additions to our knowledge made so far by the determined leader of the expedition is a pretty full account of the country and the people from Western Ugogo northwards to Nyanza, and a survey of over 1,000 miles of the shores of the lake, which apparently is studded with islands. The Shemeeyu River, known by other names in the upper part of its course, which Stanley seems mainly to have followed, and which he regards as the chief tributary of the Nyanza, enters the lake at the village of Kagehyi. Stanley calculates its length roughly at 350 miles. At 400 miles from the coast he came upon the base of the watershed of a number of streams which feed the river, and which he evidently regards as at least one of the Nile sources. According to Stanley's observations, and they seem to have been carefully made, as computed by Capt. George, the height of the Nyanza above sea-level is 3,740 feet—68 feet higher than Speke made it out to be. He has made some other corrections on Speke's observations, especially in the matter of latitude. Speke he makes out to be fourteen miles wrong in his latitude along the whole of the coast of Uganda. The mouth of the Katonga, for example, which in his map is a little south of the equator, Stanley makes by meridian altitude to be in N. lat. 0° 16′. We sincerely hope the indomitable leader of this expedition will be able successfully to accomplish the large task he has set before him—the exploration of the whole of the lake region of Central Africa.

PROF. FAWCETT'S address at the opening of the winter session of the Birmingham and Midland Institute on Monday was, as might be expected, instructive and impressive. The tone of it was mainly that of our article last week on the Yorkshire College of Science, that the object of education should be to develop an intelligence which will be cultured all round, and which may be applied to any work in life. Prof. Fawcett spoke mainly of elementary education and of the education which the working classes may obtain in such an institution as the Birmingham and Midland. He advocated the study of botany and political economy from a disciplinary and practical point of view, and very properly discouraged the notion that a good education ought necessarily to make anyone discontented with his position; it would simply dignify labour of all kinds, and make the life of the artisan brighter and nobler. A somewhat similar tone as to what middle-class education should be, and what a college or middle-class school should be, pervaded the address of the Dean of Durham at the opening of the fifth session of the Newcastle College of Science. In an efficient curriculum science will find its proper place, withal a place of the highest importance.

THE Organising Committee for the International Exhibition of Electricity has held its first general meeting at the Palais de l'Industrie, Paris, under the presidency of Colonel Laussedat, one of the delegates appointed by the French Minister of War. The committee approved the regulations proposed by Count Halley d'Arroz, the originator of the scheme, appointed him general director, and divided the exhibition into eighteen groups. Amongst these are the History of Electricity, a section in which will be collected, as far as possible, the instruments which were used by Davy, Faraday, Volta, Arago, Ohm, Oerstedt, Ampère, and others, in making their discoveries. The eighteenth group will be Bibliographical; a library as complete as possible will be formed of all the books and papers published in the Transactions of the several Academies, and scientific periodicals relating to electricity. A requisition will be sent to the administration of the National Library, asking them to offer, for 1877, their Systematic Catalogue of Electricity. The President of the French Republic will be the head of the Committee of Patronage, and a sub-committee has received instructions to open negotiations with foreign *savants* and Governments.

THE catalogues of the various departments under the Science and Art Department at South Kensington have long been noted both for the extent and accuracy of the information contained in them, as well as for the low price at which they may be obtained. It is with pleasure we note that the catalogues of the contents of the Bethnal Green branch are not behind those of the mother institution in point of detail and careful working out. That relating to the special collection of waste products brought together by Mr. P. L. Simmonds is before us, and we recommend all those who are interested in the subject to obtain this little book, which costs only threepence and contains a fund of information on various matters connected with products of the vegetable, animal, and mineral kingdoms. The usual sequence of the three kingdoms of nature is somewhat altered here, the vegetable products being placed first, and for this reason, that "vegetable products have given more extensive and profitable employment and results, in the utilisation of formerly wasted substances and the recovery of residues from manufactures, than either animal or mineral substances." Nothing is too small or unimportant to rescue from simple destruction if it can be turned in any way to serve the purpose of man. As an illustration we may mention the fact of the application as fire-lighters of the central portion of the ear of the Indian corn after the seeds have been taken out; also of the cones of the Scotch Fir (*Pinus sylvestris*), which are sold in France under the name of *Allumettes des Landes*. These are novel applications of what would otherwise be pure waste substances; but there are others which, though waste from one manufacture, are used to adulterate others. From vegetable marrow, melon, and other cucurbitaceous seeds, many of the so-called sugared almonds of the confectioners are made. In China, the seeds of the water-melon are very largely used as food; they are carried from place to place in junks laden entirely with them; they contain a quantity of oil of a sweet or bland nature. In the manufacture of olive oil, much more economy is exercised than was formerly the case. In the olive-growing countries the pulpy portion of the fruit, which was formerly thrown away after being pressed, is now bought up at the rate of from thirteen to sixteen shillings per ton, and submitted to chemical action and powerful steam pressure, by which means about twenty per cent. more oil is obtained. This oil is of course of an inferior quality to that obtained from the first expression. After this remaining oil is extracted, the seeds, which are crushed in the process, are finally burnt as fuel or used as manure. The foregoing notes will show the kind of matter dealt with in the Official Catalogue of Waste products.

FROM the Report, dated June 1875, of Mr. George King, Superintendent of the Calcutta Botanical Gardens, we see that during the past year many important improvements have been effected in the Gardens. Among other things a fine raised terrace has been constructed, on which a large new plant-house is now being erected. This noble conservatory, when finished, will, it is expected, be the greatest addition to the Garden which has been made for years, and will give facilities for the cultivation of delicate plants hitherto unknown in Calcutta. This building is 200 feet in length by 66 feet broad. The collections in the two orchid houses and in the other conservatories have been much increased during the year, considerable additions having been received from Sikkim, the Khasi Hills, the Andamans, and Burmah, also a few plants from the Neilgherries. A number of plants were also sent to the Garden by Mr. Lister, the second gardener, who accompanied the Duffla field-force as a botanical collector. "But," Mr. King justly remarks, in reference to this, "when the floral wealth of Assam, of Eastern Bengal, and of Burmah is considered, not to mention the west and south of India, the collection in this Garden appears miserably small. In an imperial institution such as this, the natural productions of the whole Indian empire should, as far as the climate will permit, be represented. I see no way of forming such a typical collection until a good trained European collector be attached permanently to the establishment. At present I have to rely for supplies of plants from distant parts of India on correspondence with private parties, who, although usually very willing to help, are unfortunately often unskilled in botany or gardening, and neither know what plants to send nor how to pack them safely for transit. The only experts, not employed in the Garden, whose services I can command for collecting, are the manager of the Cinchona plantation and his assistants, and their efforts are of course confined to Sikkim. Had I a collector as one of the regular garden staff, I could send him about to distant districts of which the flora is little known or poorly represented in the Garden, and the result would be that in a few years a very fine collection might be got together both of living plants in cultivation and of dried specimens in the Herbarium. Another great advantage would be that this Garden would be put in a position such as it has not hitherto occupied for exchanging plants with similar institutions all over the world. The cost of maintaining such a collector would not be great, and the extremely liberal manner in which the Gardens have been supported by Government during the past year leads me to hope that this desideratum will soon be supplied."

THERE is being printed for the National Library of Paris two volumes of catalogues of French History. The series will be completed in fourteen volumes. There are also being printed two new volumes of the catalogue of Medicine, containing all the theses supported before the several French schools for a number of years. These two volumes will make the catalogue of Medicine complete in four volumes.

WE learn from the *Journal of Botany* that Prof. Kerner, o Innsbrück—to whose valuable contributions to botanical literature we have frequently called attention, especially relating to the distribution of plants as affected by climatal and geological conditions—will shortly succeed the venerable Fenzl as Professor of Botany at the University of Vienna.

A PAPER by Dr. T. Spencer Cobbold has been reprinted from the *Veterinarian* of this month, on the destruction of elephants by parasites, with remarks on two new species of entozoa, and on the so-called earth-eating habits of elephants and horses in India.

MR. SCLATER has issued an appendix to his "Revised List of the Vertebrated Animals in the Zoological Gardens," containing the names of the additions since the year 1871, among the most important of which are the superb series of Rhinoceroses, five species in all; the Chinese Water Deer of Swinhoe; the Mourning Kangaroo; the Red Oven-bird; Bouquet's Amazon, and three fresh species of Cassowary.

