THURSDAY, APRIL 13, 1899.

EARLY ASTRONOMY.

Researches into the Origin of the Primitive Constellations of the Greeks, Phoenicians and Babylonians. By Robert Brown, jun. Vol. i. Pp. xvi + 361. (London: Williams and Norgate, 1899.)

THE early history of the science of astronomy is a very fascinating, but also a very difficult, subject for study, inasmuch as it is almost impossible to say with certainty at what point astrology ends and astronomy begins. That accurate observations of the stars were made by the Egyptians at a very remote period of their history, has been conclusively proved by Sir Norman Lockyer, from a study of the orientation of the principal Egyptian temples; but in its dawn astronomy was of an essentially religious and magical character. The desire to obtain a knowledge of the future from the aspect of the heavens, was doubtless one of the principal motives which actuated the Egyptians, the Chinese, and, in particular, the Babylonians in their earlier observations of the stars; and it was only after many centuries that the practice of astrology gave place to more scientific aims and methods. That the Babylonians took astronomical observations from an early period is attested by general tradition, which in some cases, however, exhibits curious exaggeration. Pliny, for instance, refers to certain calculations in accordance with one of which the Babylonians possessed recorded observations extending over a period of 490,000 years, while according to another their calculations reached back to some 720,000 years. Yet, in spite of such absurdities, there was doubtless a substratum of truth in the tradition, and it is probable that the Babylonians, like the ancient Egyptians, from a very remote period were watching the stars and laying the foundations of astronomy. During the Assyrian empire we know that important astronomical schools existed at Ashur, Nineveh and Arbela in the eighth and seventh centuries B.C., and a number of reports made by the royal astrologers have come down to us. From these reports, and from the lists of stars, observations and calendars of the same period that we possess, we may conclude that at this time the science was still in its astrological stage of development.

Some eighteen years ago excavations were undertaken at Abu-Habbah, the site of the Babylonian city of Sippar, and they resulted in the discovery of numerous fragments of astronomical tablets belonging to the Seleucid and Arsacid eras. They are written in the late Babylonian cursive form of writing, and were found to be very difficult to decipher; but, after several years of patient study, Dr. Strassmaier and the late astronomer Dr. Epping, working in collaboration, succeeded in accurately determining the contents of many of them. From them we gather that the later Babylonians, although they made their calculations solely by the cumbrous processes of addition and subtraction, did study astronomy on a purely scientific basis. It is true they had no correct conception of the solar system, but they had at least arrived at the conclusion that the motions of the heavenly bodies were governed by laws and were amenable to calculation; in fact, the tablets prove that they calculated the time of the new moon's appearance, and the periodical occurrence of lunar and solar eclipses, that they noted the courses of the planets, and included in their observations a number of the principal constellations and fixed stars. In consequence of these discoveries it is now a generally accepted opinion that the Greeks obtained from the Babylonians of this period the greater part of their knowledge of astronomy.

According to its title-page, Mr. Robert Brown's book is concerned with the "Primitive Constellations of the Greeks, Phœnicians and Babylonians," whatever that may mean. We have read Mr. Brown's book through, and, so far as we understand his position, we gather that he has two principal convictions with regard to the history of early astronomy. One is that the Greeks had a very full and accurate knowledge of the constellations from the earliest period of their history; the other is that they gained their knowledge at this early period from the Babylonians, through intercourse with the "Hittites" and the Phœnicians. In accordance with his first supposition, Mr. Brown attempts to trace the constellations mentioned by late Greek writers on astronomy to corresponding Akkadian, Babylonian or Assyrian stars and deities; in accordance with his second supposition, he asserts that the Greeks of the Homeric and pre-Homeric ages were quite familiar with the names of the constellations known to their later descendants. Mr. Brown's methods of proof, if we may so term them, differ for these two theories; for the first they are philological, for the second archæological. Mr. Brown devotes the earlier part of his book to developing his first theory, but for the sake of convenience we will reverse his order.

To prove that the early Greeks were familiar with the later Greek names for the constellations Mr. Brown depends on certain passages in Homer, the figures on Greek coins, and representations in early Greek art. Mr. Brown's method is simple enough; he approaches his subject with his theory ready made, and looks round for evidence to support it. For instance, the Homeric poems "speak of serpents, horses, charioteers, archers, wreaths, lyres, birds, rams, goats, virgins, doves, fishes, streams, altars, and tripods" (p. 248). Mr. Brown admits that in mentioning an eagle or a hare, Homer may have no further meaning than to refer to them as living creatures; but he proceeds to note as "a singular fact' that "the poems contain references to almost every figure which formed one of the primitive constellations." Mr. Brown makes the same sort of remarks about the figures of animals, &c., on early Greek coins, which he would like to regard as symbols for constellations, or, at any rate, as "constellational subjects." With regard to such designs upon coins, which have given rise to a good deal of discussion, Prof. Ridgeway in his work upon the origin of currency has developed the very ingenious theory that they represented objects of barter, which in course of time were displaced by the more convenient metallic currency. It is possible that Prof. Ridgeway has carried his theory too far in certain

directions, but he is at any rate a scholar who works on a scientific method, and the mass of evidence he has accumulated must be either accepted or refuted by any subsequent writer on the subject. Mr. Brown, however, is not concerned with such a prosaic pursuit as the weighing of evidence. To his eyes all beasts and birds on coins assume a stellar aspect, and are at once classified in his book as "constellational"; in fact he believes he has discovered that constellation-figures "simply swarm" in coin-types (p. 239). Similarly he has no difficulty in finding "constellational subjects" in Schliemann's finds at Tiryns and Hissarlik, in the "Hittite" hieroglyphs, and in Mr. Evans's Cretan pictographs. Such wholesale assertions are not evidence, and all that is needed to refute them is a little common sense.

Mr. Brown's method of work with regard to his other conviction, which is developed in the earlier part of his volume, is equally simple, though it might not seem to be so from the learned appearance of his pages. He takes Ptolemy's catalogue of stars from the Almagest, and for each constellation proceeds to find some star or deity known to the Akkadians, Babylonians or Phœnicians, to which he may equate it. In the present state of knowledge on this subject, such comparisons, if undertaken by a competent scholar, would necessarily be made in a very tentative manner, and only after a thorough acquaintance at first hand with the literatures and inscriptions of the nations concerned. Mr. Brown has no misgivings, and finds his equations with the greatest ease; in the process, however, he proves that his knowledge of the languages he quotes is not obtained at first hand, and that he has not sufficiently qualified himself for his task. He is careful to state that in the spelling of names he adopts "the original forms, because they are the most correct"; he follows this plan, he tells us, even at the risk of being accused of pedantry, for he does not hold with those "who think that Time can consecrate error and canonise ignorance." Thus he writes "Babylôn" and "Euphratês," and refers to Darius as "Dârayavaush." Mr. Brown, however, was not well advised to adopt so high a standard, for in seeking to attain it he has fallen into a good many errors of his own making. For instance, he incorrectly writes "Tukulti-pal-esar" (p. 47) for Tukulti-pal-Eshara when Tiglath-pileser would have done equally well; and in referring to Borsippa as "Barsipki" (p. 327) he has transliterated the determinative particle *ki* as though it were a syllable of the name. His references to Hebrew, Phœnician and Assyrian words, moreover, show that he is not acquainted with these languages, for he unwittingly makes use of quite different systems of transliteration. When citing the Hebrew for "serpent" as "nâkhâsch" (pp. 29, 119, &c.), and when referring to the Phœnician deity "Eschmûn" (p. 168), he is evidently drawing on some German work; while elsewhere he renders the Hebrew and Phœnician sound *sh* in the ordinary English method; similarly the Assyrian for "heaven" is not *same* (p. 57), nor *samê* (p. 269), nor *samî* (p. 287), but *shamê*. Mr. Brown gets into a good many difficulties with his sibilants in quoting Assyrian words; he states in his preface that instead of using diacritical marks he employs *kh*, *ts* and *sh*, yet he cites the Assyrian for "king" as *sarru* (pp. 34, 62, &c.) instead of *sharru*; he translates the relative pronoun as *sa* instead of *sha* (*passim*), he writes *saplitu* for *shaplitu* (p. 116), *risi* for *rêshi* (p. 81), *satti* for *shatti* (p. 267), *Gilgames* for *Gilgamesh* (p. 46), *Samas* for *Shamash* (*passim*), &c. Now Prof. Sayce, in his popular works on Assyrian, purposely makes no distinction between his sibilants—a very reprehensible practice according to Mr. Brown's preface, and we venture to offer Mr. Brown our sincere sympathy for having himself, through ignorance of this fact, helped to "consecrate and canonise" so many errors.

Mr. Brown, however, makes worse mistakes than these, for he really ought to know there is no *h* either in Assyrian or in Akkadian, and he might be expected to know the difference between a consonantal and a quiescent *hē* in Hebrew; moreover, he seems ignorant of the construct state, and appears to be unaware of the fact that you cannot have a long vowel in a closed syllable in Hebrew unless it has the tone. These would be bad blunders in a beginner, and are scarcely expected in the work of a comparative philologist; it is hardly necessary to follow Mr. Brown further in his numerous philological comparisons.

We have, perhaps, devoted more space to this book than it deserves, though we have not mentioned more than a few of the extraordinary blunders we have come across during its perusal. The manufacture of books of this nature can surely serve no useful purpose.

LIFE ON AN ATOLL.

Funafuti, or Three Months on a Coral Island; an Unscientific Account of a Scientific Expedition. By Mrs. Edgeworth David. Pp. xvi + 318. With Portraits, Map, and Illustrations. (London: John Murray, 1899.)

MRS. DAVID accompanied her husband on the second boring expedition to the atoll of Funafuti, when, under his directions, a depth of 643 feet was attained. The island is one of the Ellice group, lying about 8° south of the equator, almost due north of Fiji, and so nearly half a hemisphere away from London. Selected by the Coral Reef Boring Committee of the Royal Society as a typical atoll, the chain of islands, of which it is composed, takes an outline which roughly resembles that of a shoulder of mutton, and encloses a lagoon about eleven miles in diameter.

Funafuti itself lies on the eastern side, a long, low, narrow island, composed wholly of coral and other organisms. It possesses a king and a native pastor; a church, a school-house, and even a royal residence; the latter, however, are edifices of the humblest kind, and it does not yet boast of an hotel or a lodging-house, so Mrs. David and the Professor took up their quarters in a native hut just outside the village. This had its advantages and its drawbacks; it was well ventilated, but not always rain-proof, and the domestic life was too open to inspection; for the Funafutian is as inquisitive as a child. "Fancy living, bathing, feeding, and sleeping in a one-roomed house with unhung door-spaces; a house with mat walls that are being constantly lifted by little brown hands, to let in little brown heads, with big

innocent inquiring eyes." The children might sometimes be got rid of, but the adults were greater difficulties, and as the women were more animated than the men by the true scientific spirit of seeing for themselves, Prof. David was placed in embarrassing situations oftener even than his wife. But they both accommodated themselves to circumstance with unfailing good humour, and so were evidently general favourites.

Mrs. David calls her book "an unscientific account of a scientific expedition." This in a sense is true, because there is no attempt at technical language, and long words are conspicuousiy absent; but every page shows close observation, keen insight, and a power of vivid description, that gives the work a real scientific value. We can almost see Funafuti, and in this are helped by sundry successful reproductions of photographs. But such a word-picture as the following suffices to bring up the scene.

"We anchored close to the lagoon reef, about a quarter of a mile from the shore, and over the side, under the shallow water, we saw irregular-shaped masses of dun-coloured coral with myriads of brilliant fishes flashing across from hollow to hollow, inquisitive but timid. Then on the shore was a long narrow crescent of brilliant white sand, lapped by the tiny idle wavelets of the lagoon; beyond that, a line of low thick tasuna and gasu bushes, and behind a dense mass of graceful cocoa-nut palms."

In former days, the Funafutians depended wholly on the cocoa-nut palm and on fishing for subsistence, with the result that starvation times were not uncommon. Now the missionaries have taught them to cultivate bananas, bread-fruit, and taro (*Arum esculentum*), and they have pigs, goats and fowls; so that though cocoa-nut is still a staple food, the "milk" being a substitute for "afternoon tea," they are much better off. But they take life easily, and are great believers in "by-and-by." In fact Mrs. David admits that it is very hard to be energetic on an atoll near the equator, for her attempts at reading generally ended in sleep. So the natives, except when fishing or some such business calls for an exceptional exercise of energy, lead, on the whole, a very easy life. Food of a simple kind generally is fairly plentiful, their wants are few; houses, furniture, tools, utensils, even clothing, are all of the simplest. As converts to Christianity, they have abandoned the graver vices of the savage, and are accustomed to the restraints of laws, sometimes perhaps rather too grandmotherly; but yet they remain, like so many such, physically adults, but mentally and morally no more than children. Mrs. David's quick apprehension of this fact gives the book its special value. She accepted them as she found them with a sympathetic tolerance, adapting to their case the experiences learnt in her own nursery, with the result that she won their hearts and their confidence. Their language is a mixture, Samoan dominating; but some can speak our tongue, and a sort of pigeon-English is commonly understood. Mrs. David obtained copies of native songs—for a musical (?) evening is a favourite form of Funafutian recreation—and of their popular tales. The former are mostly of scriptural origin, and so have little interest; but the latter are well worth preservation as samples of Pacific Islanders' folk-lore.

Funafuti has its drawbacks as a residence. The climate leaves something to be desired; it is windy, and decidedly rainy. Flies and mosquitos abound to make life a burden, with spiders, cockroaches, and other more or less obnoxious insects, while, among creatures of larger size, land-crabs and small rats seem predominant. The natives suffer greatly from skin diseases, such as itch, ringworm, and Tonu (apparently a kind of leprosy), against which they will not take any precaution. In matters of sanitation, the native pastor is no use at all; a medical missionary, as Mrs. David says, would be, indeed, a blessing to the Funafutians. But for all their quaint, tiresome, yet lovable ways, we must refer readers to the book. Written in a bright, lively style, like a series of letters to a friend, humorous, yet kindly, full of vivid word-pictures of life and scenery, it is an unusually attractive volume. T. G. BONNEY.

NATURAL RIGHTS.

The Right to the Whole Produce of Labour. By Dr. Anton Menger, Professor of Jurisprudence in the University of Vienna. Translated by M. E. Tanner, with an Introduction and Bibliography by H. S Foxwell, M.A., Professor of Economics at University College, London. Pp. cxviii + 271. (London: Macmillan and Co., Ltd., 1899.)

PROFESSOR FOXWELL treats his part of this book as complementary to Dr. Menger's treatise, but in reality he contributes more than half of the actual printed pages. To allocate the shares briefly, Dr. Menger has analysed critically and historically the socialistic theories of natural rights; Prof. Foxwell has written the history of early English socialists, and added a complete list of their works. The main interest of the book to English readers will be this rescue from oblivion of the men to whom the whole of modern socialistic theory is originally due; they are Godwin, Hall, Thompson, Gray, Hodgskin, and Bray. Godwin's "Political Justice" (1793) analyses the right to property, regarding want as the only equitable right, thus forecasting the phrase "to each according to his needs." Hall's "Effects of Civilisation on the People in European States" (1805) contends that the chief effects are, on the one hand, a constant increase of the wealth and power of the idle rich, and, on the other, the greater poverty and subjection of the labouring poor. Thompson's "Inquiry into the Principles of the Distribution of Wealth most conducive to Human Happiness" (1824) bases his hypotheses on "the ascertained truths of political economy" of the new Ricardian school, to whose "crude generalisations" socialism owed "its fancied scientific basis," and who, "by a singular irony of fate, by this imperfect presentation of economic doctrine, did more than any intentionally socialist writer to sap the foundations of that form of society which he was trying to explain, and which he believed to be the typical and natural, if not, indeed, the ideal social state." Thompson held that "to the producer should be secured the free use of whatever his labour has produced," while the capitalist should be indemnified for the wear and tear of

his goods, and receive an income equal to that of the best workmen, but that rent and interest are only forced abstractions sanctioned by law. Here, says Dr. Menger, we find the train of thought which reappears in the writings of the well-known socialists Marx and Rodbertus. Gray, the author of "A Lecture on Human Happiness" (1825), gives an analysis of Colquhoun's table of national wealth (1814), and finds that there was produced "nearly fifty-four pounds a year for each man, woman, and child in the productive classes: of which they received about eleven pounds, being but a small trifle more than one-fifth part of the produce of their own labour!" It may be mentioned for comparison that modern statistics show that now about four-ninths of the national income is received by wage-earners. Finally he holds that the unproductive classes, as he calls them, should in his reformed community be reduced to the few necessary for superintending labour, and should devote their talents to the general good. Hodgskin, a thoroughly educated man, a friend of Francis Place, the radical, and of James Mill, was more a politician than his socialist forerunners; in his "Labour Defended" he holds that by combination the labourer may "destroy altogether the profit of the idle capitalist" in the "war of honest industry against . . . idle profligacy," and "augment the wages and rewards of industry," giving "to genius and skill their due share of the national produce." Bray, in "Labour's Wrongs and Labour's Remedy" (1839), traces social anomalies to "the institution of property as it at present exists," and works out in detail a transitional project for passing to a communistic state.

Dr. Menger proves that neither Karl Marx nor Rodbertus were original in their analysis of the cause of the "rent" "surplus value" or "unearned income," which they held must accrue to the non-workers in an individualistic *régime*, when the workers had, owing to the "iron law" of wages, received "bare subsistence," but that all their ideas came from this group of English socialists. He does not criticise the truth of their hypotheses, except by showing that the "right to the whole produce of labour" has never been recognised in any permanent legal system; but he reduces the claims of socialists to three—this "right to the produce of labour," the "right to subsistence," and the "right to labour"; he shows that these rights are not consistent with each other, examines the French attempts to give effect to one or other of these claims, showing how failure always followed, and finds that socialists have never put forward any unanimous, consistent and practical scheme for the reorganisation of society, while they have only been successful in uniting their followers on negations, or criticisms of existing ills. He is clearly not entirely out of sympathy with these criticisms, for one of his chief conclusions is that "it should be recognised as a guiding principle of legislation that all measures are to be avoided which create or increase unearned income."

The importance of the book consists to a great extent in the bibliography, which must prove invaluable to any student of the growth of socialistic ideas; though it is clear that Prof. Foxwell's industry has unearthed very many rare publications, of which copies will hardly be found except in his own celebrated library. For the ranslation we have nothing but praise. A. L. B.

OUR BOOK SHELF.

L'Audition et ses Organes. Par Dr. M. E. Gellé. Pp. 326 (Bibliotheque Scientifique Internationale.) (Paris: Félix Alcan, 1899.)

IN a volume belonging to this series, one expects three primary virtues—a clear logical arrangement, a lucid method of statement, and accuracy with regard to matters of fact. The book before us attains to a fairly high standard in all these respects; it is divided into three chapters, in which the sonorous vibrations are traced in logical sequence from their origin to their final transformation into sensations of sound in the brain. A judicious use of headings in larger type is a great help to clearness; but, in a book of this kind, a little more space might with advantage have been given to the more elementary parts of the subject, especially in the physical and anatomical chapters. Misprints appear rather too frequently (*e.g.* five in 2½ lines of English quotation, p. 46), and the illustrations are often not so good as could be wished.

In the first chapter, which deals with various physical properties of sonorous vibrations, a series of phonograph tracings are given, that amongst other things show in an exceptionally clear and beautiful manner, the changes due to variations in intensity and the action of the explosive consonants on the various vowel sounds. Several of these diagrams would be improved by a fuller and more definite explanatory description. The paragraphs in this chapter on the quality of musical sounds and the formation of articulate speech strike us as especially good.

