

is not far above that point. And it seems impossible to account for the latter of these facts in any other mode, than by assuming that Polar water is continually finding its way from the depths of the Polar basins along the floor of the great oceanic areas, so as to reach or even to cross the Equator. And as no such deep efflux could continue to take place without a corresponding in-draught to replace it, a general circulation must be assumed to take place between the Polar and Equatorial areas, as was long since predicated by Pouillet.

Such a vertical circulation, it was affirmed by Prof. Buff, would be necessarily caused by the opposition of temperature between the Equatorial and the Polar seas; and this view was adopted by Dr. Carpenter, in his *Porcupine* Report of 1869, as harmonising with the temperature-phenomena which had been determined in the expedition of that year. It has been since contested, however, not only by Mr. Croll and Dr. Petermann, but also by Dr. Carpenter's colleague, Prof. Wyville Thomson, all of whom agree in regarding the amelioration of the temperature of the Arctic Sea as entirely due to an extension of the Gulf Stream, the underflow of Polar water being merely its complement. And the authority of Sir John Herschel was invoked against the idea that any general oceanic circulation could be maintained by difference of temperature alone; though his statements, when carefully examined, only go to prove that no such difference could produce *sensible currents*.

Such was the state of the question when the *Porcupine* Expedition of last year concluded its work; and the results obtained, whilst confirmatory of previous observations, suggested to Dr. Carpenter a definite Physical Theory, which now comes before us with the express approval of the great philosopher who had been said to be opposed to it.

Having ascertained, as our readers have learned from his report, the existence of an outward under-current in the Strait of Gibraltar, which carries back into the Atlantic the water of the Mediterranean that has undergone concentration by the excess of evaporation in its basin, Dr. Carpenter applied himself to the consideration of the forces by which the superficial in-current and the deep out-current are sustained; and came to the conclusion that, as had been previously urged by Captain Maury, a *vera causa* for both is to be found in excess of evaporation, which at the same time lowers the level and increases the density of the Mediterranean column as compared with a corresponding column of Atlantic water. This conclusion, when scientifically worked out, was found to be applicable, *mutatis mutandis*, to the converse case of the Baltic Sound; in which, as was long ago experimentally shown (with a result that has recently been confirmed by Dr. Forchhammer), a deep current of salt water flows inwards from the North Sea, whilst a strong current of brackish water sets outwards from the Baltic, the amount of fresh water that drains into which is greatly in excess of the evaporation from its surface.

Comparing, then, the Polar and Equatorial areas, it is shown by Dr. Carpenter that there will not only be a continual tendency in the former to a lowering of level and increase of density, which will place it in the same relation to the latter as the Mediterranean bears to the Atlantic; but that the influence of Polar cold will be to

produce a *continual descent* of the water within its area; thus constituting the *primum mobile* of the General Oceanic Circulation, of which no adequate account had previously been given. This conclusion, as our readers will have seen, has been most explicitly accepted by Sir John Herschel.

Our limits do not admit of our following Dr. Carpenter through his discussion of the relative shares of the Gulf Stream and of the General Oceanic Circulation in that amelioration of the temperature of the Polar area, of which the industry of Dr. Petermann has collected a vast body of indisputable evidence; and for this discussion we would refer such of our readers as are specially interested in the question to the last part of the "Proceedings of the Royal Geographical Society." But as Dr. Carpenter has now shown a capacity to deal not merely with Physiological but with Physical questions, in a manner which has obtained the approval of some of the ablest physicists of our time, we hope that he will not again be accused (as he was by some of those who opposed his views on their first promulgation) of venturing beyond his depth when he began to reason on these subjects, and of advancing doctrines which his own observations refuted. The exclusive doctrine of the thermal action of the Gulf Stream advocated by Mr. Croll, rests, as Dr. Carpenter has shown, upon so insecure a basis, that a very large body of careful observations must be collected before any reliable data can be obtained as to the heat it actually carries forth from the Gulf of Mexico. And how much of this heat is dissipated by evaporation, as well as by radiation, before one-half of the Stream reaches the banks of Newfoundland (the other half having turned round the Azores to re-enter the Equatorial current), is a question which there are as yet no adequate data for determining. On the other hand, in his conclusion that a great body of Ocean water slowly moving northwards, so as to carry with it a considerable excess of temperature even to the depth of 500 or 600 fathoms, must exert a much greater heating power than the thinned-out edge of the Gulf Stream, Dr. Carpenter seems to us to have both scientific probability and common sense on his side.