THE principal papers in this month's part of Petermann's *Mittheilungen* are: An account of a journey to Patagonia, by Dr. Karl Berg, of the Public Museum of Buenos Ayres, in which particular attention is given to the natural history of the country; "Chinese Travellers of the Middle Ages to Western Asia," by Dr. E. Bretschneider, of Pekin; "Travels on the Araguaya, Brazil, in January 1865," by Dr. Conto de Magalhães; "Contributions to a Knowledge of the Oasis El-Chargeh," with a map, by Dr. G. Schweinfurth; and a short paper, with map, on Weyprecht's survey of the North Coast of Novaya Zemlya in September and October 1872.

THE *Bulletin* of the French Geographical Society for September contains a careful paper by M. Jules Girard on the Elevations and Depressions which have been observed along the coast of France. This part also contains the conclusion of the Abbé Petitot's valuable contribution to the Geography of the Athabaskaw-Mackenzie region of North America, and a paper by M. E. Allain on the Statistics of Brazil.

THE French Government is sending to China a doctor, M. Durand Fardel, in order to study the important question of contagious diseases, and to elucidate the so much vexed question of quarantines.

IN the Health Section of the Social Science Congress, Prof. Wanklyn read a paper on the waters of the Nile, showing the amounts of chlorine and of hardness at different periods. The rise of the Nile commences at the end of May, and lasts through June, July, and August, up to about the middle of September, when the decrease continues till Christmas. From Christmas till May the amount is tolerably constant. Just at the time of the beginning of the rise of the waters the chlorine is 1·8 grains per gallon, but at the time when the Nile has attained its greatest size it is only 0·3 gr., and it remains very little above that proportion to the end of the year. In marked contrast with the variableness of the chlorine is the constancy of the hardness. Prof. Wanklyn's explanation is that the storm-water which adds so much to the bulk of the Nile sweeps over the country without penetrating far below the surface, and such water passing over a country long ago denuded of salt could convey but little chlorine. He thinks that the débris carried down mechanically by the flood-water contains abundance of finely divided carbonate of lime, so that the storm-water would always be saturated by carbonate of lime. Hence the constant hardness. The water which feeds the Nile, apart from the storm-water, contains 1·8 grains per gallon; and it is the accession of storm-water with chlorine that causes the relative reduction. Similar features will probably be found in other large rivers which have a flood period.

DURING the meeting of the Social Science Congress at Brighton, Mr. Booth threw open for three days his private museum which is in the course of arrangement. He has built on the Dyke Road a spacious hall of brick, lighted entirely from above, and around this are being placed 306 cases which contain groups of birds shot by himself and Mrs. Booth in Britain. There is one point about the fixing of the cases worth mentioning. A framework is constructed about three feet from the wall into which the glazed cases fit. This prevents any damp from the walls, too frequent in museums, and allows of the easy moving of the cases if needed. As these cases are arranged in three tiers only and there is abundance of light, every bird can be well seen, and the width of the hall is sufficient to admit of viewing the groups from different positions. The most important feature next perhaps to the careful stuffing of the birds, is the fidelity with which the characters of the habitat are reproduced. With birds which change their plumage during the year, two, and where needed, three illustrations are given each with the proper *entourage.* As a collection illustrating our British birds in their native haunts, this is probably unique. There is no attempt at zoological classification, however, since the position of the cases is influenced rather by their relative size and the general picturesque effect of the hall. Whoever the taxidermist is, the collection does him great credit. It is stated that when complete the collection will be thrown open to the public for the benefit of the local charities.

THE observations obtained by Prof. Violle (referred to last week, p. 527) in reference to the solar temperature, were obtained not by ballooning, but by the actual ascent of the Alps.

UNDER date Oct. 19, the *Times* Paris correspondent states that an earthquake which lasted several seconds is reported as having been felt at Moutiers-et-Brides-les-Bains, near Chambery. This phenomenon coincided with great barometrical depression. Snow has fallen on the mountains of the Puy de Dôme.

DR. PIETRE SANCTA has just started a new French periodical, the *Journal d'Hygiène*, with the object of realising, as far as possible, in France the ideal of a "city of health." The journal also treats of climatology, mineral waters, wintering and seaside resorts, and kindred subjects.

THE pair of Sea-lions which arrived at Brighton last week are, we are informed, specimens of Steller's Sea-lion, about six feet long. The species, which was originally described by G. W. Steller in a work which also contains the account of the huge extinct Manatee-like Rhytina, attains a length of sixteen feet, and has long hair surrounding the neck of the adult male, whence its name. Its under-fur is very little in quantity, so that the skin is of no use for "sealskin."

ON Monday the New Ladies' College, known as Newnham Hall, at the back of the Colleges at Cambridge, was formally opened and received into its rooms twenty-seven students. The resident mistress is Miss Clough, the sister of the poet.

A LETTER in Tuesday's *Times* describes a terrible hurricane and rain and thunder-storm which swept over the island of St. Vincent and other West India islands on the 9th September. In twelve hours the almost incredible quantity of nearly nineteen inches of rain fell.

A COURSE of twelve Gilchrist Lectures, on the Principles of Physical Geography, in connection with the School Teachers' Science Association, is being given at the Foresters' Hall, Wilderness Row, on alternate Friday evenings. The first lecture was given on the 8th inst., and the next will take place tomorrow. The lecturers are Dr. W. B. Carpenter, F.R.S., Mr. J. Norman Lockyer, F.R.S., and Prof. Martin Duncan, F.R.S.

THE evening lectures last session in connection with the Yorkshire College of Science were largely attended, and we are glad to see they are to be continued this session. Professors Rucker, Thorpe, and Green are to lecture on special departments of Physics, Chemistry, and Geology respectively, and Mr. L. C. Miall on "The Principal Forms of Animal Life."

THE following is the programme of the Glasgow Science Lectures Association for the coming Session :—Nov. 11, "Navigation," by Sir Wm. Thomson, F.R.S. ; Nov. 24, "Coals and Coal Plants," by Prof. W. C. Williamson, F.R.S. ; Dec. 8, "Recent Researches into the Chemical Constitution of the Sun," by J. Norman Lockyer, F.R.S. ; Dec. 22, "Kent's Cavern—its testimony to the Antiquity of Man," by Wm. Pengelly, F.R.S. ; Jan. 27, "Mountain Architecture," by Prof. Geikie, F.R.S. ; Feb. 16, a lecture by Prof. Huxley, F.R.S., subject not yet announced.

FROM the thirteenth quarterly report of the Sub-Wealden Exploration, it appears that another effort is to be made to reach a depth of 2,000 feet. The engineer has reported favourably on the possibility of completing that distance by attaching a crown to the 3-inch tubes, and, after boring to 1,824 feet, to recommence with a 2½-inch crown.

THE additions to the Zoological Society's Gardens during the past week include two Persian Gazelles (*Gazella subgutturosa*) from Persia, presented by Mr. Archibald Gray ; a Ruddy Ichneumon (*Herpestes smithii*) from India, presented by Mr. W. R. Best ; a Common Kestrel (*Tinnunculus alaudarius*), European, presented by Mr. J. H. Willmore ; a Golden-crowned Conure (*Conurus aureus*) from S.E. Brazil, presented by Col. McArthur ; two Crested Porcupines (*Hystrix cristata*), two Servals (*Felis serval*) from S. Africa, a Scarlet Ibis (*Ibis rubra*) from Para, a Common Boa (*Boa constrictor*) from S. America, deposited ; a Derbian Wallaby (*Halmaturus derbianus*) born in the Gardens.

A CITY OF HEALTH*

II.

THE warming and ventilation of the houses is carried out by a common and simple plan. The cheerfulness of the fireside is not sacrificed ; there is still the open grate in every room, but at the back of the fire-stove there is an air-box or case which, distinct from the chimney, communicates by an opening with the outer air, and by another opening with the room. When the fire in the room heats the iron receptacle, fresh air is brought in from without, and is diffused into the room at the upper part on a plan similar to that devised by Capt. Galton.