The early part of the second chapter, describing the evolution of the auditory organ within the animal series, is a weak point in the book. The subject is treated too briefly to escape ambiguity—*e.g.* from the description on pp. 140–141, no one would suppose that an external opening to the ductus endolymphaticus was a general feature among Elasmobranchs; and a little lower down the page it is far from easy, without previous knowledge, to distinguish the statements that refer to the shad from those referring to the carp. We may further mention that the auditory sac is open in the lobster, and although monotremes and many marsupials have a columelliform stapes, their ossicles cannot be said to be reduced to a columella. The remainder of the chapter—dealing with the anatomy and physiology of the human ear—is excellent. We notice that in the discussion on the external auditory meatus no mention is made of its apparent importance in the realisation of the external origin or outwardness of sounds. In the question of the mode of transmission of the sonorous vibrations through the ossicles and in the labyrinthine fluids, the author is strongly in favour of its being mainly molecular, although he allows a certain amount of movement of the ossicles *en bloc*. The pages that deal with the internal ear form certainly one of the best parts of the book.

The subject of the last chapter—the relation that exists between the brain and the auditory impulses—is one of great obscurity, and is here largely treated by the citation of cases, that bring out in various ways how entirely the perception of sound depends upon the state of the brain and nervous system. In short, this may be called a good book on a highly interesting subject.

Early Chapters in Science. By Mrs. W. Awdry. Edited by Prof. W. F. Barrett. Pp. xviii + 348. (London: John Murray, 1899.)

A VOLUME which gives instruction in the chief biological and physical sciences in 348 pages cannot very well be satisfactory in all its parts. The aim of the present volume is to provide "a first book of knowledge of natural history, botany, physiology, physics and chemistry for young people"; and, so far as it goes, it represents a praiseworthy attempt to create and promote an interest in natural things and phenomena. The animal and vegetable kingdoms are described in two hundred pages, and

physics and chemistry in the remaining part of the book. Electricity is dealt with in sixteen pages of this part, and chemistry in twenty-eight pages. Most of the illustrations are line drawings, and will not be attractive to the young people for whom the book is intended; for few natural history objects can be well represented by outline sketches, and children often have a difficulty in understanding them.

In the preface the editor, referring to the object of the book, suggests that it should be especially useful in "the junior classes in schools." But few teachers who have had experience in giving instruction to such classes would approve of the order in which some of the subjects are dealt with. For instance, the first chapter deals with the difficult subject of classification of animals, and leaving out of account the fact that the scheme of classification described is somewhat old-fashioned, we think it pedagogically wrong to begin the study of natural history by classifying the animal kingdom. Teachers may, however, find the volume useful in providing information for lessons on natural history objects, and suggesting experiments in physics and chemistry.

Notes from a Diary in Asiatic Turkey. By Lord Warkworth, M.P. Pp. xvi + 268. (London: Edward Arnold, 1898.)

THE author of this book, now Earl Percy, travelled by several of the main routes and some unfrequented ways of Asiatic Turkey in 1897. He shows himself to be a wide-awake politician, an instructed antiquarian, and something of a sportsman; hence the narrative necessarily deals with matters from a point of view somewhat remote from the scientific. The book is charmingly got up, gracefully written, and illustrated by some choice reproductions of good photographs, one of which represents a dervish with a dagger thrust through both cheeks and apparently insensible to pain. Throughout the journey, indeed, there seems to have been very little objection on the part of the people to allow themselves and their belongings to be photographed, a result doubtless of the infiltration of Western ideas even into the remoter parts of the Turkish empire. Incidentally, one or two points of scientific interest are touched upon. The strange idea is noted that the honey of a district near Erzerum is not only poisonous when taken in large quantities, but that if the red water-melon is eaten at the same meal with some of the honey, death would result from the formation of large crystals in the stomach. A curious statement is made as to the extent of the occasional inundations of Lake Van, one of the natives declaring that the water had recently risen as much as 400 feet, a degree of flood which the author prudently views as an exaggeration. The discovery of a spring "bubbling over with a copious flow of liquid sulphur" (p. 204) would certainly be interesting, but it probably was no more than water impregnated with sulphuretted hydrogen.

As an intelligent, modest, and serious account of an interesting journey in a country still difficult of access, this book deserves very hearty commendation, and it would be gratifying to believe that all members of Parliament could make so good a use of their holidays as Lord Percy has done.

Lectures on Theoretical and Physical Chemistry. By J. H. van 't Hoff. Translated by R. A. Lehfeldt. Part I. Chemical Dynamics. Pp. 254. (London: Edward Arnold.)

TO what has already been said regarding the French edition of this excellent work (NATURE, p. 458) there is little to add. The translation is accurate, the few slips that occur being mostly referable to the original, and easy of detection. As to paper and printing the book leaves nothing to be desired, although perhaps this result has been attained at the expense of a wider popularity which the book might have enjoyed had its price been lower.

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 intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*]

Experiment to Illustrate the Zeeman Effect.

PROF. A. GRAY has kindly called my attention to his Royal Institution lecture of April 29, 1898, in which, nearly a year ago, he pointed out the analogy between a pendulum with a gyrostat in its bob, and the molecule of a gas vibrating in a magnetic field, which I called attention to in my recent letter (p. 509). GEO. FRAS. FITZGERALD.

Trinity College, Dublin, April 5.

Formation of Egg-capsules in Gasteropoda.

THE function of the sole-gland of the foot in certain divisions of the Gasteropoda seems hitherto to have remained unknown. None of the works I have been able to consult give a definite account of the function of the organ. This sole-gland appears from the literature to exist only in the dioecious Azygobranchia, whereas the more anterior marginal gland of the foot is found both in these and in Pulmenata and Opisthobranchia.

On the other hand, I have been unable to find any published account of the origin and formation of the horny capsules, in which the ova of most Azygobranchia are deposited and contained during their development. Many writers seem to assume that these capsules are formed in the generative duct, which is not the case.

I have recently satisfied myself that these two gaps in our knowledge of the Mollusca are really one; in other words, that the egg-capsules are formed by the sole-gland, and that the latter is really the nidamental gland. I first discovered this in the common whelk *Buccinum undatum*, which I found in numbers in the act of spawning on the shores of Falmouth Harbour in November 1897. Pulling away the animals from the stones to which they adhered, I found incompletely formed capsules in the cavity of the sole-gland, and saw that the "spawn" was formed and deposited by the "foot." The ova are probably transferred to the cavity of the gland, before the closure and deposition of the capsule. I have recently verified the same fact in the same locality in another species, namely *Murex erinaceus*. In this case the capsule is long and narrow in shape, and I saw it in an imperfectly matured though fully formed condition, drawn out of the aperture of the sole-gland, when I detached a specimen in the act of spawning.

Lacaze Duthiers has shown that the float of *Janthina* is formed by a glandular depression of the foot corresponding to the sole-gland, and Johannes Thiele maintains that the egg-capsules of this animal, attached to the float, are produced also by a certain portion of this gland. Simroth, however, believes with Lacaze Duthiers that the "cocoons" or capsules are derived from the sexual organs. I have no doubt Thiele is right, but he does not appear to have extended his doctrine to other forms than *Janthina*.

The function of the sole-gland being thus established, the question arises whether there is not a difference in the structure or size of the gland between the male and female, since the male does not produce egg-capsules. This and other questions I must leave to be investigated in future. Not knowing when I may have leisure to make a more detailed study of the subject, I wish to make known the main fact, which can be easily verified by the observation of living Prosobranchs in the act of spawning. J. T. CUNNINGHAM.

1 Morrab Terrace, Penzance.

The Natural Prey of the Lion.

WHAT constitutes the natural prey of the lion in his wild state is, I believe, a disputed point. The majority of people, probably, are of opinion that he is extremely fastidious in his tastes; others, again, assert that he will eat almost anything. Certainly, it is only reasonable to suppose that a lion sufficiently under the impulse of hunger will eat "almost anything"!

Years ago I was present on more than one occasion when animated discussions on this point took place between two notable African ecclesiastics—both since dead—Bishop Smythies

and Archdeacon Maples (he was then), both of whom had travelled a good deal in Africa—Maples more especially—and had seen something of the habits of lions.

Bishop Smythies defended the former theory; Archdeacon Maples—a most talented and entertaining man—the latter, saying he had known instances of lions killing porcupines, and adding that he believed the porcupine to be specially endowed with the power to propel his quills into his assailant when so attacked.

At this juncture, Bishop Smythies generally lost patience and declined to continue the argument.

Had Bishop Smythies lived, it would have interested him, as it may interest some of NATURE's readers, to know that in March last, at the Salt Stream, two days' march N.W. of Kibwezi, I shot a fine old lion in whose left fore-paw were deeply buried the tips of three porcupine quills.

These are in my possession at the present time: the longest measures exactly 1 inch; another is almost as long, and measures $\frac{1}{16}$ of an inch. How long he had been afflicted with these painful appendages I could not say—months at any rate, or may be years; since the paw was not inflamed, and from constant friction and pressure in using it the cartilage surrounding the quills had become callous.

There is no immediate reason for supposing that in this case the lion killed the porcupine acting on the impulse of inordinate hunger: the Salt Stream country teems with game—such as rhinoceros, zebra, hartebeeste, gnu, gazelles, and ostriches; it is also just such a country for cover as lions habitually frequent, and *do* frequent in numbers, as may be judged from the fact that in two days I saw them on three occasions.

Leopards, I was already aware, prey freely on porcupines. But this is the first instance which has occurred—in my own experience—of a lion's doing so. RICHARD CRAWSHAY.

Neugia, Kitwi, British East Africa, February 6.

Precipitation of Gold by Charcoal.

IN your "Notes" this week, the use of charcoal as a precipitant for gold from solutions is mentioned as being pretty largely applied in Australia, and that the cause of precipitation is not understood.

I venture to put it this way: that by some process, accelerated no doubt by surrounding physical changes, there is formed within the charcoal carbon *mon*oxide (and also carbon dioxide), which is a precipitant for gold. The difficulty of ridding charcoal of oxygen without chemical combination is well known.

I may mention that I am now using carbon monoxide as an industrial precipitating agent in gold-winning.

JAMES C. RICHARDSON.

19 Claremont Square, London, March 29.

IT is an old idea that carbon monoxide is the real agent in the precipitation of gold from solutions of the chloride by means of charcoal. An objection to Mr. Richardson's suggestion, that the same view may be taken in the case of cyanide solutions, lies in the fact that, according to my own experiments, carbon monoxide does not appear to precipitate gold under ordinary conditions from these solutions.

The main objection, however, to all the theories put forward to account for the precipitation of gold by charcoal is that they are not supported by the results of any published experiments.

THE WRITER OF THE NOTE.

Instincts of Wasps.

PERHAPS it may interest your reviewer of Dr. and Mrs. Peckham's work "On the Instincts and Habits of the Solitary Wasps," to learn that one of the main results in question has been already arrived at in a paper by the late Prof. Schiff, of Geneva, in *Mémoires de la Soc. de Physique et d'Histoire naturelle de Genève*, vol. xxviii., 1882-3. I quote the following passage, as in some way complementary to the observations of Dr. Peckham:

"D'ailleurs, un examen microscopique approfondi du système, nerveux des animaux intoxiqués par les guêpes n'a pas revélé la moindre lésion dans les nerfs et les ganglions de ces animaux."

Freiburg, Badenia, March 18. DAVID WETTERHAN.

CORUNDUM AND ITS USES.[1]

THE three works cited below give much new and valuable information concerning the mode of occurrence, the processes of mining, and the uses of corundum. As the mineral is of growing economic value, and is every day finding fresh applications in the arts, it seems desirable to call attention to some of the facts which are for the first time made accessible to the public in these works. We may exclude from view, for our present purposes, the clear and brightly coloured varieties of corundum, so much prized as gem-stones (ruby, sapphire, &c.), and also the composite material known as emery. The latter substance should be regarded not as a mineral, but as a rock—one in which the mineral corundum is a predominant constituent, though always mixed with magnetite, tourmaline, and many other minerals.

Among the works of which the titles are given below, precedence may be fairly conceded to that which deals with Indian corundum. Corundum is a distinctively Indian mineral; its name is of Indian origin, and its recognition as a distinct mineral species was the result of the study of Indian specimens. The plan, now adopted by the Director of the Geological Survey of India, of republishing the "Manual of Economic Geology" in a series of separate memoirs, each dealing with a particular mineral, or group of minerals, is one which must commend itself to every one as being calculated to furnish us with the most complete and exact information from the pens of the best qualified authorities. It is fortunate that the writing of the memoir on corundum has fallen into the hands of so competent a mineralogist and geologist as Mr. Holland.

The first nine pages of the memoir are devoted to a condensed, but very clear and exact, account of the mineralogical characters of corundum. The next ten pages contain an admirable discussion of the geological relations of corundum. Mr. Holland's studies of the famous corundum-yielding rocks of Southern India have furnished him with much fresh material bearing on the mode of occurrence and association of the mineral. In the work before us only a brief sketch can be given of these, and of the theoretical questions upon which they throw much new light. It is to be hoped that the present short memoir will be followed by detailed accounts of the geology of Salem and other districts in Southern India, where Mr. Holland and several of his colleagues have had the opportunity of re-examining the rocks made known to us by the travels of Leschenault de la Tour, and the petrographical researches of Prof. Lacroix.

The larger portion of the memoir is occupied by detailed accounts of the exact distribution of corundum throughout the Indian Empire, and a discussion of the uses of corundum. In this latter part of the work much valuable information, carefully collected from a number of trustworthy sources, has been brought together; and the reader cannot fail to find much that is new, and also has important bearings on the economic uses and the manufacture of the various varieties of corundum as known in the markets of the world.

While the corundum of India has been sought for from the earliest times for use in grinding gems, and other purposes in which abrasive materials of the greatest hardness are required, the rich deposits of the same mineral in the Eastern United States have only been worked for similar purposes during the last twenty years.

[1] "A Manual of the Geology of India.—Economic Geology." By the late Prof. V. Ball, C.B. LL.D., F.R.S. Second edition revised in parts. Part I. Corundum. By T. H. Holland, A.R.C.S., F.G.S. (Calcutta, 1898.)

"Mineral Resources of the United States: Seventeenth Annual Report of the U.S. Geological Survey: Corundum Deposits of the Southern Appalachian Regions." By J. A. Holmes. (Washington, D.C., 1896.)

"Economic Geology of Eastern Ontario: Corundum and other Minerals." By Willet G. Miller. Report of the Bureau of Mines. Vol. vii. Pt. 3. (Toronto, 1898.)

Corundum deposits are known to occur all along the southern flanks of the Appalachian Chain, from the State of New York to that of Alabama, but it is in only a few localities, principally in North Carolina and Georgia, that the corundum has been extracted on any considerable scale. In 1871 attention was first drawn to the deposits in North Carolina as a possible source of gems, and in 1878 mining operations were commenced to extract the abundant corundum of the district as an abrasive material. A great deal of secrecy has been maintained respecting the nature and extent of the corundum industry in the United States; but there appears to be no doubt that since 1878 a steady increase in the output of the corundum mines has been maintained.

The discovery of valuable deposits of corundum in the third of the localities noticed above, that of British Ontario, dates only from 1896. But already there seems to be promise that the counties of Hastings, Renfrew and Peterborough in Eastern Ontario, may, at no distant date, yield large supplies of corundum to the manufacturer.

The Indian corundum is usually found among the gneissose and schistose rocks; the exact conditions under which the mineral makes its appearance will be better understood when the investigations, upon which Mr. Holland has been engaged for some years, are fully published. He has already shown that in some cases the corundum is found in connection with nepheline-bearing rocks, and a precisely similar association has been demonstrated for the corundiferous deposits of Eastern Ontario. The corundum of the Appalachian belt of the United States, however, as shown by Dr. J. H. Pratt, would appear in all cases to occur in the Peridotites (Dunites, Serpentine, &c.), which are intrusive in crystalline schists, and especially in the zones of contact on the outer limits of those intrusive masses.

Corundum, the crystallised oxide of aluminium, has been prized from the earliest times on account of its hardness—which exceeds that of all other natural substances, with the exception of the diamond. In India, blocks of corundum and fragments mounted in tools have been used for grinding, perforating and engraving gems. For general abrasive purposes elsewhere, the rock emery (especially that of Naxos and the adjoining islands and mainland of Asia Minor) has long been preferred to corundum itself. The reason of this is that although emery has a far less "effective hardness," or power of abrading hard materials, than pure corundum, yet the ease with which it can be reduced to powder greatly facilitates its use.

Pure corundum, when freed from its adhering matrix of softer materials (mica, chlorite, &c.), is crushed between rollers and sifted, the "corundum sand" thus formed having far more abrasive power than crushed emery. The chief use of corundum sand is for making corundum wheels; the cementing materials employed in making these wheels seem to be very varied. Shellac alone, or with the so-called "oxidised linseed oil," is one of the commonest materials employed, as in the so-called "red wheels." Silicate of soda is employed in the "silicate wheels," and india-rubber and other substances in the "vulcanite" or "black wheels"; while the cementing material in the "union wheel" is oxychloride of magnesia, and in the "tanite wheel" some form of a so-called "solution of leather," the process of manufacture being kept secret.

Pure corundum wheels are said to be at least twice as effective and durable as emery wheels. Corundum wheels are made in India, with the lac-resin as the cementing material.

Emery and corundum wheels may be regarded as rotary files, whose cutting points never grow dull. They are rapidly replacing files for cutting down metal surfaces, and taking the place of grindstones for sharpening tools. The corundum grains throughout the wheel retain their cutting power, so that it can be worked until quite 90 per cent. of its weight has been worn off, while a file is useless before it has lost 5 per cent. of its weight. It has been estimated that to remove one pound weight of iron with a file costs 2*s.* 6*d.*, while the same amount of work can be done with an emery or corundum wheel in about one-eighth of the time and at one-seventh of the cost. Compared with grindstones in grinding tools, experiments by some English firms show that the cost of the emery wheel is about one-fifth, and the time only one-half of that required by the use of the old grindstone, and at the same time the danger of bursting during rapid revolution, which is such a common accident with the latter tool, is practically abolished.

The corundum wheel is said to be twice as effective as the emery wheel, while its cost is only 15 per cent. more.

It will be seen irom these statements that there cannot fail to be a great future for wheels made from corundum and similar materials.

As is pointed out by Mr. Holland, corundum is the richest ore of the valuable metal aluminium. So long, however, as abundant supplies of bauxite (impure hydrated oxides of aluminium) can be obtained, it is scarcely likely that the hard and intractable corundum will be used for the extraction of the metal. The time may, however, come when such a use will be made of the material, which is now almost wholly sought for abrasive purposes.

MULTIPLE VISION.

IT is well known that, owing to what is termed irregular astigmatism, a small bright object, for which the eye is not accommodated, often presents a multiform appearance, the number of separate images perceived varying in different cases from about six to fifteen.

Irregular astigmatism, to which every one is in some degree a victim, can be easily demonstrated in the following manner. With the point of a fine needle a very small hole is pricked in a sheet of tin-foil; this is held up to the light, and the hole is looked at with one eye, the other being closed. Even at the distance of most distinct vision—ten inches, or thereabouts—there will probably be a ragged appearance about the perforation, as if it were not perfectly round. But if the tin-foil be brought an inch or two nearer to the eye, the perforation will not seem to be even approximately circular; it will generally assume the form of a little star with six or more pointed rays. The form of the star is not often the same for the right eye as for the left; but if several holes be pricked in the tin-foil, all the stars as seen by the same eye will appear to be formed after the same model, though some may be larger or brighter than others.

If the luminosity of the source of light is sufficiently diminished by screening with a coloured glass, or otherwise, the star will be seen to consist of several distinct images of the hole superposed upon an irregular nebulous patch. Seven such images can generally be perceived—a central one surrounded by six others, but sometimes there may be more. This and other allied phenomena exhibited by a healthy eye are commonly attributed to the fact that the crystalline lens is composed of several sections connected by radial sutures, six or more in number, which occur upon the two surfaces of the lens.