SCIENCE IN ITALY

Atti dell' Accademia Pontificia de' Nuovi Lincei.

Reale Istituto Lombardo di Scienze e Lettere. Rendiconti.

Annali di Chimica Applicata alla Medicina. Compilati dal Dottor Giovanni Polli.

ITALY has become a nation. It is no longer enslaved by the barbarous despotism, of a single city, nor divided into mutual throat-cutting republics, nor diplomatically parcelled into heir-looms for royal families. It has at last become the country of its own people. The moral and intellectual laws of Natural Selection are now freely operating, and they will soon show what manner of people these Italians really are.

There are many ways of gauging the civilisation of a community. The consumption of soap has been suggested, and has the advantage, being numerically definite. Thus, let s represent the quantity of soap used, p the population,

and x the state of civilisation, we obtain the following equation—

$$x = \frac{s}{p}$$

and thus moral philosophy is brought within the reach of the mathematician. But there is another test which is, I think, even safer than soap, that is, the current literature of the nation, and more especially its periodical literature. The readers of *Reynolds's Weekly Newspaper* and the *Sporting Life* diverge so widely from the subscribers to NATURE, that their differences almost come within the reach of ethnological specification, and I believe that the direction of the growth of Young Italy may best be determined by watching the progress of its periodical and general literature.

It is a very interesting and promising fact that during the last two years the proportion of purely scientific works to those of light literature has been greater in Italy than in either England, France, or Germany. This refers only to original Italian works, and does not include translations. The periodicals named at the head of this article are good examples of the progress of the highest kind of intellectual culture in Italy. The first is published at Rome, the second and third at Milan. "The Transactions of the Pontifical Academy of the New Lynxes" does not belong to Young Italy, as the fasciculi before me are for the twenty-second year of the Academy, and the new Lynceans claim Pontifical patronage, and announce it in their name, which of course is derived from the old classical society of the Lynx-eyed Philosophers of the middle ages; a title which, in spite of its fanciful character, presented one of the earliest formal recognitions of the paramount importance of laborious observation, as opposed to the speculative and disputatious spirit of contemporary philosophy.*

The papers of Father Secchi and Prof. Respighi, on their spectroscopic and telescopic observations on the sun and stars, occupy a considerable portion of these Transactions. Father Secchi's observations are tolerably well known to English readers, but I doubt whether such is the case with Respighi's spectroscopic researches on "Stellar scintillation," the results of which were stated in papers read at the Lyncean meetings of May 10, 1868, and February 14, 1869. These second papers supplemented the first and embraces 720 observations, extending from October 4 to February 12. The primary results obtained by Prof. Respighi were that in the spectrum of a star near the horizon, dark lines and bright bands travel along the spectrum, most frequently from the red to the violet, but sometimes in the contrary direction, and occasionally oscillate from one colour to the other. The nearer to the horizon, the more distinct and definite are these moving lines and bands, and the more slow and regular their movements. The bright moving bands are more rare and less regular

* The original *Accademia Lincea* was founded in Rome by Federigo Cesi, the Marchese di Monticelli, in 1603. Cesi was the first president, and Bapista Porta the Neapolitan vice-president. Galileo became a member in 1611. It preceded our Royal Society and the French Academy by about half a century, and combined the functions of these societies with a scheme of philosophical brotherhood and affiliated lodges, somewhat resembling the masonic organisation. Its members were required to be "philosophers eager for real knowledge, who will give themselves to the study of nature, and especially to mathematics." They were to waste no time in "recitations and declamatory as-embles," and to "pass over in silence all political controversies and quarrels of every kind, and wordy disputes, especially gratuitous ones." They are commended to "Let the first fruits of wisdom be love; and so let the Lynceans love each other as if united by the strictest ties, nor suffer any interruption of this sincere bond of love and faith, emanating from the source of virtue and philosophy."

than the dark lines, and are only seen when the star is very near the horizon. Further observations brought out the law that in the normal condition of the atmosphere their motion is from the red to the violet in the spectrum of all stars on the west, and from the violet to the red when the star is in the east; while near the meridian, whether on the north or south horizon, the motion is generally an oscillation from one colour to the other; and sometimes the lines appear stationary, or traverse only a portion of the spectrum. In abnormal states of the atmosphere the moving lines are weaker and more irregular in form and motion; this is especially the case during strong winds, which sometimes reduce the movements on the spectrum to mere variations of brilliancy, even in stars very near to the horizon.