As each house is complete within itself in all its arrangements, those disfigurements called back premises are not required. There is a wide space consequently between the back fronts of all houses, which space is, in every instance, turned into a garden square, kept in neat order, ornamented with flowers and trees, and furnished with playgrounds for children, young and old.

The houses being built on arched subways, great convenience exists for conveying sewage from, and for conducting water and gas into, the different domiciles. All pipes are conveyed along the subways, and enter each house from beneath. Thus the mains of the water-pipe and the mains of the gas are within instant control on the first floor of the building, and a leakage from either can be immediately prevented. The officers who supply the commodities of gas and water have admission to the subways, and find it most easy and economical to keep all that is under their charge in perfect repair. The sewers of the houses run along the floors of the subways, and are built in brick. They empty into three cross main sewers. They are trapped for each house, and as the water supply is continuous, they are kept well flushed. In addition to the house flushings there are special openings into the sewers by which, at any time, under the direction of the sanitary officer, an independent flushing can be carried out. The sewers are ventilated into tall shafts from the mains by means of a pneumatic engine.

* An Address by Dr. B W. Richardson, F.R.S., at the Brighton meeting of the Social Science Association. Revised by the author. Concluded from p. 525.

The water-closets in the houses are situated on the middle and basement floors. The continuous water supply flushes them without danger of charging the drinking water with gases emanating from the closet; a danger so imminent in the present method of cisterns, which supply drinking as well as flushing water.

As we walk the streets of our model city, we notice first an absence of places for the public sale of spirituous liquors. Whether this be a voluntary purgation in goodly imitation of the National Temperance League, the effect of Sir Wilfred Lawson's Permissive Bill and most permissive wit and wisdom, or the work of the Good Templars, we need not stay to inquire. We look at the fact only. To this city, as to the town of St. Johnsbury, in Vermont, which Mr. Hepworth Dixon has so graphically described, we may apply the description Mr. Dixon has written: "No bar, no dram shop, no saloon defiles the place. Nor is there a single gaming hell or house of ill-repute." Through all the workshops into which we pass, in whatever labour the men or women may be occupied—and the place is noted for its manufacturing industry—at whatever degree of heat or cold, strong drink is unknown. Practically, we are in a total abstainers' town, and a man seen intoxicated would be so avoided by the whole community, he would have no peace to remain.

And, as smoking and drinking go largely together, as the two practices were, indeed, original exchanges of social degradations between the civilised man and the savage, the savage getting very much the worst of the bargain, so the practices largely disappear together. Pipe and glass, cigar and sherry-cobbler, like the Siamese twins, who could only live connected, have both died in our model city. Tobacco, by far the most innocent partner of the firm, lived, as it perhaps deserved to do, a little the longest; but it passed away, and the tobacconist's counter, like the dram counter, has disappeared.

The streets of our city, though sufficiently filled with busy people, are comparatively silent. The subways relieve the heavy traffic, and the factories are all at short distances from the town, except those in which the work that is carried on is silent and free from nuisance. This brings me to speak of some of the public buildings which have relation to our present studies.

It has been found in our towns, generally, that men and women who are engaged in industrial callings, such as tailoring, shoe-making, dress-making, lace-work and the like, work at their own homes amongst their children. That this is a common cause of disease is well understood. I have myself seen the half-made riding-habit that was ultimately to clothe some wealthy damsel rejoicing in her morning ride, act as the coverlet of a poor tailor's child stricken with malignant scarlet-fever. These things must be in the ordinary course of events, under our present bad ordinary system. In the model city we have in our mind's eye, these dangers are met by the simple provision of workmen's offices or workrooms. In convenient parts of the town there are blocks of buildings, designed mainly after the manner of the houses, in which each workman can have a work-room on payment of a moderate sum per week. Here he may work as many hours as he pleases, but he may not transform the room into a home. Each block is under the charge of a superintendent, and also under the observation of the sanitary authorities. The family is thus separated from the work, and the working man is secured the same advantages as the lawyer, the merchant, the banker now possesses: or, to make the parallel more correct, he has the same advantage as the man or woman who works in a factory and goes home to eat and to sleep.

In most towns throughout the kingdom the laundry system is dangerous in the extreme. For anything the healthy householder knows, the clothes he and his children wear have been mixed before, during, and after the process of washing, with the clothes that have come from the bed or the body of some sufferer from a contagious malady. Some of the most fatal outbreaks of disease I have met with have been communicated in this manner. In our model community this danger is entirely avoided by the establishment of public laundries, under municipal direction. No person is obliged to send any article of clothing to be washed at the public laundry; but if he does not send there he must have the washing done at home. Private laundries that do not come under the inspection of the sanitary officer are absolutely forbidden. It is incumbent on all who send clothes to the public laundry from an infected house to state the fact. The clothes thus received are passed for special cleansing into the disinfecting rooms. They are specially washed, dried, and prepared for future wear. The laundries are placed in convenient positions, a little outside the town; they have extensive drying grounds, and, practically, they are worked so economically, that home-washing days, those invaders of domestic comfort, are abolished.

Passing along the main streets of the city we see in twenty places, equally distant, a separate building surrounded by its own grounds—a model hospital for the sick. To make these institutions the best of their kind, no expense is spared. Several elements contribute to their success. They are small, and are readily removeable. The old idea of warehousing diseases on the largest possible scale, and of making it the boast of an institution that it contains so many hundred beds, is abandoned here. The old idea of building an institution so that it shall stand for centuries, like a Norman castle, but, unlike the castle, still retain its original character as a shelter for the afflicted, is abandoned. The still more absurd idea of building hospitals for the treatment of special organs of the body, as if the different organs could walk out of the body and present themselves for treatment, is also abandoned.

It will repay us a minute of time to look at one of these model hospitals. One is the *fac simile* of the other, and is devoted to the service of every five thousand of the population. Like every building in the place, it is erected on a subway. There is a wide central entrance, to which there is no ascent, and into which a carriage, cab, or ambulance can drive direct. On each side the gateway are the houses of the resident medical officer and of the matron. Passing down the centre, which is lofty and covered in with glass, we arrive at two side-wings running right and left from the centre, and forming cross-corridors. These are the wards: twelve on one hand for male, twelve on the other for female patients. The cross-corridors are twelve feet wide and twenty feet high, and are roofed with glass. The corridor on each side is a framework of walls of glazed brick, arched over head, and divided into six segments. In each segment is a separate, light, elegant removable ward, constructed of glass and iron, twelve feet high, fourteen feet long, and ten feet wide. The cubic capacity of each ward is 1,680 feet. Each patient who is ill enough to require constant attendance has one of these wards entirely to himself, so that the injurious influences on the sick, which are created by mixing up, in one large room, the living and the dying; those who could sleep, were they at rest, with those who cannot sleep because they are racked with pain; those who are too nervous or sensitive to move, or cough, or speak, lest they should disturb others; and those who do whatever pleases them; these bad influences are absent.

The wards are fitted up neatly and elegantly. At one end they open into the corridor, at the other towards a verandah which leads to a garden. In bright weather those sick, who even are confined to bed, can, under the direction of the doctor, be wheeled in their beds out into the gardens without leaving the level floor. The wards are warmed by a current of air made to circulate through them by the action of a steam-engine, with which every hospital is supplied, and which performs such a number of useful purposes, that the wonder is how hospital management could go on without this assistance.

If at any time a ward becomes infectious, it is removed from its position, and replaced by a new ward. It is then taken to pieces, disinfected, and laid by ready to replace another that may require temporary ejection.

The hospital is supplied on each side with ordinary baths, hot-air baths, vapour baths, and saline baths.

A day sitting-room is attached to each wing, and every reasonable method is taken for engaging the minds of the sick in agreeable and harmless pastimes.

Two trained nurses attend to each corridor, and connected with the hospital is a school for nurses, under the direction of the medical superintendent and the matron. From this school nurses are provided for the town; they are not merely efficient for any duty in the vocation in which they are always engaged, either within the hospital or out of it, but from the care with which they attend to their own personal cleanliness, and the plan they pursue of changing every garment on leaving an infectious case, they fail to be the bearers of any communicable disease. To an hospital four medical officers are appointed, each of whom, therefore, has six resident patients under his care. The officers are called simply medical officers; the distinction, now altogether obsolete, between physicians and surgeons being discarded.