Some observations described in a recent communication to the Royal Society (*Proc. Roy. Soc.*, January 1899) indicate that under certain conditions the number of independent images due to a single luminous point is far greater than could be accounted for in this way; there may, in fact, be several hundreds, and their formation probably arises from the cellular structure of the transparent media of the eye.

In my earlier experiments the luminous object consisted of a small bright disc, but it was soon found desirable to employ a source of light having a more distinctive and conspicuous form than that of a simple circle, and after several trials an excellent object was found in the horseshoe-shaped filament of an electric lamp. The lamp should be dimmed, either by placing coloured glasses before it, or, preferably, by inserting a resistance. An Edison-Swan 50-volt lamp of 8 candle-power has a suitable filament, and may advantageously

FIG. 1.

be connected in series with one or two of the lamps ordinarily used on the circuit. Most electric lamps have looped filaments, and are not so well adapted for the observation.

When the dimmed lamp is looked at from a distance of a few feet through a lens of about 6 inches focal length, held close to the eye, the patch of luminosity formed upon the retina appears to be made up of a crowd of separate images of the filament, some being

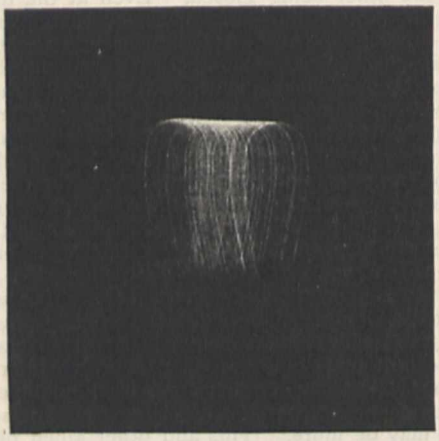

FIG. 2

brighter than others, as represented in Fig. 1.[1] When the observer is near the lamp, the number of images is comparatively small; as he retires, it gradually increases, but after a certain distance has been reached the definition of the images becomes impaired, and they can no longer be easily distinguished. The method of observation as thus described may obviously be varied, and, indeed, an experienced observer can put his eye sufficiently out of focus without the aid of any lens.

To assist in analysing the luminous field, an adjustable slit, taken from a spectroscope, was interposed between the eye and the lens. The appearance presented by the filament when the slit was made $\frac{1}{80}$ inch (0·3 mm.) wide, is very well imitated in Figs. 2, 3 and 4, which show the effect with the slit in horizontal, vertical and intermediate positions. The imitation was produced by photographing the lamp by means of a lens covered with two layers of

FIG. 3.

gauze, the one containing 75 meshes to the linear inch, the other 50; a slit $\frac{1}{25}$ inch (1 mm.) in width was placed before the lens.

An attempt was made to count the greatest number of images that could be seen with fair distinctness. The whole of the filament was screened from view except a short portion of one limb, which was viewed from a distance of about 8 feet through a horizontal slit and a lens of 5 inches focus. According to the estimates of

FIG. 4.

several different observers, the number of images was greater than 20 and less than 30 (whence it is calculated that without the slit there would be some 500). Exact enumeration is perhaps impossible, for though at the first glance one receives the impression that the number is quite definite and probably about 25, closer examination shows that it is often very difficult to localise the line of demarcation between successive images.

If the distance between the eye and the incandescent filament is much more than 8 feet, or if a lens of shorter

[1] The photographs, Figs. 1 to 4, are too delicate for satisfactory reproduction. In the originals each picture is easily seen to be entirely composed of separate images of the filament.

focus is employed, the multiple images become blurred and indistinct. The appearance ultimately presented is that of a band of light crossed by a very large number—probably 400 or 500—of hazy dark lines at right angles to its length. These might be produced by some structure in or near the crystalline lens or the cornea composed of elements measuring about $\frac{1}{2000}$ inch in length or breadth.

I do not know of any simple structure sufficiently coarse-grained to account for the images of which 25, or thereabouts, occur in a row. The mesh of a network which would explain these should be about $\frac{1}{125}$ inch (0·2 mm.) in length, and nothing of the kind is, I believe, to be found in the eye. Probably, however, the effect is a composite one, like that of the two pieces of gauze used in photographing the lamp. If light passed through two superposed nets having fine meshes, dark bands would generally be produced, which would take the form of a network of a coarser mesh than those of the nets themselves—possibly much coarser, as would be the case if the two nets were nearly alike in structure.

SHELFORD BIDWELL.

NEW STAR IN SAGITTARIUS.

A CIRCULAR (No. 42) from the Harvard College Observatory, informs us of the detection of a new star in the constellation Sagittarius by Mrs. Fleming, during the examination of the Draper Memorial photographs. The date of appearance is not yet definitely determined, but was either in the latter part of the year 1897 or the early part of 1898. The approximate position for 1900, as found from the Durchmusterung Chart of the region, is

R.A. = 18h. 56m. 12·2s. Decl. = − 13° 18′ 16″.

The star was too faint to be photographed on eighty-seven plates exposed during the period 1888 September 5 to 1897 October 23, even though the last of the plates taken in 1897 showed stars down to the 15th magnitude, the instrument being the 24-inch Bruce telescope at Arequipa. The Nova first appears on eight plates taken in March and April of last year—four at Arequipa with the 8-inch Bache telescope and four at Cambridge, Mass., with the 8-inch Draper telescope, both of these instruments being provided with prisms outside the objectives. It may be added that both the lenses are doublets. The estimated magnitudes are from comparisons with adjacent stars, and are to be regarded as approximate, as the star was away from the centre of plate in several cases. On March 8, 1898, the magnitude is given as 4·7 ; while on April 29, 1898, it is 8·2.

The Nova has of course been detected from the peculiarity of its spectrum, which consists chiefly of bright lines. The best photograph was obtained on April 19, 1898, with an exposure of sixty minutes, the magnitude of the star then being 8·2. The spectrum, 3 mm. in length, shows the lines Hβ, Hγ, Hδ, Hε, Hζ, Hη, and probably Hθ, due to hydrogen, *bright*. A *broad* band at λ 4643 is also bright, and *narrow* bright lines are present at λλ 4029, 4179, 4238, 4276, 4459, and 4536, these latter appearing to be identical with lines at corresponding positions in the spectrum of Nova Aurigæ. The strongest dark line is at λ 4060. As in the Novæ Persei, Aurigæ, Normæ, and Corinæ, the line Hε is *bright;* while in variables of long period this line is always *dark*, being possibly obscured by the neighbouring broad calcium line H. This difference may serve to distinguish between Novæ and variables. The accompanying dark lines on the more refrangible edges of the bright bands of Novæ Aurigæ, Normæ, and Corinæ are not visible in the spectrum of Nova Sagittarii. The calcium line K is also invisible. In the photograph obtained two days later—1898 April 21—certain marked differences are noted. The broad dark line λ 4060 has disappeared, and a narrow bright line appears at λ 5005, possibly identical with the chief nebula line at λ 5007. The hydrogen lines appear to be narrower and more intense.

Plates exposed at Arequipa on October 7 and 8, 1898, but not yet examined, will furnish important information as to the rate of diminution of the light of the Nova. On the morning of March 13 of this year, Prof. O. C. Wendell examined the star with the photometer at Cambridge, and found that its magnitude was then 11·37. Visual examination showed its light to be nearly monochromatic, with a faint continuous spectrum, in this respect resembling other Novæ that have preceded it, in having changed to a gaseous nebula. This change had evidently begun at the time of the photograph taken on 1898 April 21, showing the line λ 5005.

It is interesting to note that of the six new stars which have been discovered since 1885, five have been found by Mrs. Fleming during her detailed examinations of the Henry Draper Memorial photographs of stellar spectra.

During the last four hundred years fifteen stars have appeared which may be regarded as Novæ, and, in general, have been found in the vicinity of the central line of the Milky Way, their average galactic latitude being about 11°·2. Nova Andromedæ and Nova Centauri showed no bright lines in their spectra, and, if these be excepted, the average galactic latitude of the remaining thirteen is 9°·0. Of these Nova Coronæ is the only new star with bright lines in its spectrum which has appeared far from the central line of the galaxy, its latitude being 46°·8. If this also be excepted, the average galactic latitude of the other twelve is reduced to 5°·8. It is thus to be inferred that there is some association between the galaxy and the new stars whose spectra contain bright lines, as the probability that such a distribution is due to accident is extremely small.

FRANZ RITTER VON HAUER.

A DISTINGUISHED Austrian geologist has passed away in the person of Dr. Franz Ritter von Hauer, the Intendant of the Royal Imperial Natural History Museum of Vienna. Von Hauer was born in Vienna on January 30, 1822, and received his education partly in that city, and subsequently at the mining academy of Schemnitz. In 1846 he became assistant to Wilhelm von Haidinger, who was then councillor of mines and lecturer on mineralogy in Vienna. Later on, in 1849, when Von Haidinger was appointed director of the then newly-established Imperial Geological Institute, Von Hauer was engaged as geologist, and he took a leading part in the work of the survey, succeeding to the post of director on the retirement of his chief in 1866.

Among his special geological works, those on the Cephalopoda of the Triassic and Jurassic formations of eastern Alpine regions are the most numerous and important ; but he contributed other papers and works on mineralogy and applied geology.

His most important general work was that of the geological map of the Austro-Hungarian monarchy, which was issued in twelve sheets, 1867–71, and of which a fourth edition, including Bosnia and Montenegro, was published in 1884. His explanatory pamphlets relating to this great map have been described as "models of concise description," while his general manual of Austrian geology, published in 1875, "is the best guide we have to some of the most interesting parts of Central and Eastern Europe." The remarks quoted were made by Mr. R. Etheridge in 1882, when as president of the Geological Society he forwarded to Von Hauer the

Wollaston Medal, which was then awarded to him by the Council. Von Hauer had been elected a foreign member of the Society in 1871. In 1886 he was appointed Intendant of the Natural History Museum at Vienna, and since 1892 he has been a life-member of the upper house of the Austrian parliament. He died on March 20, aged seventy-seven.

NOTES.

AT a meeting of members of the Royal Institution on Monday, it was announced that the Hodgkins Medal, the first gold medal for scientific work ever given by the Smithsonian Institution, has been conferred upon Prof. J. Dewar, F.R.S., in recognition of his researches on the liquefaction of air.

MR. A. P. TROTTER (at present Government electrical engineer for Cape Colony), has been appointed electrical adviser to the Board of Trade, in succession to Major Cardew, who has resigned.

A FRENCH warship, upon which experiments in aerial telegraphy will be made, has arrived at Calais, and the experiments will be carried out between different points in the English Channel and the South Foreland. The French Government have under consideration the question of adopting the system generally for use in the navy. It is reported that the Wireless Telegraphy Company have been approached by the representative of a proposed syndicate, which desires to acquire the sole rights of establishing wireless telegraphic communication between England and America.

THE Rotterdam correspondent of the *Times* reports that the seventh Dutch Physical and Medical Congress opened on Friday, April 7, at Haarlem. Though it is a national institution the Congress is entertaining a foreign guest, Prof. Ramsay. On Thursday evening, in an address on the merits of Haarlem as a home of science, Prof. Bosscha, the director of Teyler's Museum, mentioned Kirschhuyzen, the humble teacher of mathematics whose manual of algebra was translated into Latin by Newton. Prof. Bosscha, in opening the Congress on Friday, reviewed the progress that science has made in this century, and dwelt especially on the researches of Lord Kelvin. In one of the sections Prof. Ramsay delivered an address on recent researches, and at the end the audience gave him enthusiastic applause.

DURING the months of March and April a public conference is being held at the Botanical Institute at Rome, under the presidency of Prof. Pirotta, on the Nutrition of Plants.

DR. L. BUSCALIONI has set out for a lengthy botanical expedition to Brazil, especially to the little known affluents of the Amazon. The collections will be forwarded to the Botanical Museum at Rome.

WE learn from the *Journal of Botany* that Mr. I. H. Burkill has been appointed assistant to the Director of Kew Gardens, and that Mr. C. C. H. Pearson has joined the Kew staff as assistant for India.

WE regret to have to report the death of two distinguished diatomists—Surgeon-Major G. C. Wallich, M.D., who died in London on March 31, in his eighty-fourth year, and Count Abbé F. Castracane, of Rome. Dr. Wallich and Count Castracane were, with one exception, the two oldest Honorary Fellows of the Royal Microscopical Society.

SIR WILLIAM JENNER, who died on December 11, 1898, bequeathed 10,000*l.* to the Royal College of Physicians of London. The bequest will, however, only take effect in default of appointment being made by Lady Jenner of the ultimate residue of the estate, if any, after the principal legacies have been provided.

THE death is announced of Dr. P. L. Rijke, of the University of Leyden, at eighty-six years of age, and of Dr. Oliver Marcy, professor of natural history in North-Western University, Evanston, U.S.A.

IT is announced in *Science* that the report that Dr. T. J J. See has been designated Chief of the U.S. Nautical Almanac Office is incorrect.

THE Imperial Academy of Sciences, St. Petersburg, celebrates to-day the fiftieth anniversary of the foundation of the central physical observatory.

THE London Geological Field Class, conducted by Prof. H. G. Seeley, F.R.S., will commence their annual series of Saturday afternoon excursions on April 22. Full particulars can be obtained from the Hon. Secretary, Mr. R. Herbert Bentley, 43 Gloucester Road, Brownswood Park, N.

THE death is announced of Mr. Joseph Stevens, for some years honorary curator of the Reading Museum. Mr. Stevens was a Berkshire man, having been born at Stanmore in that county on April 14, 1818. After qualifying for the medical profession he settled in the village of St. Mary Bourne, in the Test valley between Andover and Highclere in Hampshire. Here he devoted himself largely to archæological subjects, and gave considerable attention also to geology. In 1867 he published, in pamphlet form, "A Descriptive List of Flint Implements found at St. Mary Bourne; . . . with a sketch of the geological features of the upper Test valley, and a list of fossils from the upper and lower Chalk," &c. He was the author of other papers on similar subjects. He died on April 7, at the age of eighty-one.

THE Easter dredging expedition of the Liverpool Marine Biology Committee was brought to an untimely end by an unfortunate boat accident in Port Erin Bay. On March 31 dredging and trawling were carried on from the Fisheries steamer *John Fell*, and on the following forenoon the Tanner closing net and the method of pumping plankton from the bottom by means of a hose-pipe were tried on the steamer. On the afternoon of Saturday, April 1, two of the workers in the Biological Station went out to collect surface plankton n a small boat. While hauling in the tow-net when returning, the boat capsized, and both were thrown into the water. One of them (Mr. E. J. W. Harvey, of Liverpool) was picked up by another boat from the Biological Station, but his companion (Mr. Eric T. Townsend, of Manchester) was unfortunately drowned before assistance could reach him. The body was eventually recovered. Mr. Townsend was a student of the Owens College, and was occupying the College work-table at the Port Erin Biological station.

THE Belgian Royal Academy has issued its programme of subjects for essays in competition for gold medals of value 600 francs each, to be awarded in 1900. The essays are to be sent to the Secretary before August 1, 1900, each bearing a motto, and written in French or Flemish. Contrary to the usual custom, five subjects instead of three have been selected in each of the two departments of mathematical and physical science and of natural science. The mathematical and physical questions refer to (1) critical phenomena in physics; (2) viscosity of liquids; (3) the carbon derivatives of an element whose combinations are little known; (4) the history and theory of variation of latitude; (5) the algebra and geometry of n-linear forms where $n > 3$. The questions in natural science refer to (1) the geological formations at Comblain au Pont, and whether these are

Devonian or Carboniferous; (2) the physical modifications produced in minerals by pressure; (3) the organisation and development of the platoda; (4) the presence of a nucleus in the Schizophyta; and (5) the Devonian flora of Belgium.

M. P. VILLARD, writing in the *Journal de Physique* for March, continues his observations on kathodic rays. Among other interesting conclusions, the author is led to the view that hydrogen plays a prominent part in the production of kathodic rays; this view explains the action of these rays in reducing oxides.

M. D'OCAGNE'S system of "abaques" is remarkable for the number of problems it enables the mathematician and the physicist to solve graphically. An interesting application of the method is given by M. A. Lafay in a recent number of the *Journal de Physique*, where Fresnel's laws of reflection and refraction are represented by means of "abaques."

IN a note communicated by M. E. Carvallo to the *Journal de Physique* for March, on Clausius' theorem, the author points out that although abundant proof is given in text-books that for a reversible cycle $\int dQ/T = 0$ the property that this integral is negative for irreversible cycles receives scanty demonstration. The author considers it desirable that this question should be more fully considered in elementary courses than is usually done, and points out that this can best be effected by a more or less detailed consideration of the different transformations which lead to irreversible cycles.

DR. RUDOLF MEWES has published a second edition of his pamphlet on "Licht-, Electrizitäts-, and X-Strahlen," of which the first edition appeared in 1896. The vast literature on Röntgen rays which has accumulated during the past three years has rendered it necessary for the author to restrict his attention to researches bearing on the analogy between Röntgen rays on the one hand and light and electric waves on the other, both in their nature and in their fundamental laws. The author in an appendix also discusses an application of the wave theory to the problem of gravitation.

UNDER the title "Two discharges derived from one condenser," Prof. A. Ròiti, writing in the *Atti dei Lincei*, viii. 1, describes the phenomena produced when a condenser, charged by an electrostatic machine working uniformly, is connected, by means of two pairs of coils, with a Röntgen ray tube on one hand and a spark gap on the other, the two being arranged in parallel. By varying the self-induction of the coils and the length of the sparking gap, the two discharges are made to take place simultaneously, and the intensity of the Röntgen rays is made a maximum; and Prof. Ròiti gives a mathematical investigation of the results observed in his experiments.

IN the *Proceedings* of the Philosophical Society of Glasgow, Dr. W. J. Fleming describes a simple and inexpensive method of localising with Röntgen rays. This, like other methods, is based on the measurement of the distance apart at which two images are produced by rays impinging on the object in two directions at known angles to each other. The advantage of the stand described by Dr. Fleming is that it enables the tube to be rotated on two axes crossing at the centre of the anode, the point from which the rays proceed. In this way it is possible to make the slanting surface of the anode face in any direction in which it is desired to project the rays, without affecting its position; while the change of position of the tube can be effected separately by moving the supporting stand, and can be readily measured.

THE annual report of the Institute of Jamaica states that an almost complete series of the thirty-five known species of Jamaica actiniaria, collected by the curator, Mr. J. E. Duerden, has been placed on exhibition. A large series of sponges, contributed by the Caribbean Sea Fisheries Development Syndicate, constitutes almost the beginning of the local collections in this group. One compact massive sponge is two feet in diameter. A 3 to 5 per cent. solution of formalin has now been employed for over two years as a preservative fluid for fish, cœlenterates, holothurians, &c., and has proved satisfactory, preserving the natural form and colours of the animals better than alcohol. A polished slab of mahogany, four feet in diameter, has been added to the collection of woods, and illustrates the irregular increase in thickness of tropical trees, as compared with the regular annular rings in dicotyledons of temperate parts. New types and many duplicate examples of relics of the aboriginal Indian inhabitants continue to be received and added to the already large collection on view and in store cases.

MESSRS. E. H. HALL AND C. H. AYRES contribute to the *Proceedings* of the American Academy of Arts and Sciences a determination of the thermal conductivity of cast iron. In their experiments a disc of cast iron was coated with an electrolytic deposit of copper on its two faces, and the difference of temperature of the faces recorded by galvanometric readings depending on the thermo-electromotive forces of the two couples thus formed. Water at different temperatures was made to flow across the two copper faces, and the total flow of heat measured by comparing the differences of temperature between the water entering and leaving the vessels. The thermal conductivity of the cast iron used was found to be about 0·1490 at 30° C., its temperature coefficient being about −0·00075 between 20° and 75°. The electric conductivity of this sample was about 112,200 C.G.S. units, its temperature-coefficient between 17° and 67° being about −0·00118. The method used is thought by the authors to be capable of giving better results than have yet been obtained by it.