Prof. Respighi observes that these appearances are not due to an oscillation of the characteristic spectrum of the star, and that there is no superposition of its colours due to any sensible movement of the image of the star in the normal states of the atmosphere, though he does not deny that there may be such sensible oscillation and superposition, under conditions of abnormal atmospheric disturbance. He has observed that when the moving lines are regular in form and motion, there is usually a continuance of fine weather, and that the phenomena of scintillation are most marked and decided on those nights when there is much humidity in the atmosphere. He believes that by careful study of these phenomena the spectroscopy may become an important meteorological instrument.

It would occupy too much space to follow Prof. Respighi through his theoretical reflections on these phenomena, which he attributes to irregularities in the temperature, and distribution of aqueous vapour, &c., in the earth's atmosphere, and the effects of its rotatory movement with the earth, which carries it across the direction of the radiation of the light from the stars.

Besides the above-named, there are some very interesting papers on electro-static induction, and electrical induction or influence in rarefied gases, by Prof. Volpicelli.

The four first numbers of the present year of the Reports of the Royal Institution of Lombardy are remarkably rich in interesting papers, extending over a wide range of subjects. Buccellati on Military Punishment, Lambrosi on the Italian Races, and Ciavarini on the Laws of Human Progress, are the chief essays in the Department of the Moral and Political Sciences. In the Department of the "Mathematical and Natural Sciences" the subjects of the papers are more varied, including, Roviada on the Pulse of the Veins, Barbieri on the Utility of Statistics of Hernia in Italy, Experimental Researches on the Origin of Fibrin, and a new Theory of the Cause of the Coagulation of the Blood, by Mantegazza, and Serpieri on the Probable Relation between the Luminous Cones (*pennacchi*) of the Solar Corona, and the Positions of the Planets.

The author of this paper supposes that the corona is an electrical phenomenon identical with that of our terrestrial aurora borealis, that the sun and all the planets mutually act and react upon each other inductively; that the cones of rays which stretch out from the corona are electrical streamers pointing towards one of the planets; that the curved lines and rays which have been observed

are other streamers, pointing obliquely to planets or comets; that the zodiacal light is the general stream of electrical influence emanating from the sun and embracing all his planetary children; and that the sun-spots and the hydrogen prominences are due to electrical outbursts. We have had similar hypotheses put forth in England, but not so well argued as by Prof. Serpieri. Like the rest, he fails, however, to supply us with any explanation of the source of such tremendous electric energy. We may have the cylinder, the prime conductors, the insulators, the Leyden jars, and all the apparatus of a fine electrical machine; but we shall get no sparks unless somebody turns the handle. We obtain no electrical force without an expenditure of equivalent mechanical power. In the battery we must oxidise an equivalent of zinc for each equivalent of electricity produced. We know something about the laws of electrical excitation; and those who assume the existence of such huge electrical forces without indicating their origin in accordance with these known laws, only carry the problem of the source of solar energy one stage further back without advancing a single step towards its solution. Among the other papers are Lannetti on Etruscan Crania, and some on Pathology and pure Mathematics.

The Annals of Chemistry, compiled by Dr. Polli, is a carefully collected and valuable record of the progress of Chemistry, in which the subjects are classified under the heads of Pharmacy, Hygiene, Dietetics, Physiology, Toxicology, Pathology, Therapeutics, and Miscellaneous. It is published monthly in octavo fasciculi of sixty-four pages, each containing abstracts of papers from native and foreign journals. It sells at rather less than one shilling. As our *Philosophical Magazine*, with eighty pages of the same size, scarcely pays expenses at 2s. 6d., we may infer that the *Annali di Chimica*, of Milan, has a better circulation than its old-established scientific contemporary of "London, Edinburgh, and Dublin."