The hospital is brought, by an electrical wire, into communication with all the fire-stations, factories, mills, theatres, and other important public places. It has an ambulance always ready to be sent out to bring any injured persons to the institution. The ambulance drives straight into the hospital, where a bed of the same height on silent wheels, so that it can be moved without vibration into a ward, receives the patient.

The kitchens, laundries, and laboratories are in a separate block at the back of the institution, but are connected with it by the central corridor. The kitchen and laundries are at the top of this building, the laboratories below. The disinfecting-room is close to the engine-room, and superheated steam, which the engine supplies, is used for disinfection.

The out-patient department, which is apart from the body of the hospital, resembles that of the Queen's Hospital, Birmingham : the first out-patient department, as far as I am aware, that ever deserved to be seen by a generous public. The patients waiting for advice are seated in a large hall, warmed at all seasons to a proper heat, lighted from the top through a glass roof, and perfectly ventilated. The infectious cases are separated carefully from the rest. The consulting rooms of the medical staff are comfortably fitted, the dispensary is thoroughly officered, and the order that prevails is so effective that a sick person, who is punctual to time, has never to wait.

The medical officers attached to the hospital in our model city are allowed to hold but one appointment at the same time, and that for a limited period. Thus every medical man in the city obtains the equal advantage of hospital practice, and the value of the best medical and surgical skill is fairly equalised through the whole community.

In addition to the hospital building is a separate block, furnished with wards, constructed in the same way as the general wards, for the reception of children suffering from any of the infectious diseases. These wards are so planned that the people, generally, send sick members of their own family into them for treatment, and pay for the privilege.

Supplementary to the hospital are certain other institutions of a kindred character. To check the terrible course of infantile mortality of other large cities—the 76 in the 1,000 of mortality under five years of age, homes for little children are abundant. In these the destitute young are carefully tended by intelligent nurses ; and mothers, while following their daily callings, are enabled to leave their children under efficient care.

In a city from which that grand source of wild mirth, hopeless sorrow and confirmed madness, alcohol, has been expelled, it could hardly be expected that much insanity would be found. The few who are insane are placed in houses licensed as asylums, but not different in appearance to other houses in the city. Here they live, in small communities, under proper medical supervision, with their own gardens and pastimes.

The houses of the helpless and aged are, like the asylums, the same as the houses of the rest of the town. No large building for the poor of pretentious style uprears itself; no men badged and badgered as paupers walk the place. Those poor who are really, from physical causes, unable to work, are maintained in a manner showing that they possess yet the dignity of human kind ; that, being worth preservation, they are therefore worthy of respectful tenderness. The rest, those who can work, are employed in useful labours which pay for their board. If they cannot find work, and are deserving, they may lodge in the house and earn their subsistence ; or they may live from the house and receive pay for work done. If they will not work, they, as vagrants, find a home in prison, where they are compelled to share the common lot of mankind.

Our model city is of course well furnished with baths, swimming baths, Turkish baths, playgrounds, gymnasia, libraries, board schools, fine art schools, lecture halls, and places of instructive amusement. In every board school drill forms part of the programme. I need not dwell on these subjects, but must pass to the sanitary officers and offices.

There is in the city one principal sanitary officer, a duly qualified medical man elected by the Municipal Council, whose sole duty it is to watch over the sanitary welfare of the place. Under him as sanitary officers are all the medical men who form the poor-law medical staff. To him these make their reports on vaccination and every matter of health pertaining to their respective districts ; to him every registrar of births and deaths forwards copies of his registration returns ; and to his office are sent, by the medical men generally, registered returns of the cases of sickness prevailing in the district. His inspectors likewise make careful returns of all the known prevailing diseases of the lower animals and of plants. To his office are forwarded, for examination and analysis, specimens of foods and drinks suspected to be adulterated, impure, or otherwise unfitted for use. For the conduction of these researches the sanitary superintendent is allowed a competent chemical staff. Thus, under this central supervision, every death and every disease of the living world in that district, and every assumable cause of disease, comes to light and is subjected, if need be, to inquiry.

At a distance from the town are the sanitary works, the sewage pumping works, the water and gas works, the slaughter-houses and the public laboratories. The sewage, which is brought from the town partly by its own flow and partly by pumping apparatus, is conveyed away to well-drained sewage farms belonging to the city, but at a distance from it, where it is utilised on Mr. Hope's plan.

The water supply, derived from a river which flows to the south-west of the city, is unpolluted by sewage or other refuse, is carefully filtered, is tested twice daily, and if found unsatisfactory is supplied through a reserve tank, in which it can be made to undergo further purification. It is carried through the city everywhere by iron pipes. Leaden pipes are forbidden.

In the sanitary establishment are disinfecting rooms, a mortuary, and ambulances for the conveyance of persons suffering from contagious disease. These are at all times open to the use of the public, subject to the few and simple rules of the management.

The gas, like the water, is submitted to regular analysis by the staff of the sanitary officer, and any fault he may detect which indicates a departure from the standard of purity framed by the Municipal Council is immediately remedied, both gas and water being exclusively under the control of the local authority.

The inspectors of the sanitary officer have under them a body of scavengers. These each day, in the early morning, pass through the various districts allotted to them, and remove all refuse in closed vans. Every portion of manure from stables, streets, and yards, is in this way removed daily and transported to the city farms for utilisation.

Two additional conveniences are supplied by the sanitary scientific work of this establishment. From steam-works steam is condensed, and a large supply of distilled water is obtained and preserved in a separate tank. This is conveyed by a small main into the city, and at a moderate cost distilled water can be supplied for those domestic purposes for which hard water is objectionable. The second sanitary convenience is a large ozone generator. By this apparatus ozone can be produced in any required quantity, and is made to play many useful purposes. It is passed through the drinking water in the reserve reservoir whenever the water shows excess of organic impurity, and it is conveyed into the city for diffusion into private houses for purposes of disinfection.

The slaughter-houses of the city are all public, and are separated by a distance of a quarter of a mile from the city. They are easily removable edifices, and are under the supervision of the sanitary staff. The Jewish system of inspecting every carcase that is killed is rigorously carried out, with this improvement, that the inspector is a man of scientific knowledge.

All animals used for food—cattle, fowls, swine, rabbits—are subjected to examination in the slaughter-house, or in the market, if they be brought into the city from other depots. The slaughter-houses are so constructed that the animals killed are relieved from the pain of death. They pass through a narcotic chamber, and are brought to the slaughterer oblivious of their fate. The slaughter-houses drain into the sewers of the city, and their complete purification daily, from all offal and refuse, is rigidly enforced.

The buildings, sheds, and styes for domestic food-producing animals, are removed a short distance from the city, and are also under the supervision of the sanitary officer ; the food and water supplied for these animals comes equally with human food under proper inspection.

One other subject only remains to be noticed in connection with the arrangements of our model city, and that is the mode of the disposal of the dead. The questions of cremation and of burial in the earth have been considered, and there are some who advocate cremation. For various reasons the process of burial is still retained : firstly, because the cremation process is open to serious medico-legal objections ; secondly, because, by the complete resolution of the body into its elementary and inodorous gases in the cremation furnace, that intervening chemical link between the organic and inorganic worlds, the ammonia, is destroyed, and the economy of nature is thereby dangerously disturbed ; thirdly, because the natural tendencies of the people lead them still to the earth, as the most fitting resting-place into which, when lifeless, they should be drawn.

Thus the cemetery holds its place in our city, but in a form much modified from the ordinary cemetery. The burial-ground is artificially made of a fine carboniferous earth. Vegetation of rapid growth is cultivated over it. The dead are placed in the earth from the bier, either in basket-work or simply in the shroud; and the monumental slab, instead of being set over or at the head or foot of a raised grave, is placed in a spacious covered hall or temple, and records simply the fact that the person commemorated was recommitted to earth in those grounds. In a few months, indeed, no monument would indicate the remains of any dead. In that rapidly-resolving soil the transformation of dust into dust is too perfect to leave a trace of residuum. The natural circle of transmutation is harmlessly completed, and the economy of nature conserved.

Results.

Omitting, necessarily, many minor but yet important details, I close the description of the imaginary health city. I have yet to indicate what are the results that might be fairly predicted in respect to the disease and mortality presented under the conditions specified.