IN these columns frequent reference has been made to Dr. Folgheraiter's researches on the magnetisation of ancient vases, from which the author long ago advanced the hypothesis that the magnetic dip had changed sign within historic times at the places where these vases were made. The evidence on this point, derived from examination of Grecian vases in the Museums of Florence and Syracuse, forms the subject of the most recent paper of the series published by Dr. Folgheraiter in the *Atti dei Lincei*, viii, 5. Some of the vases, owing to the ornamentations and projections above their mouths, could only have been placed in the furnace in an upright position, and although the presence of these projections rendered it necessary for Dr. Folgheraiter to restrict his observations to the bases of the vases, the *sign* of the magnetic dip, if not its magnitude, was readily determinable. Dr. Folgheraiter concludes (1) that at the commencement of the period of fabrication of the Corinthian vases and of the Attic ones with black figures on a red background (seventh century B.C.), the magnetic dip in Greece was austral; (2) that shortly afterwards, perhaps at the beginning of the sixth century, while Corinthian vases were still being made, the magnetic dip was nearly zero, and then became boreal; (3) that at the end of the period of fabrication of the Attic vases (about 400 B.C.) the magnetic dip was boreal and amounted to about 20°.

AMONG the latest results obtained by Drs. B. Grassi, A. Bignami and G. Bastianelli, regarding the propagation of malaria by mosquitos, the following conclusions are stated in their paper in the *Atti dei Lincei*, viii. i. (1) The hæmosporids of malaria undergo in man the well-known life-cycle characterised by the long duration of the amœboid phase and the absence of incapsulate stages; in this cycle they are reproduced an indefinite number of times, but also give rise to

forms which in man remain sterile. Such forms on entering the intestine of the perfect insect of *Anopheles claviger*, are developed as typical sporozoa which form an enormous number of sporozooïds, and these, accumulating in the salivary glands of the mosquito, return to man in the act of puncture. They may, however, instead undergo another life-cycle giving rise to spore-formation. (2) The development of malarial hæmosporids in the body of the mosquito has been demonstrated for the parasite of autumnal fever and for that of ordinary fever. (3) While the transference of the hæmosporids from man to mosquitos and *vice versa* has been abundantly proved, it is still an undecided point whether the parasites are transmitted from mosquitos to their progeny.

IN the *Journal of Conchology* for April 1899, Mr. L. St. G. Byne describes a series of investigations undertaken by him, at the instigation of Mr. J. Cosmo Melvill, on the corrosion and consequent deterioration of marine shells in public collections. This corrosion Mr. Byne is led to attribute to the action of butyric acid upon the calcium carbonate of the shells. The butyric acid was derived originally from the decay of portions of the animal left in the shells. A subsidiary cause is the action of acetic acid, formed by the fermentation of the gum used in attaching the shells to tablets. The white powdery substance upon the surface of the affected shells consists of calcium butyrate, mixed in some cases with a little calcium acetate. Mr. Byne thinks that, in all probability, treatment with corrosive sublimate solution will prove an effectual remedy. We would suggest that Mr. Byne's conclusions may have an important bearing on another question, namely, the permanency or otherwise of microscopic preparations of foraminifera.

THE *Comptes rendus* of the Paris Academy of March 27 contains a notice, by M. Léon Teisserenc de Bort, of three unmanned balloon ascents made under his directions on March 24. One of the balloons was despatched from his observatory at Trappes at 8h. 30m. a.m., in clear weather, and with a light north-west wind, and fell at Trèves (in Rhenish Prussia); the instruments have not yet been returned. Another was sent up near Limoges at 9h. 27m. a.m., in cloudy weather, with moderate N.N.W. wind, and occasional snow-squalls. It fell at Péroles, after a flight of thirty-seven miles, having attained an altitude of about twenty-eight thousand feet; the lowest temperature recorded was $-47°{\cdot}2$, the temperature on the ground being $32°{\cdot}5$. In order to determine the influence of the sun's rays on the temperatures recorded, one of the balloons was despatched from Trappes (before sunrise) at 3h. 45m. a.m. This fell about seventy miles in an east by south direction. At the above altitude a temperature of $-61°{\cdot}4$ was recorded, the temperature on the ground being $26°{\cdot}6$.

WE have received from M. A. Lancaster, the director of the Belgian Meteorological Service, a very interesting sketch of the climate of the Congo, abstracted from the *Annuaire* of the Royal Observatory of Belgium for 1899, and chiefly based upon a work entitled "Le Climat du Congo," by A. Lancaster and E. Meuleman, published in 1898. In our latitude temperature is the principal element which determines the character of the seasons, but in the Congo State temperature is relatively uniform throughout the year, the principal element being rainfall, the frequency and amount of which are very marked during some months, while in others rain completely fails. In the equatorial zone, the mean temperature in the afternoon during the year is generally about 86° and about 68° during the night, with but slight variation from one day to another. The rainy season commences in the early part of October, and ends about the middle of May. In proportion to the distance from the coast and to the proximity of the equator, the wet and dry seasons are less marked, and rain falls with variable intensity throughout the year. Generally speaking, the rainfall of the Congo is nowhere exceptional. Thunderstorms are very frequent in the interior of the State; in the equatorial regions they occur at all seasons, while more to the south and in the west they only take place during the rainy season.

THE Chicago Health Department are to be congratulated on the results which they are able to publish attending the use of diphtheria antitoxin in combating diphtheria. During a period of forty-one consecutive months, 4000 cases of "true diphtheria" were treated with a mortality rate of less than 6·8 per cent., whilst within the last four months still greater success has followed the work of the department, for 418 cases have been treated with a mortality of less than 4·8 per cent. In the three years following the introduction and use of the antitoxin, the department record a decline in deaths from diphtheria of 43 per cent., compared with the death rate from this disease registered for the three years previous to the use of antitoxin.

THE *Journal of the Society of Arts* contains in one of its recent numbers the report of the lecture given before the Society by Mr. H. A. Acworth, on leprosy in India. In the discussion which followed, a warm tribute was paid to the author for the splendid work which he carried out in starting, entirely through his own efforts, a magnificent leper asylum on the outskirts of Bombay at Matoonga. As Lord Onslow (who presided) justly stated, "after mature consideration, the Government of Bengal and the Supreme Government of India had adopted the recommendations which Mr. Acworth was th first to bring into practrice, viz. the segregation of lepers. Opinion is still divided as to the wisdom of this policy in com bating leprosy, but there is no doubt that Mr. Acworth's ex periment has been attended with success. To all interested in this important subject, the paper in question contains a mass of interesting information, as well as statistics culled from very various sources.

THE University of the State of New York has just issued, as *Museum Bulletin* No. 19, "A guide to the study of the geological collections of the New York State Museum," by Dr. Frederick J. H. Merrill, director and state geologist. The bulletin aims to supplement the collections with such general information as cannot be given by cabinet specimens, and to direct visitors to trustworthy sources for more detailed information. For this purpose it places within the reach of students a brief synopsis of the geology of the State, and shows by photographic illustrations the exact appearance of many typical exposures. After a general introduction, follow sections dealing with the geologic formations of the State, economic geology, suggestions for study under the heads of geological text, reference-books and field work, and the origin of the museum. The bulletin, which may in fact be regarded as an introductory text-book of geology illustrated by local examples of geological structures, contains 162 pages of text and 119 plates, and is sent post paid by the University for forty cents. Teachers of science in the colleges and schools of the State will doubtless appreciate the efforts of Dr. Merrill and his associates to extend the usefulness of the museum and increase the interest in the collections.

A CAREFUL examination of the rude stone monuments of Japan, and of the sepulchral chambers termed "dolmens," has led Mr. W. Gowland to conclude (*Transactions and Proceedings* of the Japan Society, vol. iv. part iii., 1899) that they were built by the ancestors of the present Japanese. The aboriginal inhabitants were apparently the Ainu, who occupied the whole country until they were gradually driven back to the north by a more powerful race. Whence came the invaders from whom

the present Japanese have descended is not known, and the dolmens afford little information upon this question. No dolmens have been found in China, and those which occur in Korea differ entirely from those in Japan. In fact, Mr. Gowland points out, it is not until, in passing westwards through Asia, the shores of the Caspian Sea are reached, that dolmens similar to the Japanese kind are found; and for more closely allied forms it is necessary to go yet further to Western Europe. The approximate date of the end of the Dolmen Period is regarded as lying between 600 and 700 A.D., and of its beginning about the second century B.C. To sum up, Mr. Gowland shows "that the period during which the dolmens were built in Japan was characterised, from its beginning to its close, by a well-developed civilisation and a culture which had advanced far beyond the limits of barbarism, and was, in fact, the birth-time of the ornamental arts; that the builders of the dolmens were the ancestors of the present Japanese; that during this period the clans of the race had driven out the aborigines from the richest portion of the country, had become a settled and united people, and made great progress in both the arts and industries."

"The Permocarboniferous Fauna of Chitichun, No. 1," orms the subject of a memoir by Prof. Carl Diener, recently published by the Geological Survey of India in the Himalayan fossil series of Palæontologia Indica. The fossils described occur in the white limestone which forms the main mass of the peak Chitichun (17,740 feet) in the Tibetan area between the Laptal ranges and the head of the Dharma valley. They represent altogether forty-eight species, among which brachiopods, numbering forty species, far predominate, both in species and individuals, and comprise five-sixths of the entire fauna. With regard to the general character of the fauna, Prof. Diener sums up his views as to the stratigraphical position of the Chitichun limestone as follows:—"The Chitichun limestone is approximately homotaxial with the upper division of the Productus limestone in the Salt Range. It probably corresponds in age to the permocarboniferous horizon (Artinskian stage) in Russia, but the description of the brachiopods from the Fusulina limestone of Sicily must be awaited for, before it is possible to decide whether it does not hold a slightly higher position in the stratigraphical sequence than the Artinskian deposits."

We have received the second edition of Dr. W. B. Phillips' monograph on iron making in Alabama, published by the Geological Survey of that State. It contains a general description of the ores, fluxes, and fuels used, together with some particulars of the manufacture. The first edition was issued in 1896, and did much to further the development of the iron industry of the State. Since then the blast furnace practice has not materially altered. The same soft and hard calcareous hæmatites and brown ores are used, and the same coke. The use of dolomite as flux has steadily increased. The cheap soft red ore is becoming scarcer, and consequently new deposits of rown ore have been opened. The coke industry shows some notable advances. A complete coal-washing plant, with a capacity of forty tons an hour, and a plant of 120 Semet-Solvay by-product coke ovens have been erected. In connection with the making of steel, the author gives a full description of the manufacture of basic iron in Alabama, and details of the cost of making pig-iron. The lowest cost reached was 23*s.* per ton. Indeed the figures given clearly show that the cheapest pig-iron made in the world is made in Alabama; and the exportation of 218,633 tons to England and the continent during 1897, as against 65,000 tons in 1896, shows the importance of this fact in the development of outside markets for Alabama iron.

Messrs. Dulau and Co., of Soho Square, have issued an eight-page catalogue of books and papers on Fossil Botany.

Mr. Clement Reid has in preparation a work on "The Origin of the British Flora," which will shortly be published by Messrs. Dulau and Co.

Mr. R. Bullen Newton and Mr. Richard Holland contribute to the *Annals and Magazine of Natural History* for March an account of some Nummulites, Orbitoides, and other Foraminifera from Eocene and later Tertiary strata in Borneo.

The sixth volume of "A System of Medicine," edited by Prof. Clifford Allbutt, F.R.S., was published on Tuesday by Messrs. Macmillan and Co., Ltd. The subjects dealt with are diseases of the circulatory system (continued), diseases of muscles, and diseases of the nervous system. Prof. Welch's contribution on thrombosis and embolism, which was not received in time for vol. v., appears in the new volume. We propose to deal with these and succeeding volumes when the work is complete.

A dainty little monthly magazine of photographic information has just made its appearance under the title of *The Photo-Miniature*. It is edited by Mr. John A. Tennant, and published by Messrs. Tennant and Ward, New York (London: Dawbarn and Ward, Ltd.). A survey of the progress of photographic optics, so far as it bears upon modern lenses, forms the greater part of the first number of the magazine; the remaining pages consisting of a digest of photographic information.

The "Handbook of Jamaica" for 1899, comprising historical statistical and general information concerning the island, compiled by Messrs. T. L. Roxburgh and J. C. Ford, has been published by Mr. Edward Stanford. Among the events of 1898 mention is made of the establishment, already announced in these columns, of a West India Weather Service in connection with the Government observatories and stations in the Unied States and several islands in the Carribean Sea.

The third memoir on the materials collected on the atoll of Funafuti has been published by the Australian Museum, Sydney. Mr. Thomas Whitelegge describes the Hydrozoa, Scyphozoa, Actinozoa, and Vermes in the collection; and Mr. Charles Hedley describes the Molluscs. In his introductory remarks, he subjects British conchologists to criticism for neglecting anatomical material in order to discover new species. "As a consequence," he says, "of the devotion of the London school to the study of the Pacific fauna, we have a great mass of involved synonomy, inadequate descriptions, poor figures or none, crude classification, and total neglect of soft anatomy." Owing to pressure of museum duties, Mr. Hedley has been compelled to omit various inquiries on anatomy and other related matters from his own report; and, with the exception of brief notes on geographical distribution, he restricts himself to the mere systematic treatment of the species.

It has been known for some time that the transition temperature, or "melting point," of crystallised salts should be constant for pure materials; but prior to the researches of Messrs. T. W. Richards and J. B. Churchill, it was not realised that this constancy was sufficient for standardising thermometers. In these experiments, which are published in the *Proceedings* of the American Academy of Arts and Sciences, a complete study was first made of sodium sulphate, the transition temperature of which was found to be remarkably constant at 32°·484 C. on the mercury thermometer scale, or 32°·379 C. on the hydrogen scale. These results were then extended to eight other salts, the preliminary figures for which are given ranging from 19·7 for sodium chromate, $Na_2CrO_4.10H_2O$ to 78·0 for barium hydroxide, $Ba(OH)_2.8H_2O$. Commenting on the suggestion by Meyerhoffer and Saunders to use such baths for securing constant temperature during determinations of electrolytic con-

ductivity and similar measurements, the authors think that the Ostwald thermostat bath is still the safest and most convenient appliance for preserving a constant temperature in the laboratory, the baths of "melting" crystals finding their greatest use in the standardising of thermometers at fixed points.

THE additions to the Zoological Society's Gardens during the past week include a Rhesus Monkey (*Macacus rhesus*, ♂), from India, presented by Mr. David M. Greig; two Western Pin-tailed Sand Grouse (*Pterocles pyrenaica*) from Spain, deposited; four Black-tailed Hawfinches (*Coccothranstes melanurus*) from Japan; a Lapwing (*Vanellus vulgaris*), European, purchased.

OUR ASTRONOMICAL COLUMN.

COMET 1899 *a* (SWIFT).—The unfavourable conditions in England appear to have prevented any observations of this comet, but on the continent it has been frequently seen. From a detailed list of all the recorded observations given in *Ast. Nach.* (Bd. 149, No. 3554), we see that the reported presence of a central condensation is confirmed. Most of the observers agree in estimating the magnitude as about 6·5, or just visible to the naked eye. Prof. Max Wolf says that it was quite bright in the finder, and easily seen with the naked eye when guided to the correct place by the telescope. With a 6-inch telescope a short tail was distinctly visible.

The comet is now very near the sun, but under favourable conditions may possibly be seen with the help of the following extended ephemeris:—

0*h*. *Berlin Mean Time.*

1899.	R.A.	Decl.	Br.
	h. m. s.	° ′	
April 13 ...	1 19 36 ...	+ 9 36·7 ...	3·6
14 ...	15 8 ...	10 15·4 ...	3·7
15 ...	10 41 ...	10 54·0 ...	3·5
16 ...	6 18 ...	11 32·4 ...	3·4
17 ...	1 2 0 ...	+12 10·8 ...	3·3

In the beginning of May, however, it is likely that the comet will be easy of observation in the early morning, as it will rapidly recede from the sun after perihelion passage.

TUTTLE'S COMET (1899 *b*).—The previous ephemeris given was based on data obtained in 1885; but successful observations, obtained at Heidelberg, Lick and Konigsberg, have enabled Herr J. Rahts to recompute the elements and furnish a more accurate ephemeris, which he has communicated to *Ast. Nach.* (Bd. 149, No. 3555).

Elements.

T = 1899, May 4·5 Berlin Mean Time.

M =	359° 59′ 46″·7	
π =	116 29 3·0	1900·0
Ω =	269 49 53·6	1900·0
i =	54 29 16·3	1900·0
φ =	55 15 23·7	
μ =	259″·6234	

Corrected Ephemeris for 12*h*. *Berlin Mean Time.*

1899.	R.A.	Decl.	Br.
	h. m. s.	° ′ ″	
April 13 ...	3 43 27·7 ...	+19 35 52 ...	
14 ...	47 3·7 ...	19 11 13 ...	1·71
15 ...	50 39·2 ...	18 46 17 ...	
16 ...	54 14·0 ...	18 21 5 ...	
17 ...	57 48·2 ...	17 55 37 ...	
18 ...	4 1 21·7 ...	17 29 54 ...	1·77
19 ...	4 54·5 ...	17 3 55 ...	
20 ...	8 26·6 ...	16 37 42 ...	
21 ...	11 58·1 ...	16 11 14 ...	1·80

NEW STAR CATALOGUE.—The eighth volume of the "Astronomical Observations and Researches made at Dunsink," the observatory of Trinity College, Dublin, contains a catalogue of the mean places of 1101 stars, together with the separate results of 4022 observations of right ascension and 3999 observations of declination, the range of declination being from − 28° to + 80°.

The observations were made with the Pistor and Martin's meridian circle by Mr. Charles Martin, under the direction of Prof. A. A. Rambaut, then Astronomer Royal for Ireland, during the period 1896, March 16, to 1897, July 17. All the places are brought up to epoch 1900, and the probable error is about ± 0·0328s. in R.A., and ± 0″·480 in Decl. A useful feature of the catalogue is the inclusion of the corresponding numbers denoting the various stars in other catalogues in vogue, viz. Bradley's, Piazzi's, and the B.A.C., and various others, so that cross references are readily seen.

THE SUN'S HEAT.—Mr. A. S. Chessin, in a communication to the *Astronomical Journal*, vol. xix. No. 456, relating to Dr. See's article in *Ast. Jour.*, No. 455, noticed on p. 350 of the current volume, writes as follows:—

"Allow me to observe with regard to Dr. See's 'remarkable' law, which he discusses at length in the last number of the *Journal*, that it is derived by the author with a superb neglect of the principles of thermodynamics. The last stage of the 'proof' is especially curious, as the assertion that T_0 must be multiplied by $\frac{R_0}{R}$ in order to preserve the equilibrium, is nothing else than an assumption of that very 'law' which Dr. See proposes to derive."

ALLOYS.