W. MATTIEU WILLIAMS

SEELEY ON THE ORNITHOSAURIA

Index to the Fossil Remains of Ornithosauria, Aves, and Reptilia from the Secondary Strata, arranged in the Woodwardian Museum, Cambridge. By Harry Govier Seeley. 8vo. pp. 144. (1869. Cambridge: Deighton.)

The Ornithosauria, an Elementary Study of the Bones of Pterodactyles. By Harry Govier Seeley. With 12 plates. 8vo. pp. 136. (1870. Cambridge: Deighton.)

THANKS to the activity of the "Coprolite" workings in the Upper Greensand around Cambridge, the Woodwardian Museum possesses particularly rich series of interesting reptilian remains, especially those belonging to the *Ornithosauria* or Pterodactyles (Flying Lizards) of the Secondary rocks; to which the second work with its twelve plates is entirely devoted, as is also a large part of the Catalogue first published.

The "Index to the Fossil Remains" is introduced to the attention of the student and anatomist by a prefatory notice from the Rev. Adam Sedgwick, Woodwardian Professor, who, although in his eighty-fifth year, evinces still considerable remains of his wonted fire, when taking up his pen to write of the treasures contained in the Museum of his Alma Mater. The cost of preparing these works has been borne by Prof. Sedgwick, but the printing of both

books has been defrayed out of the funds of the Syndics of the University Press.

1. The first book is intended to serve as a guide to the student in the examination of the remains of the extinct birds and reptiles preserved in the Woodwardian Museum, each case, shelf, and bone being numbered so as to correspond with the catalogue in which it is described. The list of specimens from the Cambridge coprolite bed occupies about half the book.

Many new forms are here announced by the author for the first time, as *Enaliornis* (a new bird) several new *Ichthyosaurs*, a new Crocodile, 3 species of *Stereosaurus*, 2 new Chelonians; so that we have altogether 70 species from the Cambridge Greensand. There are also Chalk (8 sp.), Gault (2), Wealden (12), Purbeck (7), Potton beds (18), Portland (1), Kimmeridgian (10), Coral rag (3), Oxford clay (8), Oolites (4), Lias (20), foreign reptiles (24), making a total of 187 species.

2. In the second work, that on the Ornithosauria, the author enumerates the materials at his disposal, namely, 500 bones in one collection, and 400 in another, probably representing not fewer than 150 individuals, which well displays the richness of the area.

The bones from the coprolite diggings are much broken, but they retain sufficient character to be readily determined by the comparative anatomist.

Probably, no group of animals have caused more contention between Naturalists than the Ornithosaurians. They have been regarded as bats (Sömmering), as intermediate between birds and reptiles (Goldfuss), amphibians (Wagner), and so on. Herman von Meyer, who has paid more attention to them than any other anatomist, concludes them to be reptiles, though with strong avian affinities. Prof. Owen maintains that they are Saurians.

Mr. Seeley combats these views, and contends that the Pterodactyles were more nearly allied to birds than reptiles, and he refers them all to a new genus, *Ornithocheirus*.

He contends against the cold-blooded view taken of them by Prof. Owen, and asserts that they were warm-blooded, chiefly founding his opinion on the form of the brain. There is a very strong objection to be made against the retention of the terms "cold-blooded," and "warm-blooded," for it seems to us that the heat developed by the animal's body is in direct proportion to the work to be performed. Thus, in aerial locomotion, the efforts of the pectoral muscles to sustain the body in the air, necessitate also a correspondingly more rapid action of the heart and lungs, producing, therefore, more rapid circulation, and an increased bodily temperature. We are therefore inclined to agree with Mr. Seeley on the grounds that, in proportion to the rapidity and the sustained action of the great motor muscles of the body (whether of legs or wing) so will be the rapidity of the action of the heart and lungs, and consequently the acceleration of the temperature of the whole body.

The bones from the Cambridgeshire Greensand are very often so fragmentary that their determination requires the most exact anatomical skill, and we think the plates would have been more useful if in a few instances (perhaps in all) the missing parts and processes had been indicated in outline, so as to help to the better understanding thereof by the student.

H. WOODWARD