Two kinds of observation guide me in this essay: one derived from statistical and sanitary work, the other from experience, extended now over thirty years, of disease, its phenomena, its origins, its causes, its terminations.

I infer, then, that in our model city certain forms of disease would find no possible home, or, at the worst, a home so transient as not to affect the mortality in any serious degree. The infantile diseases, infantile and remittent fevers, convulsions, diarrhœa, croup, marasmus, dysentery, would, I calculate, be almost unknown. Typhus and typhoid fevers and cholera could not, I believe, exist in the city except temporarily and by pure accident; small-pox would be kept under entire control; puerperal fever and hospital fever would probably cease altogether; rheumatic fever, induced by residence in damp houses, and the heart disease subsequent upon it, would be removed; death from privation and from puerpera and scurvy would certainly cease; delirium tremens, liver disease, alcoholic phthisis, alcoholic degeneration of kidney, and all the varied forms of paralysis, insanity, and other affections due to alcohol, would be completely effaced. The parasitic diseases arising from the introduction into the body, through food, of the larvæ of the entozoa, would cease, and that large class of deaths from pulmonary consumption, induced in less-favoured cities by exposure to impure air and badly-ventilated rooms, would, I believe, be reduced so as to bring down the mortality of this signally fatal malady one-third at least.

Some diseases, pre-eminently those which arise from uncontrollable causes, from sudden fluctuations of temperature, electrical storms, and similar great variations of nature, would remain as active as ever; and pneumonia, bronchitis, congestion of the lungs, and summer cholera would still hold their sway. Cancer, also, and allied constitutional diseases of strong hereditary character would yet, as far as we can see, prevail. I fear, moreover, it must be admitted that two or three of the epidemic diseases, notably scarlet fever, measles, and whooping-cough, would assert themselves, and, though limited in their diffusion by the sanitary provisions for arresting their progress, would claim a considerable number of victims.

With these facts clearly in view, I must be careful not to claim for my model city more than it deserves; but calculating the mortality which would be saved, and comparing the result with the mortality which now prevails in the most favoured of our large English towns, I conclude that an average mortality of eight per thousand would be the maximum in the first generation living under this salutary *régime*. That in a succeeding generation Mr. Chadwick's estimate of a possible mortality of five per thousand would be realised, I have no reasonable doubt, since the almost unrecognised though potent influence of heredity in disease would immediately lessen in intensity, and the healthier parents would bring forth the healthier offspring.

As my voice ceases to dwell on this theme of a yet unknown city of health, do not, I pray you, wake as from a mere dream. The details of the city exist. They have been worked out by those pioneers of sanitary science, so many of whom surround me to-day, and specially by him whose hopeful thought has suggested my design. I am, therefore, but as a draughtsman, who, knowing somewhat your desires and aspirations, have drawn a plan, which you in your wisdom can modify, improve, perfect. In this I know we are of one mind, that though the ideal we all of us hold be never reached during our lives, we shall continue to work successfully for its realisation. Utopia itself is but another word for time; and some day the masses, who now heed us not, or smile incredulously at our proceedings, will awake to our conceptions. Then our knowledge, like light rapidly conveyed from one torch to another, will bury us in its brightness.

> By swift degrees the love of Nature works
> And warms the bosom, till at last, sublim'd
> To rapture and enthusiastic heat,
> We feel the present Deity, and taste
> The joy of God to see a happy world!

THE INTERNAL HEAT OF THE EARTH

PROF. MOHR, of Bonn, has contributed to the *Neues Jahrbuch für Mineralogie*, &c. (1875, Heft 4), a very important paper on the causes of the internal heat of the earth. After indicating some of the objections which may be urged against the Plutonistic theory of the origin of the earth's internal heat, he discusses the data obtained by the thermometric investigation of a boring about 4,000 feet deep, through pure rock salt, at Speremberg, near Berlin.

The proposition from which he starts is as follows:—If the interior of the earth is still fused, then with every increase in depth, as we approach this furnace, a less space must be necessary to produce the same increase of heat. The heat passes outwards by conduction from a smaller into a constantly enlarging sphere, and supposing the conductivity of the materials to be uniform, the temperature of the outer coats of the sphere must gradually diminish in proportion as their volume increases; or, in other words, the increase of heat per 100 feet must become greater and greater in proportion as we descend.

Now the results of the thermometric investigation of the Speremberg boring give the following numbers:—

For a depth of		Increase per 100 feet.
700 feet	15·654° R.	—
900 ,, ...	17·849 ,, ...	1·097
1100 ,, ...	19·943 ,, ...	1·047
1300 ,, ...	21·939 ,, ...	0·997
1500 ,, ...	23·830 ,, ...	0·946
1700 ,, ...	25·623 ,, ...	0·896
1900 ,, ...	27·315 ,, ...	0·846
2100 ,, ...	28·906 ,, ...	0·795
3390 ,, ...	36·756 ,, ...	0·608

The third column is a diminishing arithmetical series of the first order, showing equal differences of 0·050° or $\frac{1}{20}$° R. for every 100 feet. By applying this principle to the gaps left above 700 feet and between 2,100 and 3,390 feet, Prof. Mohr gets the following table of increase of heat for the whole depth:—

Depth.	Increase per 100 feet in depth.
100 to 200 feet	1·35 ° R.
200 ,, 300 ,, ...	1·30 ,,
300 ,, 400 ,, ...	1·25 ,,
400 ,, 500 ,, ...	1·20 ,,
500 ,, 600 ,, ...	1·15 ,,
600 ,, 700 ,, ...	1·10 ,,
700 ,, 900 ,, ...	1·097 ,,
900 ,, 1100 ,, ...	1·047 ,,
1100 ,, 1300 ,, ...	0·997 ,,
1300 ,, 1500 ,, ...	0·946 ,,
1500 ,, 1700 ,, ...	0·896 ,,
1700 ,, 1900 ,, ...	0·846 ,,
1900 ,, 2100 ,, ...	0·795 ,,
2100 ,, 2300 ,, ...	0·745 ,,
2300 ,, 2500 ,, ...	0·695 ,,
2500 ,, 2700 ,, ...	0·645 ,,
2700 ,, 2900 ,, ...	0·595 ,,
2900 ,, 3100 ,, ...	0·545 ,,
3100 ,, 3300 ,, ...	0·495 ,,
3300 ,, 3390 ,, ...	0·445 ,,

and from this series he concludes that at a depth of 5,170 feet the increase will be *nil*, because, as he says, "the end of the increase will come when the last increase of 0·445° R. is absorbed by the deduction of 0·05° R., therefore after $\frac{0{\cdot}445}{0{\cdot}05}$ or 8·9 strata of 200 feet, and therefore 1,780 feet deeper than 3,390 feet,* and he adds that even if the diminution of the increase of heat with depth took place at the rate of only $\frac{1}{100}$° R. instead of $\frac{5}{100}$° R., the region of constant temperature would be reached at 13,500 feet.

A similar diminution of the increase of heat with depth was observed in the case of the boring at Grenelle; but here the depth reached was far less, and the diverse character of the rocks passed through caused doubts to be entertained as to the accuracy of the result.†

In these results Prof. Mohr finds a strong confirmation of all the objections that have been urged from other sides against the Plutonistic theory. "The cause of the increasing heat in the interior of the earth," he says, "must lie in the upper strata of the earth's crust. . . . The theory of volcanoes must of course adapt itself to the above results, and the fluidity of the lavas is not a part of the incandescence (no longer) present in the earth, but a local evolution of heat by sinkings which have always been produced by the sea and its action upon solid rocks, as indeed all volcanoes are situated in or near the sea. This local superheating of the volcanic foci contributes greatly to the internal heat of the earth. For the internal nucleus of the earth can lose but little heat outwards on account of the bad conductivity of the siliceous and calcareous rocks, whilst, in the lapse of ages, it must propagate uniformly all the heat-effects of the volcanoes, and thus a constant elevated temperature must prevail in the interior, and therefore we come to the conclusion that increase of heat in the interior of the earth which is everywhere met with is the result of all preceding heat-actions, uniformly diffused by conduction in the internal nucleus of the earth." Further causes of terrestrial heat are, according to Prof. Mohr, the formation of new crystalline rocks from sun-warmed, infiltrated fluids, and also chemical processes such as the evolution of carbonic acid by the contact of oxide of iron with the remains of organisms, the formation of pyrites and blendes by the reduction of sulphates in contact with organic matters, the decomposition of lignite and coal, &c.