THE fifth Report, by Sir William Roberts-Austen, to the Alloys Research Committee of the Institution of Mechanical Engineers contains some details of much scientific interest. The system of taking cooling curves of metals and alloys, originated by the author of the Report, is now well known, but in the present Report he has indicated a method for obtaining curves of extraordinary delicacy. An ordinary thermo-junction of platinum and platinum iridium wires is placed within the mass of metal which is heated in a vacuous tube, and allowed to cool from a bright red heat. The result, in the case of iron, is

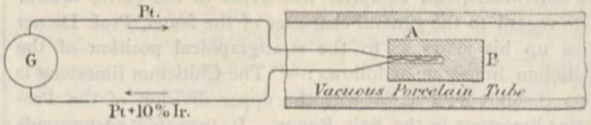

FIG. 1.

that as the mass cools down there are several points at which heat is evolved. In the curve of iron of a high degree of purity only two such points have hitherto been detected, one at about 890° and the other at 760°. Both of these have been supposed to represent allotropic changes in the metal, and the lower one (at 760°) is that at which the magnetic properties of the iron change. In ordinary cooling curves, however, both these points have been indicated by little more than a change in direction of the curves. By adopting the following method curves of great delicacy have been obtained, and the result is that the old

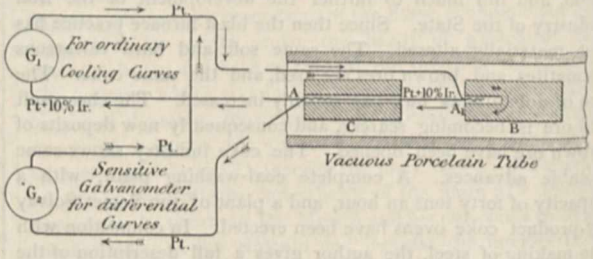

FIG. 2.

changes in direction of the curves in the case of iron, have been developed into large prominences and, moreover, new points in the cooling curves, have been discovered.

The following is the new method, of which a very brief description will be sufficient. In the ordinary method, the twisted end of the thermo-junction A (Fig 1) is placed in the heated mass of metal B under examination, and its free ends are connected with the galvanometer G. In the new method (Fig 2) two thermo-junctions, A and A_1, are employed. One of these

is placed in the piece of metal B, and the other in a compensating piece of copper platinum of fire-clay C. A sensitive galvanometer G_2, connected to both thermo-couples, measures on a large scale the difference between the temperatures of B and C, and magnified records of the evolutions of heat in B can thus be obtained, which are not affected by the general fall of temperature of the system. The actual temperature of the piece of metal B is simultaneously registered by the less sensitive galvanometer G_1 in the usual way. In the new method, therefore, the heat lost by the cooling mass of metal B (Fig. 2) is compensated or balanced by the heat lost by a mass of platinum C. The result is, that the effect on the galvanometer G_2 of any evolution of heat in the cooling mass B is greatly augmented. The heat suddenly evolved by the mass of iron or steel B, which is liable to molecular change, is, as has already been indicated, not masked by the fact that the mass is itself rapidly losing heat, as the temperature of the entire system does not affect the sensitive galvanometer, and the heat which is evolved by the mass B is free to make itself felt. Hence the curves recorded by its mirror possess extraordinary sensitiveness. In the Figs. 1 and 2 the arrows show the direction of the currents. Those with feathers indicate the direction of the current which is due to the difference of temperature. This difference is caused by the excess of heat in the iron B, as compared with the platinum C. The featherless arrows show the direction of the current through the unsensitive galvanometer G_1, which records ordinary cooling curves.

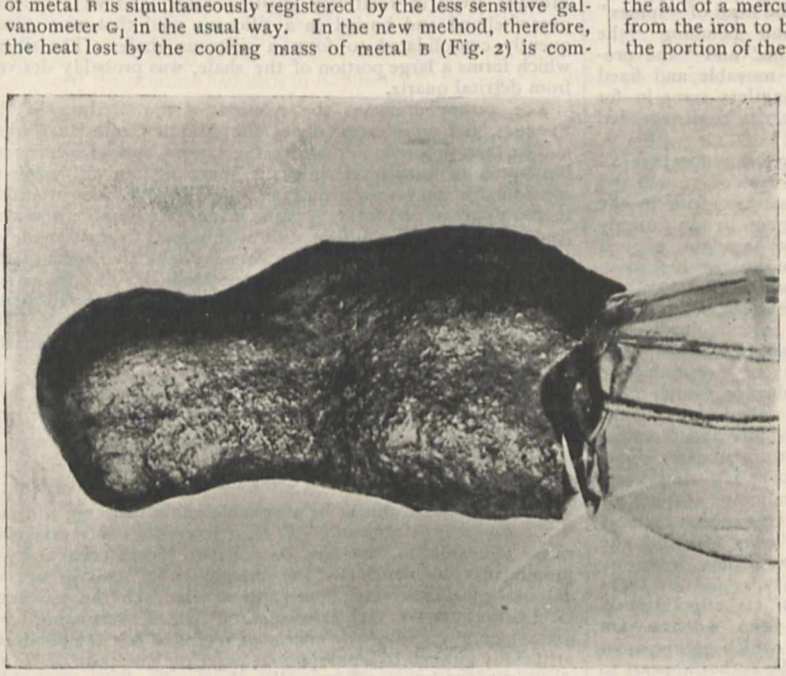

FIG. 3

Reference to a special case, furnished by the cooling of electro-iron from a white heat, will serve to make this clear. Electro-iron was deposited on a thermo-junction protruding from a glass tube into which the wires were fused. The iron was deposited from a solution of ferrous chloride which had been purified with scrupulous care, the anode being a plate of electro-iron. The iron so deposited weighed five grammes, and its appearance, magnified four diameters, is shown in the accompanying Fig. 3.

It was then arranged as shown in Fig. 2, and placed in a porcelain tube glazed inside and out and rendered vacuous by the aid of a mercurial pump which also enabled the gas evolved from the iron to be collected. Hydrogen was freely evolved as the portion of the tube containing the iron was gradually heated; but, although the evolution of gas never absolutely ceased, the amount of hydrogen delivered by the mercurial pump with which the porcelain tube was connected was very small when the iron attained a temperature of some 1300° C. A cooling curve of this iron after four successive heatings is shown in Fig. 4, on $\frac{1}{3}$ of the actual scale it was recorded, and it will at once be evident that in this curve at least three hitherto unobserved points are revealed. These points occur respectively at 580°, 487°, and 261°. The coordinates are, as usual, time and temperature, but the temperature represents on a large scale, molecular evolutions of heat, and not the temperature of the mass under examination.

There is at A the point at 1130° C. Then at B there is the ordinary Ar. 3 of Osmond, which in this case occurs, not as in mild steel at the normal temperature of 850° C., but at 895° C. When the mass continues to cool down there is, as it was anticipated there would be, the point Ar. 2, which in this case occurs at 770° C. The carbon point Ar. 1 could not be expected to occur in iron of so high a degree of purity, and it does not exist; but there is evidence of evolution of heat at a point which is between 550° and 600° C. It is difficult to fix this point accurately, it seems to vary somewhat in successive curves. The next point, at which heat evolved, is a new one of extraordinary interest. It occurs between 450° and 500° C., and there is evidence to show that it is connected with the retention of hydrogen by the mass of iron, even though it had been heated to 1300° C. Finally there is a small point at 270° C., that is, at a temperature of no less than 400° C. below redness.

The significance of these new points which, seem to be connected with the retention of hydrogen by the iron, though they may be true iron points, revealed by the presence of hydrogen, is to some extent considered in the Report. All that need be pointed out here is, that it is important to have obtained a new and delicate method of recording molecular changes which take place in metals and alloys as they cool down from the fluid state to the ordinary temperature.

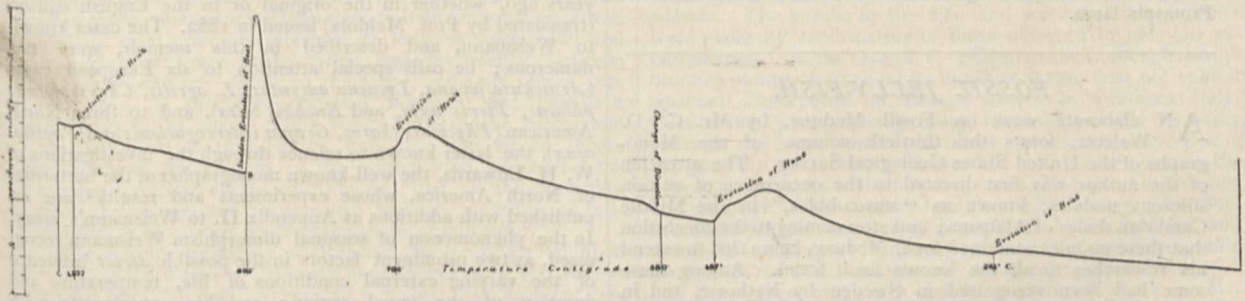

FIG. 4.—Photographic Record ($\frac{1}{3}$ actual size) of the Cooling of Electro-Iron.

By the aid of a long series of such curves Sir William Roberts-Austen has laboriously investigated the carburised-iron series of alloys, which are usually known as steel and cast iron. He shows that they behave exactly as certain saline solutions do, and he has thus afforded a basis for much of the hitherto somewhat obscure procedure in the industrial treatment of iron and steel.

A TREATISE ON SPINES.

A SERIES of papers upon "The Origin and Significance of Spines: a Study in Evolution," contributed by Dr. C. E. Beecher to the *American Journal of Science* from July to October last, has now been distributed by their author in a collected form. There are 80 pages in all, with 73 text illustrations, tables, and a plate delineating leading types of Radiolarian spines after Haeckel. Under the head of "spines" there are dealt with objects between and including "the modified hairs of the *Echidna* and Porcupine," and "the projecting rays and processes of Radiolaria"; movable and fixed forms are alike passed in review, horns and antlers come in for consideration, and only such "spines" appear to be disregarded as are "distinctly internal structures."

The author has been at immense pains to bring together all that is known concerning the nature, origin, laws of growth and limitations of spines, not excluding those met with in the vegetable kingdom; and while, in arranging in an orderly manner this vast accumulation of facts, he has done a good service, we venture to think that the utility of his essay is, to a large extent, marred by the too sudden diversion into side topics which at times appear to us irrelevant. The "law of variation," according to Cope; that of "multiplication of effects," according to Herbert Spencer; the principle of "localised stages of growth," by Jackson; of "reproductive divergence," by Vernon; with "sexual selection," and other supposed laws and heresies, are all in turn called in for comment and consideration. The author so flits about among extremes concerning both organs and doctrines under review, that the reader is often at a loss to discover his views and arguments, and at what he is sometimes aiming. Of all his theses, that which he seems to us to have best substantiated is expressed in his concluding remark that "after attaining the limit of spine differentiation spinose organisms leave no descendants, and . . . that out of spinose types no new types are developed." The subject of "spines" is a notoriously fascinating one upon which much has been written. On perusal of the excellent list of references which accompanies the papers, and comparison with the text, the author appears to us to have exercised too little discrimination in his reading, and to have been too prone to accept much which he found in print. Some of his allusions to the fishes and the desert plants appear especially open to this objection. His reputation is now so well established among working zoologists, in connection with his recent magnificent investigations into the phylogeny of the Brachiopoda and the structure and systematic position of the Trilobites—achievements of which even Yale College Museum may well be proud—that his present series of papers will be widely read. While we are profoundly thankful to him for having collected together and arranged in a workable form so instructive an amount of detail, we doubt if some of his conclusions will prove any more convincing to the majority than those which three years ago led him to a belief in the so-called Protaspis larva.

FOSSIL JELLY-FISH.

AN elaborate work on Fossil Medusæ, by Mr. C. D. Walcott, forms the thirtieth volume of the Monographs of the United States Geological Survey. The attention of the author was first directed to the occurrence of certain siliceous nodules, known as "star-cobbles," in the Middle Cambrian shales of Alabama; and after coming to the conclusion that these nodules contained fossil Medusæ, he was led to extend his researches to all the known fossil forms. Among these some had been recognised in Sweden by Nathorst, and in Bavaria by Haeckel; and the full record embraces forms from the Cambrian of the United States, Sweden, Russia, and Bohemia; from the Permian of Saxony; and from the Jurassic of Bavaria.

The author points out that, under certain conditions, when a Medusa is overwhelmed by muddy sediment, it may retain its shape sufficiently long for the sediment to solidify and make a mould of its external form. Plaster-casts of certain jelly-fish may in some instances be readily obtained. The most favourable conditions for the natural preservation of a Medusa appear to be by burial and rapid consolidation of sediment beneath water; but the author observes that not one in a hundred of the fossil specimens, shows traces of any structure within the body, and, so far as is known, the particularly favourable conditions required "were confined during geologic time to the vicinity of the spot in the Cambrian sea that is now occupied by the township of Cedar Bluff, Cherokee County, Alabama." There the nodules with Medusæ occur in finely laminated shales, and much of the silica forming the nodules appears to be original, and derived from the solution of siliceous organisms. The Medusæ lived in relatively shallow water, and were quickly overwhelmed and buried in a siliceous mud that was subsequently consolidated to form a siliceous shale. The silica, which forms a large portion of the shale, was probably derived from detrital quartz.

The author discusses the relation of the Medusæ to the Sponges, and more especially of the Middle Cambrian forms; and he then proceeds to describe the various species, which are illustrated in forty-seven plates. These figures will prove of considerable interest to geologists; they serve to draw attention to many curious and hitherto problematical structures; and may lead to more precise information with regard to their mode of occurrence. There appears to be no doubt that some of the forms, even of Cambrian age, are true Medusæ; and the author believes that at this early period, if not in pre-Cambrian times, the acraspedote Medusæ were mainly differentiated. He remarks, however, that we have yet much to learn about the medusiform ancestors of the Hydrozoa.

SEASONAL DIMORPHISM IN LEPIDOPTERA.[1]

I HAVE thought this to be a suitable subject for my address, because it is not only of high interest as a remarkable phase of variation, but has also of late years been brought prominently to notice by the researches of two groups of entomological observers; firstly, those who, like the pioneers, G. Dorfmeister, W. H. Edwards and August Weismann, have experimentally studied the effects of high and low temperatures artificially applied to lepidopterous pupæ of European or North American species; and secondly, those who have noted the seasonal changes in butterflies occurring naturally in various tropical and subtropical regions, and have in some cases reared one seasonal form of a species from ova deposited by the other. The earlier temperature experiments in Europe and North America were long in advance of the observations on seasonal dimorphism in tropical countries, the latter indeed being the natural outcome of the former. It may prove not uninteresting if I briefly pass under review the published memoirs relating to both sets of observations, but, as regards the temperature experiments, limiting my remarks almost exclusively to those relating to seasonally-dimorphic species.

No doubt many of us remember with what interest we welcomed Weismann's able treatise[2] published twenty-three years ago, whether in the original or in the English edition (translated by Prof. Meldola) issued in 1882. The cases known to Weismann, and described in this memoir, were not numerous; he calls special attention to six European cases (*Araschnia levana*, *Lycaena amyntas*, *L. agestis*, *Chrysophanus phlaeas*, *Pieris napi*, and *Euchloe belia*), and to three North American (*Phyciodes tharos*, *Grapta interrogationis* and *Papilio ajax*), the latter known to science through the investigations of W. H. Edwards, the well-known monographer of the butterflies of North America, whose experiments and results[3] are republished with additions as Appendix II. to Weismann's essay. In the phenomenon of seasonal dimorphism Weismann recognised, as two prominent factors in the possible *direct* influence of the varying external conditions of life, temperature and duration of the pupal period; and his experiments with *Araschnia levana* and *Pieris napi* were accordingly carried on with the view of ascertaining whether the dimorphism exhibited by those species could be traced to the direct action of those factors. In the case of *A. levana*, he first subjected the pupæ obtained from eggs laid by the winter form, immediately after pupation, to artificial low temperatures, and the result was that, by exposure to temperature of 0°–1° R. for four weeks, three-

[1] An address read before the Entomological Society of London at the annual meeting on January 18, by Roland Trimen, F.R.S., President of the Society.

[2] "Studien zur Descendenz-Theorie. I. Ueber den Saison-Dimorphismus der Schmetterlinge," 1875.

[3] *Canadian Entomologist*, vii. p. 236 (1875), and ix. p. 69 (1879).

fourths of the pupæ produced, not the summer form *prorsa*—as under natural conditions they would have done—but the intermediate form *porima* (extremely rare in nature), three of these being very nearly the pure winter form *levana*. Increasing the period of exposure to cold to eight weeks did not materially add to the extent to which the summer form was lost and the winter form substituted. The converse experiment, frequently repeated, consisted in placing in a hot-house (temperature 12°–24° R.) immediately after pupation, pupæ from eggs laid by the August brood of the summer form, *prorsa*; but here the artificial temperature had little or no effect, all, or nearly all, the pupæ hibernating, and emerging in the following spring as the pure winter-form *levana*. This latter result led the author to the opinion that cold and warmth could not be the *immediate* causes of a pupa emerging in the *prorsa* or *levana* form; and that the explanation of the facts seemed to be (*a*) that the winter form *levana* is the original type of the species, seeing that it was found possible to make many specimens of the summer form *prorsa* revert to it by means of cold, whereas the converse change could not be effected; and (*b*) that the species originally existed in the glacial period as a single-brooded and monomorphic butterfly, and only became double-brooded and gradually developed the *prorsa* form as warmth of climate increased.

With *Pieris napi*, Weismann found the pupæ from eggs laid by the winter form much more responsive to the action of cold (applied immediately after pupation and continued for three months) than those of *A. levana*, by far the larger number emerging as the pure winter form when transferred to a hot-house, and the remainder (which resisted forcing and hibernated) all producing the same form in the following spring. The converse experiment was not tried with the pupæ of ordinary *P. napi*, but with those of the Alpine and Polar variety, *bryoniae*, but the result was in accordance with that of the corresponding experiment in the case of *A. levana*—the application of heat had no transforming effect, and all the butterflies emerged as pure *bryoniae*. Weismann was thus led to regard the single-brooded variety *bryoniae* as the original form of the species from the glacial period, and *napi* in its winter and summer forms as gradually produced under increasing climatic warmth.

The experiments conducted with so much skill and perseverance by W. H. Edwards with the North-American *Papilio ajax* and *Phyciodes tharos* yielded much the same results as those obtained by Weismann in Europe. In the complicated case of *P. ajax*—where the winter form presents itself in the two differing generations known as *walshii* and *telamonides*, and the summer form known as *marcellus* appears in three similar generations—Mr. Edwards, by the application of ice for a period of two months, found that fifty pupæ reared from eggs laid by the second generation of the winter form (*telamonides*), which under natural conditions would nearly all have given the summer form *marcellus*, produced no fewer than twenty-two *telamonides*, one specimen intermediate between *telamonides* and *walshii*, eight examples intermediate between *telamonides* and *marcellus*, but nearer to the former, eight intermediate between the same forms but nearer to the latter, and only eleven true *marcellus*. It should be observed, however, that there is a difference in the shape of the wings between the winter and summer forms of this *Papilio*, and that the strong innate tendency of the progeny of the winter form to assume the summer form was evidenced in the fact that all the butterflies from the refrigerated pupæ which had the markings of *telamonides* or of *walshii* yet bore the shape of *marcellus*.

The extreme variability of *Phyciodes tharos* renders it difficult to follow the details of Edwards' experiments with the various broods from different districts, but it is clear that, as in the case of *P. ajax*, the application of cold induced the summer form to revert to the winter form (*marcia*). I do not gather that the converse experiment was tried with this butterfly; but it was attempted to a certain extent with *Papilio ajax*, whose hibernating pupæ were subjected to a moderate degree of heat during some months, for several years in succession, without any change being effected in the resulting winter form of the butterfly. The evidence in the case of *Grapta interrogationis* has a different bearing on the subject, seeing that this species does not hibernate as pupa but as imago, and that therefore there is not, strictly speaking, any "winter" form; but it would appear that the first of the four broods in the year consists wholly of the form named *umbrosa* and the fourth of the form named *fabricii*, while the intervening second and third broods are each composed of both forms.

Only brief reference is made by Weismann to the experiments on *Araschnia levana* made by G. Dorfmeister,[1] an account of which was published as far back as 1864, but a full *résumé* of them has been given by the late Prof. Th. Eimer.[2] From this I find that, although, as Weismann points out, Dorfmeister did not succeed—apparently from not employing a low enough temperature—in transforming the *prorsa*-form into the *levana*-form, but obtained only some few of the intermediate form *porima*, yet he was apparently repeatedly successful in the important converse experiment (where Weismann's results were almost negative), obtaining *prorsa* by means of warmth from the *prorsa* August brood. He further obtained numerous gradations of the intermediate form *porima*, stages which under natural conditions occcur so rarely that, during forty years' collecting, he met with only a single specimen in the wild state in places where the forms *levana* and *prorsa* were quite common. Dorfmeister was clearly the first to point out that temperature exercises its chief influence during the act of pupation or shortly afterwards, but he expressed his "inability to decide whether the modifications obtained were the direct consequence of the rise in temperature, or only the indirect, depending on the shortening of the time of development caused by the increased temperature."