SCIENTIFIC SERIALS

THE *Journal of Anatomy and Physiology*, which in future will appear quarterly instead of twice a year, and has two additional editors, both physiologists, Dr. Foster and Dr. Rutherford, contains several important memoirs. The first is by Mr. Frank Darwin, on the primary vasculai dilatation in acute inflammation, in which, from a study of the effect of irritants on the web of the frog's foot, he concludes, in opposition to Cohnheim, and in accordance with Schiff, that local irritants produce these effects on vessels by acting on the peripheral terminations of the vaso-motor nerves; that they do *not* cause dilatation by direct paralysis of the tissues of the arteries, and that when the vaso-motor nerves include both inhibitory and constrictor fibres, both are stimulated by them, the attendant alteration in the calibre of the vessel being the result of the victory of the one set over the other.—Mr. F. M. Balfour has an important article on the origin and history of the urinogenital organs of Vertebrates, in which the independent discovery by Semper and himself of the segmental-organ condition of the primitive Wolffian bodies and kidneys in Elasmobranchiata is fully described, and the mode of development of the Mullerian duct explained. The way in which the segmental organs, opening externally in Annelids, have a ductal termination in Vertebrates is discussed. It is analogous to the manner in which the gill-sacs of Petromyzon, opening externally; those of Myxine have a single external orifice. The paper deserves careful perusal.—Dr. Ogston writes on articular cartilage, and illustrates his observations with six plates. After a description of healthy cartilage, the changes developed in scrofulous arthritis and chronic rheumatoid arthritis are discussed. The paper is more pathological than physiological.—Mr. W. H. Jackson and Mr. W. B. Clarke describe elaborately the brain and cranial nerves of the Shark *Echinorhinus spinosus*, from two specimens transmitted from Penzance to the Oxford Museum, to which are appended accounts of the digestive and urogenital organs.—Mr. J. Priestley demonstrates that the so-called corneal cells described by Dr. Thin as being brought into view by the action of saturated caustic potash solution at 110° F. are, in reality, those of the corneal epithelium.—Mr. E. C. Baber repeats Tillmann's observations on the fibrillar nature of the matrix of hyaline cartilage, confirming them, but differing as to the reagents which best demonstrate them.—Prof. Turner has an important memoir on the structure of the diffused, the polycotyledonary, and the zonary forms of placenta, which contains the substance of his course of lectures on that subject at the Royal College of Surgeons last summer.—Prof. Rutherford replies to Mr. Lawson Tait's comments on his freezing microtome, satisfactorily demonstrating the value of the instrument. —Dr. Stirling describes his way of preparing skin for histological examination by the rather crude method of partial artificial digestion.—Finally, Mr. J. N. Langley writes on the action of Jaborandi on the heart, discussing its slowing action, which he was the first to determine.—Dr. Stirling's Report on Physiology concludes the number.

THE current number of the *Quarterly Journal of Microscopical Science* commences with an illustrated memoir, by Mr. D. J. Hamilton, "On Myelitis, being an experimental inquiry into the pathological appearances of the same," in which the effect of traumatic injury of the cord is investigated microscopically.—The second paper is an abridged translation by Dr. W. R. M'Nab, of a paper by Dr. Oscar Brefeld, from his "Botanische Untersuchungen über Schimmelpilze," Heft. II., on the life-history of Penicillium.—This is followed by an article "On the Resting-Spores of *Peronospora infestans*, Mont, by Mr. Worthington Smith, with photographic illustrations.—After this Dr. Klein describes the Structure of the Spleen. He finds "that the pulp of the spleen of the rat and the cat is similar to that of the dog, whereas that of the monkey is similar to that of man; also that in the pulp the matrix, instead of being composed of fine fibres, has the appearance of honey-combed membranes, which only when seen in profile have the appearance of fibres. All the author's observations support the view of the splenic circulation adopted by W. Müller, Frey, and others, that the venous radicles represent merely a labyrinth of spaces in the splenic parenchyma. He agrees with those who find that there is a gradual passage from the matrix of the pulp to that of the adenoid tissue of the arterial sheaths and the Malpighian corpuscles.—Mr. C. H. Golding-Bird describes a simple differential warm stage by which a fairly uniform temperature may be maintained for a long time. To the central copper stage proper are fixed a tongue of copper and an iron wire, round both of which, for part of their extent, bell-wire is wound.—Mr. W. H. Poole describes the effect of the double-staining of tissues with hæmatoxylin and aniline. The nuclei stained by hæmatoxylin are made of a richer colour by the second reagent, whilst the protoplasm surrounding them is much bluer than the nuclei themselves.—Mr. J. M'Carthy makes some remarks on Spinal Ganglia and Nerve-fibres.—Dr. Klein has a note on a Pink-coloured Spirillum (*Spirillum rosaceum*).—The last paper is by Mr. Frank Darwin, on the Structure of the Proboscis of *Ophideres fullonica*, an orange-sucking moth, in which the peculiar conformation of the apex of that organ is described and figured, as is the interlocking of the two halves of its component maxillæ.—Notes, chronicle, and proceedings of Societies complete the number.

THE *Transactions of the Linnean Society of London* will in future be published, like the *Journal*, in two series, Zoological and Botanical. Three parts have recently been issued. The third and concluding part of vol. xxix. completes the account of the Botany of the Speke and Grant Expedition, by Prof. Oliver and Mr. J. G. Baker, and is illustrated by sixty-four plates, making 136 for the whole volume. The first part of the first volume of the second series (Zoology) includes Mr. W. K. Parker's paper On the Skull of the Woodpeckers; Dr. Willemoes-Suhm's, On the Crustacea of the *Challenger* Expedition; and Prof. Allman's, On the structure and systematic posit on of *Stephanoscyphus mirabilis*, the type of a new order of Hydrozoa: and the first part of the new Botanical series is occupied by Mr. Miers's papers on *Napoleona*, *Omphalocarpum*, *Asteranthos*, and on the Auxemneæ. An account of all these papers was given at the time of their delivery before the Society.

THE *Geological Magazine*, Nos. 133, 134, 135.—The principal original articles are instalments of long articles on volcanoes, by Mr. Judd; on *Cretaceous aperrhaïdæ*, by Mr. Starkie Gardner; on meteorites, by Dr. Walter Flight. Carl Pettersen contributes a sketch of the geology of Northern Norway, in No. 135. A list of previous writers is given. Five groups of stratified rocks are recognised: 1. The primitive; 2. The Tromsö mica slate group, probably the equivalent of the Cambrian; 3. Slates

* In this calculation Prof. Mohr seems to have made a slight slip. If the increase of heat diminishes at the rate of 0·05° R. per 100 feet, it is hard to see why strata of 200 feet should be taken as the units in the calculation. Taking 100 feet as the unit of space, the zero point should be reached at 4,280 feet.

† See Vogt's "Lehrbuch der Geologie," Bd. I. p. 29.

of Balsfjord, age very uncertain, perhaps late Cambrian; 4. Alten group, regarded as Silurian; 5. Golda group, Devonian. The groups of the Secondary period are quite unrepresented. Throughout the Quaternary period the land has been subjected to an upheaving of about 120 metres, and this elevation has been continued down to the historic time. As to whether the land is still rising, there is no positive evidence existing. In any case it is certain the elevation during the last thousand years has been insignificant. When it is stated in so many quarters as a geological fact that the northern part of Norway rises about one-third of a metre in a century, this rate is evidently much too great. The unstratified rocks met with are also described. To No. 135 there is a supplement of forty-four pages, containing a report with plates of Mr. Tylor's lecture to the Geologists' Association on denuding agencies.