Familiar to all of us is the fine series of papers on temperature experiments contributed to our *Transactions* and *Proceedings*, to the *Entomologist*, and to the *Proceedings* of the South London Entomological Society by our Secretary, Mr. F. Merrifield; they are eight in number, the first having been published in 1888 and the last in 1897.[3] Mr. Merrifield's earlier experiments were made with Geometrid moths of the genera *Selenia* and *Ennomos*, certain species of which have normally two differing seasonal forms in England, and they extended to the application of both icing and forcing for various periods in all stages from egg to imago. The results were of much interest from many points of view, and more especially as showing (*a*) that the continued application of low temperature to the pupæ reared from eggs laid by the spring brood produced moths more and more like their parents, instead of the natural summer form; (*b*) that the opposite experiment of applying heat to the pupæ from eggs of the summer brood was fatal to a majority of individuals, and produced in the survivors a proportion of the summer form but mainly specimens intermediate only between the spring and summer types; (*c*) that it was in the pupal state that temperatures exercised their chief influence; (*d*) that forcing produced pale and comparatively spotless moths, while cooling or icing produced dark and much spotted ones. Another noteworthy point was that the application of *moisture* in combination with various temperatures to the pupæ of *S. tetralunaria* and *E. autumnaria* had no effect on the resulting moths.

The dimorphic species next treated by Mr. Merrifield in 1892–93 were *Pieris napi*, *Araschnia levana*, and *Chrysophanus phlaeas*. The results in the first and second of these species were generally confirmatory of those obtained by previous experimenters. In the case of *C. phlaeas*, which, though many-brooded almost throughout its immense range, does not exhibit seasonal dimorphism in Europe except in Southern Italy, Corsica and Greece, forcing caused on the upper side the dusky suffusion and larger black spots of the forewings characteristic of the southern summer form *eleus*, while cold induced exactly the opposite characters in the forewings, and also a great broadening and radiation of the coppery band in the hindwings. In 1896, Mr. Merrifield experimented on pupæ of *Pieris daplidice*, and found that forcing produced the ordinary summer form, while cooling for six weeks brought out the spring form *bellidice*.

I have here only very briefly mentioned those of Mr. Merrifield's experiments which dealt with seasonally-dimorphic species. His researches extended besides to upwards of twenty monomorphic ones; they were carried out with admirable skill, care, and exactness of record, and the resulting phenomena—especially in the species of *Vanessa*—were not only most

[1] "Ueber der Einwirkung verschiedener während der Entwickelungsperioden angewendeter Wärmegrade auf das Farbung und Zeichnung der Schmetterlinge." (*Mittheil. Naturw. Vereins für Steiermark*, 1864.)

[2] "Entstehung der Arten auf Grund von Vererben erworbene Eigenschaften nach der Gesetzen organischer Wächsens," 1888. (Engl. transl., by J. T. Cunningham, 1890, Sect. iv. pp. 131–134. I have to thank Mr. Merrifield for lending me this work.)

[3] For a most convenient *précis* and illustration of Mr. Merrifield's work, by Dr. F. A. Dixey, see NATURE, vol. lvii. pp. 184–188 (1897)

remarkable in themselves, but also, as disclosing apparently ancestral characters, of the deepest interest in their bearing on the phylogeny of the species concerned. The latter aspect of these investigations has been ably dealt with by Dr. F. A. Dixey, who, in his published comments on Mr. Merrifield's papers of 1893 and 1894,[1] points out that they seem to go far towards indicating the possibility that a disturbance of natural temperature conditions, whether in the direction of heat or cold, can produce in a monomorphic species a tendency towards reversion, and also notes the production by these experiments of ancestral features in *Vanessa io*, *V. polychloros*, and *Grapta C.-album*.

Concurrently with Mr. Merrifield's later work appeared both Dr. M. Standfuss's[2] and Prof. Weismann's[3] important memoirs, containing accounts of the series of temperature experiments carried on by them respectively in the course of the last decade. Standfuss's paper of 1894 deals with the effects of the warm and cold treatment of the summer pupæ of nine species of European butterflies. None of these can be included among seasonally-dimorphic species in Europe itself, but the author points out that the effect of heat on the Zürich pupæ of *Papilio machaon* was to produce specimens perfectly resembling the August form of the species that is found in Syria. Other striking results as given by the experimenter were the production of specimens representing (*a*) Local forms, such as constantly occur in nature in certain definite localities; in *Vanessa urticae*, *Pyrameis cardui*, and to some extent in *Papilio machaon* and *Vanessa antiopa*: (*b*) Aberrations, like those which now occur in nature; in *V. io*, *P. cardui*, and *Argynnis aglaia*: (*c*) Phylogenetic forms, "which may have either existed in past epochs, or may perhaps be destined to arise in future": in certain cooled *V. io* and *V. antiopa* and certain warmed *V. atalanta*, and the reverse respectively. Noting the remarkable circumstance that the same conditions lead to such diverse effects in different species—the changes wrought in one species being entirely within the limits of its variation at the present day, while in another they far surpass those limits—he suggests that the species coming under the former category are the phylogenetically older, and those belonging to the latter are the phylogenetically younger. The author found that the high temperature of 104° F. rapidly caused death in nearly all the species tested—*P. machaon* and *G. C.-album* proving least sensitive—but low temperatures prolonged for even four weeks are much better tolerated; and it was thought that this favoured the conclusion that the species so tested "were constrained in past ages to accommodate themselves much more to lower than to higher temperatures."

In the edition of his "Handbuch," which appeared in 1896, Standfuss recapitulated the cases published in 1894, and added mention of a warmth experiment with *Gonepteryx rhamni* which had the effect of inducing in the females some indications of the yellow colouring of the males. He also gave excellent coloured figures of most of the more marked variations resulting from temperature treatment, some of them exhibiting marvellous divergence from the normal form now existing in nature.

Before turning to Weismann's memoir of 1895, it will be convenient to refer briefly to Standfuss's recent and elaborate treatise issued during 1898.[4] After reviewing (in Sect. I.) his experiments as to effects from treatment of pupæ with constant moderately high (+ 37° to +39° C.) or moderately low (+4° to +6° C.) temperatures in the years from 1885 to the beginning of 1895, the author proceeds (in Sect. II.) to give an account of the continuation of these "Warm and Cold" experiments during the succeeding period from the middle of 1895 to 1897. These additional experiments were made on no fewer than fifty-six species of European Lepidoptera (thirty-six butterflies and twenty moths), and on a largely-increased number of specimens; and their results were found to be fully confirmatory of those derived from the earlier more restricted experiments, affording various fresh instances of the production of more or less marked variation in the directions previously indicated, viz. seasonal forms, local forms, aberrations, phylogenetic forms, and forms showing assumption of the male colouring by the female. Under the respective headings of "Frost-Experiments" (Sect. III.) and "Heat-Experiments" (Sect. IV.), the several results are given of employing temperatures under 0° C. (0° to −18° C., and exceptionally to −20° C.), and those above + 40° C. (up to + 45° C.); and the attempt is made (Sect. V.) to explain from the results of these two sets of experiments the active cause of most of the "Aberrations" occurring in nature. Attention is directed to the extremely interesting fact that the aberrations resulting from the artificial very high temperatures agree closely with the aberrations found in nature,[1] while aberrations like those produced by the use of very low temperatures are never found in nature; and the inference drawn from this is that the typical aberrations occurring naturally among the Nymphlidæ are produced by the temporary influence on a high degree of heat (40° to 45° C.).

I cannot here do more than just refer to the remaining sections of Dr. Standfuss's treatise; they include a consideration of the mode of action of the frost and heat experiments, a discussion as to the nature of aberrations, and an account of the further breeding of aberrational *Vanessa urticae*, and with the concluding remarks at pp. 37 and 38 will well repay perusal. Some idea of the satisfactory and extensive scale upon which the experiments were conducted, may be gathered from Standfuss's statement that he had employed altogether during 1895–97 the number of over 42,000 pupæ belonging to about sixty different species.[2]

Weismann's memoir of 1895, above referred to, contains a full record of his later experiments and results in the cases of *Araschnia levana*, *Chrysophanus phlaeas*, and *Pieris napi*, as well as in those of *Pararge egeria* (with its "climatic variety," *meione*) and *Vanessa urticae*. It further treats of the effect on pupæ of variously-coloured light, and on hibernating pupæ of warmth, and concludes with a comprehensive general review of the whole subject, including a comparison of the results of some of his own experiments with those obtained by Merrifield and Standfuss. In the case of *A. levana*, he not only succeeded, by means of temperatures of 27–28° C. and 30–32° C., in obtaining repeatedly a small number of the *prorsa*-form from the second summer generation of that form, but also proved that occasionally the same result arose in isolated instances without the use of a higher temperature than that of an ordinary warm room. It was further established that the intermediate forms known as *porima*, so rare under natural conditions, are produced whenever a brood is subjected to an unsuitable temperature at the beginning of the pupal stage, occurring indeed with the second brood from unusual cold, and with the third brood from unusual heat. As regards the seasonal forms of *Pieris napi*, it was shown that the low temperature effects the conversion of the summer form into the winter, only when specially applied immediately after pupation; while repeated experiments with the variety *bryoniae* gave no sufficient support to Weismann's view that this variety was the original parent-form of *napi*.

It is in this memoir that Weismann first recognises fully what he had formerly questioned, but had latterly ("Aeussere Einflüsse als Entwickelungsreize," 1894), put forward as probable, viz. that, besides the direct seasonal dimorphism attributable to temperature, there also exists *adaptive* seasonal dimorphism dependent on the indirect influence of the varying environment according to the time of year. He again cites the case of *A. levana* itself as possibly exhibiting in its *prorsa*-form mimicry of *Limenitis*, and suggests that the seasonal forms of *P. napi* may be adapted on the underside to the vegetation tints of spring and summer respectively. In the case of the latter species he expresses the belief that adaptive and direct seasonal dimorphism are combined, pointing out that the differences presented by the upperside may perhaps be referred to the direct influence of temperature. The possible adaptation

[1] See Dr. Dixey's papers (1) "On the Phylogenetic Significance of the Variations produced by difference of Temperature in *Vanessa atalanta*" (*Trans. Ent. Soc. Lond.*, 1893, p. 69); and (2) "Mr. Merrifield's Experiments in Temperature Variation as bearing on Theories of Heredity." (*Op. cit.*, 1894, p. 439.)

[2] "Ueber die Gründe der Variation und Aberration des Falterstadiums bei den Schmetterlingen," 1894. (Engl. transl. by Dr. F. A. Dixey in *Entomologist*, 1895.) "Handbuch der Paläarktischen Gross-Schmetterlinge für Forscher und Sammler," 1896.

[3] "New Experiments on the Seasonal Dimorphism of Lepidoptera" 1895). Engl. transl. by W. E. Nicholson in *Entomologist*, 1896.

[4] "Experimentelle Zoologische Studien mit Lepidoptern. A. Temperatur-Experimente." (*Denkschr. Schweiz. Naturf-Gesellsch.*, xxxvi. i. 1898.)

[1] This is well illustrated by Plate IV. accompanying the memoir, where figures of Aberrations, (*a*) captured at large, and (*b*) forced at very high temperature, of the following species, are given side by side, viz. *Vanessa polychloros*, *V. antiopa*, *V. atalanta*, and *Pyrameis cardui*, Figs. 1, 3, 5, 7 differing very slightly respectively from Figs. 2, 4, 6, and 8. (Plate III. figures the Aberrations produced in the same four species by "Frost-Experiments.")

[2] Dr. E. Fischer, of Zürich, has also carried out very extensive temperature experiments on European Lepidoptera with most striking results, which are mentioned by Weismann, Merrifield, and Standfuss. I have not seen Dr. Fischer's published accounts of his work, but I believe he did not experiment with seasonally dimorphic species.

of the green-and-white underside of the dimorphic *Anthocharis belia* to the respective resting plants of each season is also indicated.

The poverty, however, of such instances among the seasonally dimorphic species of the European butterfly-fauna is manifest; and it is thus satisfactory to find Weismann turning, in support of his view, to the numerous striking cases (first brought to his notice in 1894 in a paper by Dr. G. Brandes) of seasonal dimorphism occurring in tropical and subtropical regions, among which were instances where one seasonal form at least assumes a special protective colouring. Hitherto all the cases investigated and experimented on, whether in Europe or North America, had been found referable to the influence of high and low temperatures, and nobody seems to have suspected the occurrence of similar seasonal variation in hot countries; but, as Mr. L. de Nicéville, Mr. W. Doherty, and other observers have pointed out, and as Weismann was apt to recognise, the alternation of wet and dry seasons is as actively inciting an agent in the production of seasonal dimorphism in many parts of the tropics, as that of hot and cold ones is in the temperate latitudes.

I must confess that I shared in the prevalent erroneous opinion that seasonal dimorphism was not to be looked for in countries without summer and winter seasons of greatly differing temperatures; and no doubt this was mainly due to my never having resided for any length of time in a region where the rainy season is the warmer and the dry one the cooler. In the south-west of the Cape Colony, where I was stationed, exactly opposite conditions prevail, and in the rainy winter, scarcely a dozen species of butterflies appear, and none of them presents any marked difference from the dry summer specimens of the same species. I was thus unprepared to attach due value to the suggestion, by my friend, Mr. W. D. Gooch, as early as the year 1877, of the occurrence of differing seasonal forms of butterflies in Natal, or to the opinion to the same effect given by Mr. A. J. Spiller in 1880 (*Entomologist*, vol. xiii. p. 3). I believe this communication of Mr. Spiller's to have been the first published information of the apparent occurrence of seasonal dimorphism in the warmer parts of the world; and the four cases which he specially notices (in the genera *Anthocharis* [= *Teracolus*], *Pieris*, *Mycalesis*, and *Hypanis*) are undoubtedly true ones. Mr. Gooch (*op. cit.*, pp. 226 and 273) published his concurrence in the main with Mr. Spiller's view, but at the same time mentioned that, in the only two attempts he made to test the matter, by rearing *Teracolus omphale* and *Pieris severina*, he found no difference between the winter and summer broods, both belonging to the theoretical winter form with reduced black markings.

It was in 1885 that Mr. L. de Nicéville, the well-known authority on Indian butterflies, published[1] a notice of apparent seasonal dimorphism in several species of Calcutta *Satyrinae* of the genera *Mycalesis*, *Ypthima*, and *Melanitis*—the wet-season form presenting distinct ocellated spots on the underside, and the dry-season form being without those markings. He suggested as a possible explanation, that while the conspicuously marked wet-season form is concealed by the dense vegetation, the dry-season non-ocellated form had in the scantily-clothed jungle found protection by the gradual loss through natural selection of the conspicuous markings. Mr. de Nicéville's specimens illustrating his paper were exhibited at a meeting of this Society in February 1885, but his view did not meet with much acceptance among the members present, nor was any alternative explanation of the phenomenon brought forward. He was able, however, in the following year to adduce proof of the correctness of his theory in a memoir [2] giving details of the rearing of one seasonal form from eggs laid by the other in four of the seven cases named by him in his previous paper, viz. *Ypthima hübneri* and *Y. howra*; *Y. philomela* and *Y. marshallii*; *Mycalesis mineus* and *M. indistans*; *Melanitis leda* and *M. ismene*; these pairs consisting respectively of the ocellated wet-season form and non-ocellated dry-season form of each species concerned.

Just previously to the latter notable record of Mr. de Nicéville, Mr. W. Doherty had contributed to the same Journal [3] his four years' observation of seasonal variation while collecting Indian butterflies. He brings to notice that, speaking generally, there were *four* broods annually in that country, viz. two in the wet season and two in the dry season, and that, while there was no perceptible difference between the two broods of the same season, there were often very marked differences between the wet-season broods and the dry-season ones. These differences included size (the wet-season form being usually smaller), the angulation of the wings, and the colouring and ocelli of the underside, and were well illustrated by species of *Junonia*, *Ypthima*, *Mycalesis*, and *Melanitis*. The author remarks that some countries with wet climate do not yield any but wet-season forms,[1] and conversely that some very dry countries produce only dry-season ones, instancing the case of *Junonia almana*, the dry-season form of which alone occurs in Scinde, while its wet-season form (*asterie*) only is met with in Ceylon and Singapore. He is of opinion that De Nicéville's view is strengthened by the fact that the dry-season forms are more or less leaf-like both in shape and in the underside colouring, while no such resemblance is manifested by the wet-season ones, and argues that this points to the greater exposure to danger in the dry season; but he is inclined to think that the eye-like underside markings in the wet season may serve as a protection from the attacks of birds. It is singular that, while this observant collector enumerates no fewer than twenty-three species of Pierinae in his "List," he does not seem to have noticed the occurrence of seasonal dimorphism in the subfamily which is especially fertile in illustrations of it.

In view of the satisfactory evidence afforded by De Nicéville's experiments with Indian Satyrinæ, I could no longer doubt that many hitherto puzzling cases of variation among African butterflies would find their solution in the same way, especially as the dated specimens accessible all pointed to the seasonal character of the varieties. I kept the question constantly before my entomological correspondents in Natal and the other warmer parts of South Africa, and was enabled by their assistance to indicate in 1889 ("South-African Butterflies," iii. pp. 6, 7, 125, and 395, 1889), various extremely probable instances of a corresponding phenomenon among African Satyrinæ and Pierinæ. Among a most interesting collection made by Mr. A. W. Eriksson in tropical South-west Africa, described by me in 1891 (*Proc. Zool. Soc. Lond.*, 1891, pp. 59, 64, 85, 89, 96, 97, and 99), I noted what appeared to be undoubted cases of seasonal dimorphism in species of Acræinæ, Lycænidæ and Pierinæ; and again, in cataloguing Mr. F. C. Selous's Manica butterflies in 1894 (*op. cit.*, 1894, pp. 14, 22, 29, 37, 64, and 67), I showed reason for recognising the prevalence of the same kind of variation, especially pointing out how in the case of *Melanitis leda* all the dated South African examples went to confirm De Nicéville's experience at Calcutta, and what strong similar ground existed for considering the much-discussed variation in the Nymphaline *Hamanumida daedalus* to be seasonal.

An important contribution to the elucidation of the subject was made in 1894 by the late Captain E. Y. Watson in a paper entitled "Notes on the Synonymy of some Species of Indian Pierinæ" (*Journ. Bombay Nat. Hist. Soc.*, viii. p. 489 (1894).

According to this experienced entomologist's observations some species—*Terias hecabe*, for instance—produce successive broods (from four in the cooler to ten or twelve in the warmer districts) throughout the year, and the last alone of the wet-season or dry-season broods respectively yields offspring exhibiting the opposite seasonal form; but it is at the same time pointed out that "in some cases the eggs laid by one female would produce more than one form, according to the state of the atmosphere shortly before the emergence of each individual, which is the period at which it would be chiefly affected." The author calls attention to the fact that "in different parts of the Indian Region, the seasons vary to a certain extent, so that it cannot be laid down that specimens captured in any particular month will belong to any particular form"; he defines, however, roughly the limits of the rainy and dry seasons and states that "the very large majority of specimens obtained during those periods will be wet- and dry-season forms respectively." Emphasis is laid on another important point, viz. that the

[1] "List of the Butterflies of Calcutta, &c." (*Journ. Asiat. Soc. Bengal*, liv. pt. ii. p. 39.)

[2] "On the Life-History of certain Calcutta Species of Satyrinae, with special reference to the Seasonal Dimorphism alleged to occur in them." (*Op. cit.*, lv. pt. ii. p. 229, 1886.)

[3] "A List of Butterflies taken in Kumaon." (*Journ. Asiat. Soc. Bengal*, lv., pt. ii. p. 107.)

[1] Mr. de Nicéville has recorded (*Journ. Asiat. Soc. Bengal*, lxiv., pt. ii. p. 362, 1895) that in N.E. Sumatra rain falls in every month of the year, and it is rare for a week to pass without a shower, and that consequently there are no dry-season forms of butterflies to be found there, with the solitary exception of the dry-season form of *Melanitis leda*, which (as in Java) prevails all the year round as commonly as the wet-season form.

seasonally dimorphic species present numerous intermediate forms, and that these intermediate forms themselves vary according to the vegetation and rainfall, "so that the extreme of a rainy-season form from a district where the rainfall is great and the vegetation dense, is much more pronounced than the extreme of a rainy-season form from a district with slight rainfall and sparse vegetation; and these differences are even more marked in the dry-season forms." The genera of *Pierinae* dealt with in this paper are *Huphina*, *Appias*, *Ixias*, *Terias*, and *Teracolus*, and seasonal dimorphism is shown to prevail largely in all of them, so that the author feels warranted in materially reducing the number of hitherto admitted species, contending that many of these are palpably founded on mere seasonal variations.

In 1895, I had the pleasure of receiving from a valued friend and correspondent in Natal, Mr. Cecil N. Barker, the MS. of an interesting paper he had drawn up, from many years' field observations, on the seasonal variation of butterflies in that colony and the adjacent territories. This paper, which was published the same year,[1] proceeds on much the same lines as that of Captain Watson's just noticed, but, instead of being confined to the Pierinæ, traces the occurrence of the phenomenon throughout the suborder, indicating the following cases, viz. Acræinæ 1 (in *Acraea*); Satyrinæ 2 (in *Mycalesis*); Nymphalinæ 9 (1 each in *Atella*, *Junonia*, *Hypanis*, *Hamanumida* and *Charaxes*, and 2 each in *Precis* and *Crenis*); Lycænidæ 3 (in *Lycaena*); and Pierinæ 20 (9 in *Teracolus*, 4 in *Pieris*, 3 each in *Eronia* and *Terias*, and 1 in *Herpaenia*). In many of these thirty-six cases the seasonal differences and the occurrence of intermediate specimens about the change of season are carefully described; and several instances are recorded of the pairing of *Pieris gidica* with *P. abyssinica* or with intermediate examples. Mr. Barker's observations were decidedly in support of my own published opinion as to the seasonal dimorphism of *Hamanumida daedalus*, *Herpaenia eriphia*, *Teracolus regina*, *T. speciosus*, *Pieris pigea*, *P. gidica*, *Eronia cleodora*, and *E. leda*.

Mr. Barker's paper was soon followed by one of equal interest[2] contributed to our *Transactions* by Mr. G. A. K. Marshall, who has a most wide and intimate knowledge of butterfly-life south of the Zambesi. Mr. Marshall, after expressing his concurrence with Mr. Barker's opinions on the subject, proceeds to criticise with justice Dr. A. G. Butler's rather random suggestion (*Trans. Ent. Soc. Lond.* 1895, p. 519) that in the Acræinæ the presence of a broad apical black patch on the forewings indicates a wet-season form, proving this idea to be wholly untenable, at any rate in three of the five cases advanced by Dr. Butler. He goes on to indicate the signs of seasonal variation in nine species of *Acraea*, and notably in the Mashunaland *A. halali*, where both sexes vary strongly, and unlike the other known cases in the genus, have the black spots larger in the dry-season than in the wet-season form. To the numerous instances given by Barker he adds two more in *Mycalesis* and eight more in *Precis*. The latter are shown to offer a beautiful series of gradations in dimorphism, from the four species *P. natalica*, *P. elgiva*, *P. tugela* and *P. artaxia*, where—in addition to larger size and more falcate forewings—the dry-season change is almost limited to the dull withered-leaf colour and marking of the underside; then to the two species *P. ceryne* and *P. archesia*, where the upperside as well presents considerable alteration both in colour and marking; and finally, to the species *P. simia* and *P. octavia-natalensis*, where the suggested respective dry-season forms *P. cuama* and *P. sesamus* present such extreme disparity in the aspect of both upper and under sides as to render it almost incredible that they can belong to the same species as the two wet-season forms in question.

The actual rearing of the dry-season form of *Terias zoe* from eggs laid by the latter, and its proving to be (as had long been anticipated) the butterfly known as *T. brigitta*, is recorded in this paper on the authority of that practised collector and observer, my friend Mr. J. M. Hutchinson, of Estcourt in Natal; and early in 1897, Mr. Marshall, writing from that locality, informed me that he had succeeded in rearing three specimens of *Teracolus auxo*, a wet-season form, from eggs laid by *T. topha*, a dry-season butterfly. In each of these two Pierine cases the close relationship of the seasonal forms was so manifest, that all the circumstances of their occurrence led one to expect the species-identity to be proved before very long; but it was otherwise in the case of *Precis octavia-natalensis* and *P. sesamus*, notwithstanding the significant facts—very close resemblance in both larvæ and pupæ, occasional pairing of the two forms, and the existence of various intermediate examples—which favoured a similar conclusion. Thus it was with no ordinary interest that I received from Prof. Poulton Mr. Marshall's announcement, in a letter dated June 1898, that in three cases he had bred *P. sesamus* from the eggs laid by *P. octavia-natalensis*, and that I saw the actual specimens of parent and offspring in two of the three cases, which had been sent to the Hope Department of the Oxford University Museum. An excellent account by Mr. Marshall of what he rightly describes as "the most remarkable instance of seasonal variation as yet known" was published in July last.[1] What makes the case so striking is not alone the very great difference of the upperside—deep salmon-red with black borders and spots in *octavia-natalensis*, and violaceous-blue streaked with black, and a continuous series of salmon-red spots in *sesamus*—but that of the underside also—almost the same as the upperside, but pinker in *octavia-natalensis*, and very dark greenish bronze with black streaks in *sesamus*. Owing to the latter disparity nothing could be more different than the appearance of the two forms when at rest, *octavia-natalensis* being very conspicuous, while *sesamus* is well concealed;[2] and this wide divergence is associated with the differing haunts and habits of the two forms. Mr. Marshall seems inclined to the view that the wet-season form *octavia-natalensis* is the older one, and that the dry-season form *sesamus*, with its distinctly protective underside, may be the result of greater persecution—in the scarcity of insects of other orders—during that season. On the other hand, he suggests the possibility of the wet-season *natalensis*-form being in process of modification in mimicry of the prevalent red black-spotted *Acraeae* of the same region, in which case *sesamus* would have to be taken as the older form. I consider the latter to be more likely than the former view, seeing how much less *sesamus* has diverged than *octavia-natalensis* from the general pattern of the genus *Precis*.[3]

A noteworthy fact in Mr. Marshall's experience in this case was that, while in the second instance recorded he reared an example of *sesamus* from an egg laid by *octavia-natalensis*, he also obtained, only five days later, from another egg laid by the same mother, on the same day, a pure *octavia-natalensis*. He expressly states that the two larvæ from which these amazingly different butterflies resulted were reared from the egg under precisely similar conditions; and he adds that not a few similar instances had come under his notice. This is sufficiently remarkable, but it by no means exhibits the apparent extreme of variation among the offspring of one mother; for Mr. de Nicéville (in a letter of June 13 last) assures me that in India "at the change of the season, in one brood, from one batch of eggs laid by one female, you sometimes get both seasonal forms and all intermediate ones."[4] Such cases, like those of more or less complete resistance to altered temperature, so frequent in the experiments of Weismann and others, point very clearly to the operation of some other factor than the degree of humidity, or of temperature; but it must be admitted that we are as yet quite in obscurity as to its actual nature, and that our investigations into seasonal dimorphism must be far more systematically and thoroughly prosecuted before conclusions of a satisfactory character can be arrived at.

While the observations already on record, to which I have drawn attention above, render it beyond question that seasonal dimorphism is of world-wide prevalence, it is at the same time surprising—considering the great and increasing study devoted to exotic butterflies of late years—that so very little is definitely known of the actual range and conditions of its occurrence beyond European limits. So far as the Palæarctic Region is

[1] "Notes on Seasonal Dimorphism of Rhopalocera in Natal." (*Trans Ent. Soc. Lond.*, 1895, p. 413.)

[2] "Notes on Seasonal Dimorphism in South African Butterflies." (*Op. cit.*, 1896, p. 551.)

[1] See "Seasonal Dimorphism in Butterflies of the Genus *Precis*, Doubl." (*Ann. and Mag. Nat. Hist.* (7). ii. p. 30 (1898).

[2] The rarely-occurring intermediate examples, as I have pointed out ("South Afr. Butt.," i. pp. 230, 231, and 233, 1887), exhibit a complete gradation as respects both upperside and underside.

[3] The only other species of *Precis* of the *octavia* pattern and colouring is *P. simia* (considered by Mr. Marshall to be the wet-season form of the dry-season *P. cuama*), and this species may possibly also be mimetic of the *Acraeae*.

[4] It would be of the very greatest service to these inquiries if such a series as this, the offspring of one mother, could be preserved in its entirety, together with a full record of all the conditions bearing on the case. Mr. de Nicéville does not mention the actual species to which his remark applies.

concerned we are indebted to Standfuss[1] for a comprehensive list of the cases recognised, distinguishing between those where the seasonal disparity is so marked as to have led to the bestowal of distinct names on the two forms, and those where the disparity is less and no second name has been given. In the former category there are 23 cases (17 in Butterflies and 6 in Moths), and in the latter 15 (14 in Butterflies and 1 in Moths), making in all 38 cases, viz. 31 in Butterflies and 7 in Moths. The butterflies comprised in the more marked category include 1 case in Satyrinæ, 2 cases in Nymphalinæ, 5 in Lycænidæ, 6 in Pierinæ, and 3 in Papilioninæ; while those in the less marked category are three cases in Satyrinæ, 3 in Nymphalinæ, 3 in Lycænidæ, and 5 in Pierinæ, so that taking the totals of both categories in their order of numerical importance we have 11 cases in Pierinæ, 8 in Lycænidæ, 5 in Nymphalinæ, 4 in Satyrinæ, and 3 in Papilioninæ. The moths are ranked in the more marked category with the exception of a Liparid (*Dasychira abietis*); they are two in the Bombycidæ and four Geometers. The number of known cases in the Palæarctic Region thus appears to be very small, when contrasted with the very large number of species of the groups to which they belong ascertained to inhabit the region; but it may be observed that a considerable proportion of them must be of greatly extended occurrence and very ancient standing, Pryer[2] noting no fewer than six of them in Japan (besides three additional cases in local species); and Dr. A. Fritze[3] further recording in the same country the case of *Araschnia levana* (var. *burejana*).

When we turn to the great tropical and subtropical regions, where butterfly life finds its fullest and most varied development, it is almost disheartening to find how extremely little has been done in the observation of this apparently prominent feature of seasonal variation. With the exception of India in the Oriental Region, and South Africa in the Ethiopian Region, none of the hot or warmer countries have hitherto received the slightest investigation as regards this particular subject of biological inquiry. I can find no record of any observations in East or West Africa, in Australia, or in Central and South America. Feeling especially the deplorable lack of information from that paradise of butterflies, the Neotropical Region, I consulted Dr. F. A. Dixey with the view of ascertaining whether the Pierinæ—the group which he has made so emphatically his own, and which in the Old World has yielded more cases of seasonal dimorphism than any other—offered any instances of the kind in Central or South America. He most obligingly brought together, in the Hope Department of the Oxford University Museum, a series of Neotropical species of *Callidryas*, all of which included forms corresponding in character with the seasonal varieties occurring among their Old-World congeners and allies, viz. a larger form, of deep or rich colouring with the underside freckling and markings strongly expressed; a smaller form, of paler colouring, with the underside freckling and markings very faint or altogether absent; and, in addition to these, specimens holding an intermediate position between them as regards the characters mentioned. Dr. Dixey exhibited this series (with some additions and substitutions) at the Society's meeting on December 7, and explained that, in order to meet the possible objection that the variations in question pointed to *local* forms, he had been careful in the case of each species to select examples from the same locality. The species concerned were *C. rurina* (Mexico), *C. neocypris* (South Paraguay), *C. argante* (Brazil), *C. agarithe* (Mexico), *C. sennae* (Guatemala and Brazil), and *C. philea* (Guatemala). There was no sufficient evidence as to the seasons of appearance of these variations, only seven examples (four *C. argante* and three *C. sennae*) in the whole series bearing dates of capture; but the nature of them, and the parallelism with which they were displayed by each of the six species, were such as to leave little doubt of their being seasonal.

I am further indebted to Dr. Dixey for the first indication of the occurrence of seasonal dimorphism in Australia, afforded by the Old-World section (*Catopsilia*) of the same genus *Callidryas*. In one species, *C. gorgophone*, from Melville Island and Queensland, gradations are found quite in correspondence with those observed in both Indian and Neotropical species; and the same phases are even more completely illustrated in a fine series of Brisbane examples of the well-known Oriental *C. crocale*, which lends some probability to Dr. Dixey's suspicion that *C. crocale* and *C. pomona* (including *C. catilla*) will prove to be seasonal forms of one species.[1]

In bringing to a close this attempt to give a general survey of what has been published on the subject, I purposely abstain from indulging in any speculative disquisition on my own part, because, however attractive to myself such a course might be, I very much doubt if, in the present very restricted bounds of our knowledge, it would prove of any service to the Society. To generalise or to speculate to any good purpose demands a considerable body of well-ascertained fact as a basis, and this—as my remarks have shown—is precisely what is wanting in the present instance, notwithstanding the labours of the entomologists of distinction to whom reference has been made. While fully recognising that the artificial-temperature experiments noted above have been designed and conducted with a skill and thoroughness truly admirable so far as certain species of Palæarctic and Nearctic Lepidoptera are concerned, it cannot at the same time be denied that even in Europe very little has been done to ascertain all the natural conditions under which seasonal dimorphism occurs, or to what extent it is adaptive to the environment; and when we turn to the wide tropical and subtropical regions, it is obvious that we stand upon merely the threshold of inquiry. We have, indeed, from these regions—thanks to such capable observers as De Nicéville and Marshall—some valid experimental evidence to guide us, but this must be very greatly added to, and the life-history of the dimorphic species be worked out from many different directions, before we can hope to approach to a clear comprehension of the complex problem now presented by the extraordinarily impressionable and mutable lepidopterous organism. In studying the cases under notice, it is impossible not to recognise that the most diverse influences are at work—indications of protective and mimetic adaptation, and of sexual selection as well, being combined or contrasted with the effects of varying temperatures and degrees of atmospheric humidity, and with distinct tendencies in the direction of reversion to ancestral characters.

The investigation is one to tax the insight and resource of the ablest and most zealous naturalists, and demands unremitting and most exact observation and record, with carefully controlled breeding from the ova for many successive generations, during a considerable series of years. I am as fully persuaded now as I was on the occasion of my last year's address, that such researches as these can never be satisfactorily prosecuted, and still less brought to any interpretation of permanent scientific value, without the establishment in tropical countries of fitly equipped biological stations for the special observation and study, under as natural conditions as possible, of the surrounding terrestrial fauna. It is unnecessary to dwell upon the manifest advantages attendant on well-directed work pursued steadily and continuously in such a zoological observatory, planted in the very midst of the abounding forms of tropical life, or to do more than mention the exceptionally favourable opportunities for discovery that would thus be afforded. In conclusion, therefore, I will simply express my firm conviction that from a few well-organised stations of this kind, on carefully chosen sites in the four great tropical regions, science would gain more in ten years than from the casual and incomplete observations of ordinary collectors and travellers for the next half-century.

[1] "Handbuch der Paläarktischen Gross-Schmetterlinge für Forscher und Sammler," ed. 1896, p. 229.

[2] "Rhopalocera Nihonica: a Description of the Butterflies of Japan," 1886-88. The species named are *Papilio machaon*, *P. xuthus*, *Pieris napi*, *Colias hyale*, *Vanessa C.-album*, and *Polyommatus phlaeas*.

[3] *Zool. Anzeiger*, 1890, p. 12. Transl. in *Ann. and Mag. Nat. Hist.* 6), v. p. 200 (1890).

[1] *C. crocale* is an extremely variable and very widely distributed butterfly. Mr. de Nicéville (*Gazetteer of Sikkim*, 1894, p. 166; and *Journ. Asiat. Soc. Bengal*, lxiv. ii. p. 490, 1895) considers that *C. catilla* cannot be held a distinct species from *C. crocale*, all the supposed distinctive characters proving quite inconstant, and breaking down when large numbers of specimens are compared. But he does not think seasonal dimorphism comes into play here, "the innumerable varieties which are found in both sexes occurring at all times."

THE PROGRESS OF TECHNICAL EDUCATION.

THE eleventh annual report of the National Association for the Promotion of Technical and Secondary Education is filled with details concerning the systemisation and extension of educational work during last year. A few extracts from the report will show that satisfactory progress was made.

ENGLAND.

It is pleasing to be able to record that, in the year 1897–8, the total amount of money available under the Local Taxation (Customs and Excise) Act, 1890, for technical education and distributed to the local authorities, was again larger than in any precious year, and that a further advance has been made as regards its utilisation for educational purposes.

Of the 49 County Councils in England, 38 are now giving all and 11 are giving part of their grants to educational purposes, while of the 61 County Borough Councils, 56 are devoting all and 5 are devoting part of the fund in a like manner.

In considering the amount of money devoted one way and another, it may be stated that, of the total of 827,000*l.* now available in England alone, no less a sum than 752,000*l.* is being spent upon education. It thus appears that the amount allocated to general county purposes is still as high as 75,000*l.* In this connection it is worthy of note that London's share of the fund now reaches 192,000*l.*, of which the County Council have granted to the Technical Education Board, for 1898–9, a sum of 170,000*l.*, a growth of 20,000*l.* as compared with last year's vote. Again, the Middlesex County Council have recently decided to increase their contribution during the year 1898–9 for the purposes of technical education by 5000*l.* If, after adding these two sums to the 752,000*l.* given above, a deduction is made of the 7000*l.* voted for county purposes by the Staffordshire County Council, there will remain allocated to education for the year 1898–9, the large total of 770,000*l.*

NEW TECHNICAL SCHOOLS.

In last year's report it was stated that there were 168 technical schools built, or about to be built, by local authorities in England, and that 142 involved a capital expenditure of 1,718,000*l.* This information may now be supplemented by particulars obtained in response to a special effort made during the year to secure more detailed data: the results of this effort have been published in two separate articles in the last volume of *The Record*. The articles, which are reproduced in the report, deal respectively with the developments in (1) the county boroughs and in (2) the non-county boroughs and urban districts and the administrative county areas, including London, and they show that, excluding London, a capital sum of at least 2,340,651*l.* has been spent upon technical schools in England, and that there are 239 such schools of different types under the control of, or in course of establishment by, local authorities.

Since the publication of the articles it has been decided to erect new technical schools at Barrow, Beverley, Eston and South Bank, Garston, Morecambe, Selly Oak and Walkden; while technical schools have been erected and opened at Lytham and Pokesdown (Bournemouth). The erecting of schools in seven of these towns (excluding Morecambe and Walkden) will involve a total expenditure of 25,200*l.* To this sum should be added (1) an amount of 20,000*l.*, which the Eastbourne Town Council have decided to spend on a combined technical school and free library; (2) a sum of 60,000*l.*, which the Manchester City Council are about to borrow for furnishing and equipping the new municipal technical school; and (3) 18,221*l.* expended on the establishment of the Preston Technical School. It will thus be seen that the aggregate sum incurred in the establishment of technical schools in England up to the present time is 2,464,072*l.*

WALES.