THE *Proceedings of the Natural History Society of Glasgow*, vol. ii. Part I. contains among the most interesting of its articles a paper by Mr. John A. Harvie Brown on the birds found breeding in Sutherlandshire, and another by the same author in conjunction with Mr. E. R. Alston, F.Z.S., on the mammals and reptiles of the same county. These form an excellent addition to Mr. Selby's on the same subjects.—Mr. J. Gilmour writes on the introduction of the Wild Turkey (*Meleagris gallipavo*) into Argyllshire; as does Mr. D. Robertson on the Sea Anemonies of the shores of the Cumbraes, &c.—Mr. J. Coutts describes the post-tertiary clay-beds at Kilchattan Bay, Isle of Bute.—Mr. R. Gray notes points in the distribution of the Capercaillie in Scotland; on the occurrence of the Crane in Rossshire; on the Wood Pigeon, &c.—Lord Binning gives notes on the food of the Wood Pigeon.—Capt. H. W. Fielden, now naturalist to the Arctic Expedition, writes on the Gaur or Indian Bison, and gives notes on a tour through the Outer Hebrides.—Mr. J. S. Dixon gives notes on the discovery of an ancient canoe at Little Hill, Cadder Moor.—Dr. Grieve records dredging notes from the Bay of Rothesay.—There are other short papers by Mr. W. Galt, Mr. J. Young, Dr. D. Dewer, Prof. A. Dickinson, Mr. J. Ramsey, Mr. D. Robertson, Rev. J. L. Somerville, &c.

Zeitschrift der Oesterreichischen Gesellschaft für Meteorologie, Sept. 1.—Mr. Blanford's researches on solar radiation and spots, described in a former number of NATURE, form the subject of the first paper.—In the concluding part of Dr. Theorell's description of his printing meteorograph, he states that, with certain precautions, the instrument may be kept for a long period in good working order. One has been in use at Upsala during the last three years and a half, and has lost nothing of its original precision. In a note appended to the inventor's description, Herr Osnaghi mentions some alterations which have been made in the Vienna instrument; thus the power to register great velocities of wind, in which it was formerly wanting, has been conferred upon it. Since the completion of these alterations the meteorograph has worked constantly and regularly.—In the "Kleinere Mittheilungen" we have an interesting extract from a letter written by Director Hoffmeyer, on the causes of the cold weather in May 1874. Up to the 21st of the month the synoptic charts show a maximum of pressure over N.W. and W. Europe, stretching like a great screen between the Atlantic and Central Europe, from Spitzbergen almost to Algiers, the minima coming partly from the Arctic seas, partly from the Western Mediterranean, with gradients steep towards N. and W. Such a distribution of pressure must give rise to a cold Polar stream flowing over the greater part of Europe. In Vienna the cold was greatest between the 16th and the 18th, and then the high pressure began to travel eastwards. This movement of the maximum produced a great change. The Atlantic minima, instead of moving northwards along the west coast of Greenland as hitherto, now pressed eastwards, reached Iceland and the Azores, and soon the pressure was lowest in the very district where a few days before the maximum existed. At the same time temperature rises in Central Europe. In June a similar succession of barometric changes occurred, and the maximum of pressure in the N. W. was again attended with cold at Vienna. Herr Hoffmeyer observes that areas of high pressure are much more quiet and longer lasting than minima, which travel rapidly, change their shapes, and throw off secondary disturbances. He thinks the present system of averages insufficient for the purposes of generalisation, and regards the researches of Köppen on the properties of winds in different conditions of atmospheric distribution as a step in the right direction.

THE July number of the *Bulletin Mensuel de la Société d'Acclimatation de Paris*, which is always more than a month behind date, opens with the Secretary's Annual Report on the proceedings of the Society in 1874.—Special attention has been given to the training of wild animals, such as zebras, for domestic purposes, and to the breeding of hybrids, such as those between the horse and zebra, ass and zebra, &c. Complete success is said to have attended the attempts to tame the zebras in the Gardens of the Society. The efforts of the Society are largely assisted by the experiments carried out by such gentlemen as M. Cornély, M. Mairét, M. Moreau, and others, who have succeeded in rearing many of the rarer forms of foreign animal life, and useful plants.—New Caledonia is the subject of a lengthy paper by M. Germain, who considers that that country would easily support many useful animals which do not exist there. By their introduction the country would be greatly benefited, while its importance would also be increased by additional facilities being given for utilising its indigenous produce. It is peculiarly rich in timber, which affords shelter to many kinds of useful birds.—The cultivation of the Alfa Plant (*Stipes tenacissima*), which grows wild in Algeria, is strongly recommended in the South of France, where there are large tracts of land well suited to its growth.—The cultivation of new varieties of silkworms is steadily progressing in France, and the improved breeds which have been introduced have greatly assisted in remedying the evils of the silkworm disease.

THE *Schriften der Naturforschenden Gesellschaft in Danzig* (vol. iii. heft 3).—From this publication we notice the following papers:—Researches on the Prehistoric Times of West Prussia, by Dr. Lissauer.—On the Petrefacts found in the Diluvial Deposits near Danzig, by Herr Conventz.—On the Culture of the Caterpillars of *Gastropacha pini*, by G. Brischke.—On a Humming *Acilius sulcatus*, by the same.—Report on the investigations of Antiquities made in the neighbourhood of Neustettin during 1873, by Major Kasiski.—On the Spiders of Prussia, (seventh treatise), by A. Menge, with tables. This paper is the most valuable one in the publication, and gives proof of the wonderful diligence and energy of its author.

La Belgique Horticole, September and October.—In the current number of this magazine, usually devoted almost entirely to horticulture, are several articles of more than common interest. The paper of De Candolle's is reprinted entire which has attracted a good deal of attention, on the different effects on the growth of the same species of the same temperature in different latitudes. Prof. E. Morren, the editor, has two articles on the "carnivorous" habits of *Pinguicula* and *Drosera*. Following Mr. Darwin's lead in a careful series of experiments on two Alpine species of the former genus, *P. alpina* and *longifolia*, and the common *D. rotundifolia* of the latter genus, he finds the same results as regards the secretion of a fluid which causes rapid decay of the substances in contact with it, but is not prepared to admit any process of actual digestion or assimilation on the part of the plant. M. Ch. Royer has also an interesting note on the cause of the sleep of plants.

SOCIETIES AND ACADEMIES

LEEDS

Naturalists' Field Club and Scientific Association, September 15.—Mr. Henry Pocklington, F.R.M.S., in the chair.—Mr. James Abbott exhibited a number of interesting plants collected in the West Riding, including *Potentilla norvegica*, which grows abundantly on the banks of the Leeds and Liverpool Canal between Armley and Kirkstall, and appears to have been thoroughly naturalised. It was first gathered about 1860, by Mr. Wm. Kirkley, but not satisfactorily determined at the time. In 1868 it was found, also apparently native, in Burwell Fen, Cambridgeshire, by Mr. G. S. Gibson, and recorded by him in the *Journal of Botany* for that year (vol. vi., p. 302; also see "Babington's Manual," seventh edition). In 1874 Mr. Abbott noticed it in great abundance, and in 1875 it was sent to Kew to be named. It turned out to be a Scandinavian form, though in what manner it reached the Leeds district is as yet unaccounted for. Mr. C. P. Hobkirk, of Huddersfield, reports that it grows on the canal banks in his neighbourhood, where he found it in 1873. Mr. Abbott also reported the capture of the Clouded Yellow Butterfly (*Colias edusa*) near Adel Dam, six miles north of Leeds, on the 5th September. This ordinarily southern form seems this year to have extended its range far to the northward. *Vanessa antiopa*, also recorded from Kirkstall Road, Leeds, in September.