The organisation of technical and intermediate education in Wales continues on the same lines as those indicated in last year's report. The bulk of the available funds is devoted to the purposes of intermediate education, and in several counties (*e.g.* Carmarthen, Carnarvon and Merioneth) the whole grant under the Local Taxation (Customs and Excise) Act, 1890, is similarly utilised. The halfpenny rate under the Intermediate Education Act is levied in all the sixteen counties and county boroughs, and at least ten County and County Borough Councils utilise the provisions of the Technical Instruction Acts. The following is a brief summary of the sums annually appropriated for technical and intermediate education in Wales:—

Residue grant under the Local Taxation (Customs and Excise) Act, 1890	£38,000
Raised by rate under the Technical Instruction Acts, 1889 and 1891	25,000
Raised by rate under the Welsh Intermediate Education Act, 1889, with equivalent grant from Her Majesty's Treasury	£35,000
Total	£98,000

The total sum which has hitherto been absorbed in the erection or adaptation of fifty school buildings in Wales is as much as 182,298*l.*, and in a number of cases half the cost of school buildings has been defrayed by local subscriptions.

It is understood that the University of Wales and the three University Colleges are already profiting by the work done in the county schools. A considerable number of the scholars of the county schools have passed the matriculation examination, either wholly or in part, of the University, and many scholars, with the aid of scholarships won at their several schools, have entered the University Colleges with a view to preparing themselves for a degree. A great deal of technical education is given in evening classes held in connection with some of the county schools, more especially in the mining and the manufacturing districts of Wales.

SCOTLAND.

During the year 1898 the most important matter affecting the organisation of technical and secondary education in Scotland was the passing of an Act whereby a further sum of 35,000*l.* became available on March 31 of this year for the purposes of technical and secondary education.

The Imperial moneys now available for the purposes of higher education in Scotland amount to 181,000*l.*

IRELAND.

In matters relating to technical education the past year was an eventful one in Ireland. In 1897 attention was directed to the question of the introduction of manual and practical instruction in the primary schools by reason of the appointment, by the Lord Lieutenant, of a Commission of Inquiry. Speaking broadly, if the recommendations of this Commission are put into force, the Irish system of science, art, manual and practical instruction will become assimilated to the English; and, having regard to instruction now given in elementary schools in Ireland, this will be a great step in advance.

In 1898 the examination of the system of intermediate education was commenced by another Commission, also appointed by the Lord Lieutenant. The Commissioners have already held several sittings and a large amount of evidence has been received, much of which points to the necessity of giving greater encouragement to the study of science, modern languages and commercial subjects, and to the necessity of inspection and *viva voce* examination, in order to ensure that the schools are properly provided with laboratories, that the instruction in science is not mere book learning, and that modern languages are taught as living and not as dead languages.

Under the Local Government (Ireland) Act, 1898, the new County and County Borough Councils are constituted local authorities within the meaning of the Technical Instruction Acts, and the intimation of the Government of their intention to introduce a measure dealing with technical education in Ireland gives promise of further developments.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

MR. J. ARTHUR THOMSON has been appointed to the chair of Natural History in the University of Aberdeen, vacant by the death of Prof. Alleyne Nicholson.

THE *Athenæum* states that the late W. J. Astrakoff has bequeathed to the University of Moscow a sum of a million roubles, on condition that it shall be expended upon a foundation of a "Moscow University for Women," with three faculties—mathematics, medicine, and natural science. He requires that it shall be placed under the direct administration of the Ministry of Public Education, and the programme correspond exactly with that of the university for men.

THE ninth annual report on the administration of the Goldsmiths' Company's Technical and Recreative Institute at New Cross shows that something should be done to define the work of institutions of this kind, and prevent neighbouring schools from competing with it. The Institute is one of the finest in London; it is well-equipped, and has a competent staff, yet it has to report that the number of class entries for the year ending

September 30, 1898, was 8277, as compared with the 9116 students of the previous year—a decline of 839. A further decline appears probable for the current year. This reduction of numbers is attributed to the extension of the Evening Continuation Schools of the London School Board, in which all fees have now been abolished, and to the establishment by the Board, close to the Institute, of certain special centres, at which many of the subjects already provided for by the Institute are taught gratis. The Governors point out that action of this kind on the part of a body having the control of public funds is open to much question, and, if persisted in, may render voluntary effort, by means of private resources useless, if not impossible. It is to be hoped that the appointment of a single authority to be responsible for technical and secondary education in London will be the means of preventing the unfortunate overlapping and undesirable competition referred to by the Governing Body in their report. The Institute should be given a definite place in the scheme of education in London and nothing should be permitted to interfere with its progress.

SCIENTIFIC SERIALS.

Bulletin of the American Mathematical Society, March.—On singular points of linear differential equations with real coefficients, by Prof. M. Böcher (read before the Society, October 29, 1898). Take the equation

$$\frac{d^n y}{dx^n} + \ldots + p_r \frac{d^{n-r} y}{dx^{n-r}} + \ldots + p_n y = 0,$$

where the coefficients (p_r, &c.) are throughout a certain interval $a < x < b$, continuous real (but not necessarily analytic) functions of the real variable x. By a solution the author understands any function of x which together with its first $n-1$ derivatives is single valued and continuous throughout the interval $a < x < b$, and at every point of this interval satisfies the above equation. It is well known that there is one, and only one solution which at an arbitrarily chosen point of the interval in question has together with its $n-1$ derivatives arbitrarily chosen values. The object of the paper is to consider the behaviour of these solutions as we approach one end of the interval. Prof. Böcher confines his attention to the point a. Reference is made to two papers by Kneser ("Crelle," vols. 116, 117). The paper is an extension and generalisation of some of the author's results obtained in a previous paper of this current volume, entitled "The theorems of oscillation of Sturm and Klein."—Some interesting results are given in the Hessian of the cubic surface, by Dr. J. I. Hutchinson (read at the Boston, Mass., meeting, August 1898).—On the simple isomorphisms of a Hamiltonian group to itself, is a notelet read, at the same Boston meeting, by Dr. G. A. Miller. In the paper each *system* of conjugate operators is supposed to contain more than one operator unless the contrary is stated. The results are expressed in three theorems with attendant corollaries. Useful reviews follow:—Œuvres mathématiques d'Évariste Galois (published by the Paris Mathematical Society).—Thése sur la géométrie non-euclidienne, by M. L. Gerard; Lezioni di geometria intrinseca, by E. Cesàro; L'hyperspace à $(n-1)$ dimensions; Propriétés metriques de la corrélation générale, by G. Fontené; Théorie der Abel'schen functionen, by Dr. H. Stahl; Differenzrechnung, by A. A. Markoff. All these notices are carefully drawn up, and are replete with bibliographical references. The last work, in its German form, is highly praised, and "no one interested in the calculus of finite differences can afford to be without this valuable treatise" is the reviewer's verdict. Information follows on the usual lines.

THE new number of the *Archives of the Roentgen Ray* contains Major Battersby's paper, read before the Röntgen Society, on the present position of Röntgen rays in military surgery on January 10, illustrated by several fine plates reproduced from photographs and radiographs taken in Egypt during the recent war in the Sudan. There is also a translation of Prof. Röntgen's further observations on the properties of X-rays, being the third communication to the Royal Prussian Academy of Sciences, Berlin, and dated March 10, 1897.

AMONG the articles in the April number of *Natural Science* is one on the development of rivers, and particularly the genesis of the Severn, a translation of Prof. A. Weismann's essay on "Regeneration: Facts and Interpretations."

SOCIETIES AND ACADEMIES.

EDINBURGH.

Royal Society, March 20.—Prof. Copeland in the chair.—Sir John Murray read a paper on the temperature over the floor of the ocean, and the maximum and minimum temperature of the surface of the ocean. The results were exhibited in charts, and showed that 92 per cent. of the bottom water of the ocean had a temperature under 40° F. Higher temperatures were met with in areas between the shore and the hundred-fathom line. As regards the surface waters, 87 per cent. of the maximum temperatures, and 75 per cent. of the minimum temperatures, were above 40° F. Sir John Murray pointed out the important bearing the distribution of the temperature had upon nature and amount of the calcareous deposits.—Prof. Cossar Ewart, in a paper on contributions to the theory of heredity (Part ii.), took up the question of intercrossing and variation. The paper might be described as a critical examination of the favourite dictum that intercrossing had a swamping effect, and curbed variation; and, at the same time, an argument in favour of the view that intercrossing had, like cross-fertilisation, a power of inducing variation. No concrete examples could be adduced of intercrossing leading to uniformity. On the other hand, notwithstanding free intercrossing, a new variety of the peppered moth, which recently appeared in England, had gradually displaced over a considerable area the parent form. Prof. Ewart's own experiments on intercrossing among half-wild rabbits favoured the view that intercrossing induced rather than arrested variation. The paper ended with a discussion of the relative value of intercrossing and change of environment as rejuvenators, one conclusion being that, while the constitution might be bettered by a change in the environment, active variation seemed to result from the disturbance that accompanies or flows from intercrossing.—A paper by Dr. T. Muir, on a development of a determinant of the m nth order was also communicated.

PARIS.

Academy of Sciences, April 4.—M. van Tieghem in the chair.—Observation of the planet EL (Coggia, March 31) made at the Observatory of Paris with the 38 cm. equatorial, by M. O. Callandreau.—Observations of the planet EL 1899, discovered by M. Coggia at Marseilles, March 31, by M. Stéphan. On the deformation of surfaces of the second degree, by M. G. Darboux.—The calculation by a simple hypothesis of the lateral displacement which should be given to a rider on a bicycle in motion, to carry the centre of gravity of the system to any given small horizontal distance from the base of the machine, by M. J. Boussinesq.—On the synthesis of alcohol, by M. Berthelot. The author shows that although Hennell probably prepared potassium ethyl sulphate from ethylene, he does not appear to have attempted to have prepared alcohol from this, as is usually stated in the text-books.—On antherozoids and double sexual copulation in the angiosperms, by M. L. Guignard. The observations made by the author upon the fertilisation of *Lilium Martagnon* confirm generally the results of M. Nawaschin, the essential phenomenon consisting of a double sexual copulation in the embryonic sac., one giving rise to the embryo, the other furnishing the albumen necessary to the nutrition of the embryo. The paper is illustrated by nineteen diagrams.—Observation of the Swift comet (1899 *a*) made at the Observatory of Algiers, by MM. Trépied, Rambaud, and F. Sy.—Observations of the Swift comet (1899 *a*) made at the Toulouse Observatory with the 23 cm. equatorial, by M. F. Rossard.—On several linear groups isomorphous with the simple group of order 25920, by M. L. E. Dickson.—A rapid method for the determination of the specific heat of liquids, by M. D. Negreano. The method is based upon the comparison of the times required to raise the same volumes of the liquid and of water 1° by means of a wire spiral carrying the same current.—On the use of diffraction fringes in increasing the delicacy of galvanometer readings, by M. Pierre Weiss. The method suggested increases the delicacy of reading a given galvanometer four times.—On the Wehnelt electrolytic contact-breaker, by M. A. Blondel.—On the absorption of the Hertzian waves by non-metallic bodies, by MM. Édouard Branly and Gustave Le Bon. The opacity of non-metallic substances to the Hertzian waves depends upon the thickness and nature of the substance, sand and stone being very transparent, Portland cement much more opaque. Moisture increases the opacity.—On a mode of obtaining electric figures

showing the lines of force of an electric field in air, by M. E. Baudréaux. A non-metallic powder is sprinkled upon an insulated horizontal sheet of glass placed in the electric field; on giving the plate a slight shock, the lines of force immediately appear. Diamidophenol, crystallised in small needles two or three millimetres in length, gives the best results; but, in default of this, sugar powder and many other substances give fair figures.—On the reduction of calcium phosphate by carbon in the electric arc, by M. Albert Renault. The results confirm those given last week by M. Moissan.—Absence of free iodine or gaseous iodide in the atmosphere of Toulouse, by M. F. Garrigou. Five hundred cubic metres of filtered air showed no trace of iodine or any gaseous compound of iodine.—On the acetone oils arising from the dry distillation of crude calcium acetate as a source of the methyl-propyl ketones, by MM. A. and P. Buisine. The mixture of ketones obtained by the dry distillation of crude calcium acetate gives a fraction boiling at 70°, known commercially as acetone oil. Two specimens of this were found to be rich in methyl-propyl ketone and methyl-isopropyl ketone. These ketones are readily separated from the oil by means of alkaline bisulphite, and from each other by repeated fractional distillation.—On solanine, by MM. P. Cazeneuve and P. Breteau.—Ice-breaking steamers in Russia, by M. Venukoff.

GÖTTINGEN.

Royal Society of Sciences.—December 10.—A. Sommerfeld: The numerical solution of transcendental equations by successive approximations.—D. Hilbert: On the theory of quasi-abelian *Zahlkörper*.—E. Ehlers: On Palolo (*Eunice viridis*, Gr.).

January 14.—J. Voigt: On the development of the intestinal mucosa.

DIARY OF SOCIETIES.

THURSDAY, APRIL 13.

ROYAL INSTITUTION, at 3.—The Atmosphere: Prof. J. Dewar, F.R.S.

MATHEMATICAL SOCIETY, at 8.—Note on the Characteristic Invariants of an Asymmetric Optical System: T. J. Bromwich.—Concerning the Four Known Simple Linear Groups of Order 25920, with an Introduction to the Hyper-Abelian Linear Groups: Dr. L. E. Dickson.—On the Direct Determination of Stress in an Elastic Solid, and on the Stress in a Rotating Lamina: J. H. Michell.—The Theorem of Residuation, Noether's Theorem, and the Riemann-Roch Theorem: Dr. F. S. Macaulay.—On Conformal Division: Lieut.-Colonel Cunningham, R.E.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Hissing of the Electric Arc: Mrs. Ayrton. (Conclusion of Discussion.)—Experiments on Alternate Current Arcs by Aid of Oscillographs: W. Duddell and E. W. Marchant. (Discussion to be opened by the Authors with an Exhibition of Experiments.)

FRIDAY, APRIL 14.

ROYAL INSTITUTION, at 9.—Earth Currents and Electric Traction: Prof A. W. Rücker, Sec. R.S.

ROYAL ASTRONOMICAL SOCIETY, at 8.—Further Observations of Comet Coddington (*c* 1898): John Tebbutt.—Photographs of the Radiant of the Leonid Meteors, and Attempts to Photograph the Meteor Stream: Dr. Isaac Roberts, F.R.S.—Measures of Southern Double Stars: J. L. Scott.—On the Smallness of the Errors of Star Photographs due to Optical Distortion of the Object-glass with which the Photograph is taken: Prof. H. H. Turner, F.R.S.—Spectroscopic Determinations of Velocity in the Line of Sight: H. F. Newall.—(1) Micrometer Measures of Double Stars made with the 28-inch Refractor in the Years 1896-98; (2) Observations of Planet Eros from Photographs taken with the 30-inch Reflector of the Thompson Equatorial: Royal Observatory, Greenwich.

MALACOLOGICAL SOCIETY, at 8.—Notes on *Paludesirina Jenkinsi*, Smith, and *P. confusa*, Frauenf.: A. S. Kennard and B. B. Woodward.—Descriptions of Two Supposed New Species of *Nassa*: G. B. Sowerby.—On Supposed New Species of *Streptaxis*, *Amphidromus* and *Bulimulus*: H. Fulton.—Remarks on the Genus *Rhodea*, with Descriptions of New Species from South America; also of a New Species of *Papuina* from New Guinea: S. I. DaCosta.

MONDAY, APRIL 17.

SOCIETY OF ARTS, at 8.—Leather Manufacture: Prof. Henry R. Procter.

VICTORIA INSTITUTE, at 4.30.—Sub-oceanic Terraces, Western Europe: Prof. Hull, F.R.S.

TUESDAY, APRIL 18.

ROYAL INSTITUTION, at 3.—Zebras and Zebra Hybrids: Prof. J. C. Ewart, F.R.S.

ZOOLOGICAL SOCIETY, at 8.30.—On the Extinct Birds of Patagonia. I. The Skull and Skeleton of *Phororhacos inflatus*, Ameghino: C. W. Andrews.—A Systematic Description of Parasitic Copepoda found on Fishes, with an Enumeration of the known Species: Staff-Surgeon P. W. Bassett-Smith, R.N.—On the Species of *Canidae* found on the Continent of Africa: W. E. de Winton.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Buenos Aires Harbour Works: J. M. Dobson.

ROYAL STATISTICAL SOCIETY, at 5.—The Statistical Aspect of the Sugar Question: George Martineau.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.—Apparatus for Half-tone Process Work.

WEDNESDAY, APRIL 19.

SOCIETY OF ARTS, at 8.—London's Water Supply: Walter Hunter.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Soil Temperature: Henry Mellish.—Some Phenomena connected with the Vertical Circulation of the Atmosphere: Major-General H. Schaw, C.B.

ROYAL MICROSCOPICAL SOCIETY, at 8.—The Bioplasm of Man and the Higher Animals, and its Influence in Tissue Formation, Action and Metabolism: Prof. Lionel S. Beale, F.R.S.

THURSDAY, APRIL 20.

ROYAL SOCIETY, at 4.30.—The Physiological Action of Choline and Neurine: Dr. Mott, F.R.S., and Dr. Halliburton, F.R.S.—Intestinal Absorption, especially on the Absorption of Serum, Peptone, and Glucose: Prof. R. Waymouth Reid, F.R.S.—Studies on the Morphology of Spore-producing Members. No. 4. The Leptosporangiate: Prof. F. O. Bower, F.R.S.—Note on the Fertility of Different Breeds of Sheep, with Remarks on the Prevalence of Abortion and Barrenness therein: W. Heape.—Some further Remarks on Red-water or Texas Fever: A. Edington.

ROYAL INSTITUTION, at 3.—The Atmosphere: Prof. J. Dewar, F.R.S.

LINNEAN SOCIETY, at 8.—The Botany of the Ceylon Patanas: H. W. H Pearson.—Imitation as a Source of Anomalies: Prof. R. J. Anderson.—List of British and Irish Spiders.—Rev. O. Pickard Cambridge, F.R.S.

CHEMICAL SOCIETY, at 8.—Some Dipyridyl Derivatives from Citrazinic Acid: W. J. Sell and H. Jackson.—On the Interaction of Mercurous and Mercuric Nitrites, with the Nitrites of Silver and Sodium: P. C. Ray.—The Synthesis and Preparation of Terebic and Terpenylic Acids: W. Trevor Lawrence.—The Allotropic Modifications of Phosphorus: D. L. Chapman.—β-Isopropyl Glutaric Acid: F. H. Howles and J. F. Thorpe.—Ethyl Ammoniumsulphite: Edward Divers and Masataka Ogawa.—Ethyl Ammonium Selenite and Non-existence of Amidoselenites (Selenosamates): Edward Divers and Seihachi Hada.

INSTITUTION OF CIVIL ENGINEERS, at 8.—"James Forrest" Lecture: Magnetism: Prof. J. A. Ewing, F.R.S.

FRIDAY, APRIL 21.

ROYAL INSTITUTION, at 9.—Structure of the Brain in Relation to its Functions: Frederick Walker Mott, F.R.S.

BOOKS AND SERIALS RECEIVED.

BOOKS.—An Introduction to the Carbon Compounds: R. H. Adie (Clive).—A School Arithmetic: R. F. Macdonald (Macmillan).—A System of Medicine: edited by Dr. T. Clifford Allbutt, Vol. vi. (Macmillan).—The Philippines and Round About: Major G. J. Younghusband (Macmillan).

SERIALS.—The Paidologist, April (Cheltenham).—Geographical Journal, April (Stanford).—Archives of the Roentgen Ray, February (Rebman).—Engineering Magazine, April (Strand).—Mind, April (Williams).—Journal of the Royal Statistical Society, March (Stanford).

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