Paris

Academy of Sciences, Oct. 4—M. Frémy in the chair. The following papers were read:—On the Observatory of the Office of Longitudes at Montsouris, by M. Mouchez.—On the dredging of the roadstead of Port Said, second note by M. de Lesseps.—New researches on beats of the heart in the abnormal state, and on the registration of these beats and of those of the arteries, by M. Bouillaud.—On disordered variation of hybrid plants, and deductions which may be made from it, by M. Naudin.—On the carpellary theory, according to the Irideæ, by M. Trecul.—Results of observations of solar protuberances and spots, from 23rd April to 28th June, 1875 (fifty-five rotations), by P. Secchi. Four tables are given; deductions to follow.—On the *Hemisepius*, new genus of the family of Sepians, with some remarks on species of the genus *Sepia* in general, by M. Steenstrup.—Results obtained from attempts at industrial applications of solar heat, by M. Mouchot. The apparatus (in work at Tours) consists of a silver plate mirror, in form of a truncated cone, turning with the sun; a cylindrical annular boiler at focus, with blackened surface; and a glass envelope admitting the sun's rays, but preventing their exit when transformed into obscure rays. One very hot day, five litres of water were vaporised in the hour, representing 140 litres of steam per minute.—On the mechanical properties of different vapours at saturation in a vacuum, by M. Antoine.—On the different quantities of heat produced by the mixture of olive oil with concentrated sulphuric acid, according as the boiling of the acid is more or less recent, by M. Maumené.—On the existence of ferruginous and magnetic corpuscles in atmospheric dust, by M. Tissandier. Drawings are given.—On the formation of clouds, by M. Hureau de Villeneuve.—On sexualised Phylloxera and the winter egg, by M. Balbiani.—MM. Chablaix, Corteggiani, and Pourcherol, also presented notes on Phylloxera.—M. Marsanne submitted a memoir on "Process and apparatus for production of signals, fires, and electric lights."—M. Malessart presented a second note on the problem of aviation.—M. Tellier called attention to an experimental voyage about to be made to La Plata for transport of meat preserved by cold.—M. Petit presented a note relative to the transformation of starch by diastase, and the production of a new saccharine matter.—The Secretary notified a brochure by M. Cossa, on the syenite of Biellese.—On the eclipse of the sun of 28–29 Sept. 1875, by M. Angot.—On the reduction of a ternary cubic form to its canonic form, by M. Brioschi.—On the value of the coefficient of expansion of steam from superheated water, by M. Croullebois.—Influence of stripping off the leaves on the vegetation of the beet, by M. Violette. It diminishes the root's weight and yield of sugar, increasing the proportion of other matters.—On two new meteorites of the desert of Atacama, and on the meteorites found hitherto in this region of South America, by M. Domeyko.—On clouds of ribbon-form, by M. de Fonvielle.—Observations of a bolide at Couiza (Aude) on the night of 30th Sept. 1875, by M. Amigues.—The thunderstorms of 1875, by M. d'Arbaud-Blonzac.

Oct. 11.—The following papers were read:—Results of observations of solar protuberances and spots from April 23 to June 28, 1875 (55 rotations) concluded, by P. Secchi. The daily number of protuberances and surface of spots steadily diminished. The great metallic eruptions ceased when the large spots disappeared. Two maxima of protuberances in each hemisphere disappeared, leaving only the minima of the equatorial zones. Protuberances diminished in height. Faculæ disappeared from round the poles and were confined to the zone of spots and protuberances.—M. Girardin presented a new edition of his work, "On Dung and other Animal Manures."—M. Favre gave an extract from his memoirs "On the transformation and equivalence of chemical forces."—On the rotatory polarisation of quartz, by MM. Soret and Sarazin.—New note on the processes of magnetisation, by M. Gaugain.—On the formation of hail, by M. Planté. Electricity suddenly brings the water of clouds to a state of extreme division, facilitating congelation in a medium of low temperature. Terrestrial magnetism, or the permanent electric current of the globe, causes the gyratory movement of electrified cloud masses.—Researches on the ammonia contained in sea-water, and in that of salt marshes in the neighbourhood of Montpellier, by M. Andoynaud.—On commercial analysis of sugars, and the influence of salts and glucose on crystallisation of sugar, by M. Durin.—On the hypsometric distribution of living molluscs in the Central Pyrenees, by M. Fischer.—On the necessity of surrounding the lower part of vine-stocks with coal-tarred powders, by M. Girard.—Five other communications relative to Phylloxera.—M. Lehmann presented a further note on a system of propulsion for steamships.—M. Le Breton submitted to the judgment of the Academy various apparatuses for the ascension of liquids.—M. Holzner showed specimens of carrot-roots, bearing pucerons apparently of a new species.—The Director-General of Customs presented a general tableau of the commerce of France with its colonies and foreign powers during 1874.—The Secretary called attention to a memoir by MM. Nobel and Abel on explosives, and one by M. Volpicelli, defending Melloni's electrostatical theory.—Remarks on the use made, in antiquity, of solar heat, on occasion of M. Mouchot's recent note, by M. Buchwalder.—On the electric conductivity, of pyrites, by M. Dufet. This is true metallic conductivity very variable with the physical structure of the specimen, but in a given crystal, depending neither on the direction, the intensity, nor the duration of the current.—On the toxical effects of alcohols of the series $C^n H^{2n+2} O$, by M. Rubuteau.—On the new tellurised minerals lately discovered in Chili, by M. Domeyko.—Perforation of a quartzous grit by the roots of trees, by M. Meunier.

BOOKS AND PAMPHLETS RECEIVED

British.—Report of the Meteorological Commission of the Royal Society.—Ganot's Elementary Treatise on Physics. Seventh Edition, Revised and Enlarged. Translated by E. Atkinson, Ph.D., F.C.S. (Longmans).—Ultima Thule; or, a Summer in Iceland: R F. Burton (Nimmo).—Proceedings of the Bath Natural History and Antiquarian Field Club. Vol. iii. No. 2.—Elementary Lessons in Botanical Geography: J. G. Baker, F.L.S. (Reeve).—Numerical Examples in Heat: R. E. Day, M.A. (Longmans).—Zoology for Students: C. Carter Blake, D.Sc., with Preface by Richard Owen, C.B., F.R.S. (Daldy, Isbister).—Pollution of Rivers: Wm. Hope, V.C.—Food Manufacture *versus* River Pollution: Wm. Hope, V.C.—The *Challenger's* Crucial Test of the Wind and Gravitation Theories of Oceanic Circulation: Jas. Croll.—Notes on some Comparative Microscopic Rock-Structure of some Ancient and Modern Volcanic Rocks: J. Clifton Ward, Assoc. R.S.M., F.G.S. (Taylor and Francis).—A Series of Twelve Maps for Drawing and Examination: Charles Bird, R A., F.R A.S. (Stanford).—Revised List of the Vertebrated Animals in the Zoological Society's Gardens. Supplement.—Medicinal Plants: R. Bentley, F.L.S., and Henry Trimen, M.B., F.L.S. Part I. (Churchill).—Nebraska; its Advantages, Resources, and Drawbacks: Edwin A. Curley (Low, Marston and Co.)—The Dawn of Life: J. W. Dawson, LL.D., F.R.S. (Hodder and Stoughton).—Elementary Analytical Geometry: T. G. Vyvyan, M.A. (Geo. Bell and Sons).—The Botanical Locality Record Club. Report for 1874 (E. Newman).—Elementary Biology: Prof. T. H. Huxley, F.R.S., &c., and H. N. Martin (Macmillan and Co.)

Colonial.—Hybridity and Absorption: Daniel Wilson, LL.D., F.R.S.E. (from the *Canadian Journal*).—Mineral Statistics of Victoria, Australia, for 1874.—Report of the Geology and Resources of the Region and Vicinity of the Forty-ninth Parallel: G. M. Dawson, Assoc. R.S.M., F.G.S.—Transactions of the Royal Society of New South Wales for 1874.—Report on Deep-sea Dredging Operations in the Gulf of St. Lawrence: J. F. Whiteaves.—Reasons suggestive of Mining on Physical Principles for Gold and Coal: J. Wood Beilby (Melbourne: Walker, May and Co.)—Transactions of the Literary and Historical Society of Quebec. New Series, Part II.

American.—Tinnitus Aurium: S. Theobald, M.D. (Baltimore, Innes and Co.)—Bulletin of the Bussey Institution, Boston, U.S. Parts II., III., IV.—Iowa Weather Review, No. 1: Dr. Gustavus Hinrichs.—Report of the Director of the Menagerie, New York.

Foreign.—Boletin de la Academia Nacional de Ciencias Exactas existente en la Universidad de Cordova. Part IV. (Buenos Aires).—De la Nature des Eléments de la Chimie, par J. A. Groshaus (Haarlem, Les Heritiers Loosjes).—N. Sewerzow's Erforschung des Thian-Schan-Gebirgs-Systems, 1867, &c., von A. Petermann (Gotha, Justus Perthes).

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