THURSDAY, APRIL 11, 1907.

MECHANISM OF THE WORLD.

The World Machine. The First Phase, the Cosmic Mechanism. By Carl Snyder. Pp. xvi+488. (London: Longmans, Green and Co., 1907.) Price 9s. net.

IN this book the author purposes "to go back to the simplest beginnings of things—to the days when primitive man first learned to count, to measure, to time, and to weigh, and to mark out how his every step towards positive knowledge has been an advance toward mechanical conceptions of phenomena which must one day end in a mechanical conception of the whole." Two-thirds of the book are therefore devoted to a history of man's ideas about the construction of the universe, while the remaining pages give an account of the results of the investigations of the present day. Among his predecessors the author mentions Pliny and Humboldt. It would be unfair to blame him for not coming up to the high level of Humboldt, but it is unfortunate that he too often resembles Pliny in not having understood his sources properly, without resembling him in presenting his readers with a great mass of detail. The narrative is very verbose, and does not clearly show how one idea or group of ideas has been developed from previous ones.

The author has evidently not studied the original works of the heroes of science whose judge he has constituted himself, as he is anything but a trustworthy guide in the history of astronomy. Among the historical works consulted he mentions Schiaparelli's memoir on the precursors of Copernicus, but he can hardly have read it carefully, since he repeats the old errors about Pythagoras and Philolaus having taught the heliocentric system. Mr. Snyder is not interested in those philosophers who did not know that the earth moves round the sun, and Plato and Aristotle are dealt with very severely. Though he acknowledges that Plato knew something of geometry, he thinks that "the puerile phantasies with which his pages are strewn do not give us a very high idea of his powers of mind." Aristotle "cuts rather a sorry figure as a thinker," and the only philosopher of antiquity who finds favour in the author's sight is Demokritus, on account of his atomic theory.

That the earth is a sphere the author imagines was undoubtedly known to the Egyptian priests, who communicated this discovery to Thales; and in several places it is hinted that the Egyptians and Babylonians knew a great deal more about the construction of the world than the Greeks ever did in after times. This was the belief of Bailly (whom the author quotes among his authorities), but the discoveries of archæologists have long ago shown it to be devoid of the slightest foundation. Among the Greeks, the author (or his source) fixes on a certain Bion, said to have been a disciple of Demokritus, but otherwise unknown, as the first to have worked out in detail the doctrine of the sphericity of the earth. This is done solely on the authority of Diogenes Laertius, who says that Bion was the first to assert that there are countries where there is day for six months and night for six months. That Parmenides and Pythagoras had announced the spherical form of the earth and divided it into five zones at least fifty years earlier is not mentioned.

The various measures of the size of the earth are next dealt with, and it is stated that we do not know the exact value of a stadium. It is, however, now quite certain that the stadium of Eratosthenes was equal to 157·5 metres, being the measure employed by the bematists or professional pacers, and that Posidonius used the same. Their results for the circumference of the earth, 252,000 and 240,000 stadia, were therefore not very discordant, and the former was remarkably near to the truth. Ptolemy, who gives 180,000 stadia, employed the official or Royal Egyptian stadium of 210 metres, so that he, in other words, simply adopted the value of Posidonius. That Columbus thought India much nearer to Spain than it really is was therefore not caused by an error of Ptolemy in making the earth too small, but by his believing Asia to extend much further east than it does.

If the author does scant justice to Eratosthenes in this matter, he certainly gives him far too much credit with regard to his idea of the distance of the sun. We are told that, according to the "Placita Philosophorum," Eratosthenes gave this distance as 804 million stadia, a wonderful approximation to the truth. So it would have been, but unfortunately the correct reading of the passage in question is 4,080,000 stadia, so that we need not trouble ourselves to find out how Eratosthenes came to know the distance of the sun so very accurately. Neither was the knowledge of Posidonius on this matter very miraculous, for when he assumed the sun's distance to be 500 million stadia, it was a perfectly arbitrary assumption, in which he merely followed Archimedes. In his "Arenarius," Archimedes had purposely made the circumference of the earth equal to three million stadia, in order to have large numbers to operate with, and the circumference of the solar orbit ten thousand times as great.

No attempt is made to show how Aristarchus may have been led to suggest that the earth moves round the sun, but here, as everywhere else, the author fails to realise the state of science of past ages, and thinks that it "passes understanding" that Archimedes could accept the geocentric system. The wonderful progress of mathematical astronomy, culminating in the work of Ptolemy, is quite ignored, and the picture of Greek astronomy presented by Mr. Snyder is on the whole a very misleading one. Passing to Copernicus, we find it stated that he discarded the system of epicycles, while the truth is that he had to employ them very largely, because he did not know the two first laws of Kepler. The "third motion" of the earth assumed by Copernicus has

also been quite misunderstood. As usual, the author is ready with his blame, and wonders that Lionardo da Vinci did not stand up for Copernicus. But as he died twenty-four years before the book of Copernicus came out, he may be held excused. The same is the case with Kepler, who could not very well make use of Galileo's little book on mechanics written in 1594, since it was not printed until four years after Kepler's death. Of Galileo we learn that he showed that the speed of a falling body increases with the square of the time (p. 256). Had he really done so he would have deserved to be enrolled among the delinquents castigated by the author. So would Newton, if he really had proved that the mass of a body may be calculated if we know the period and distance from the central body, or that gravity is less at the poles than at the equator (p. 261).

The author has succeeded better in the last hundred pages, which deal with stellar astronomy, the last chapter discussing the question of the probable "end of the machine." His own opinion is that all bodies will finally be congregated into a single mass, but he also sets forth the view of Arrhenius, that the matter of the universe follows a continual round of alternating aggression and dispersion.

J. L. E. D.

THE MATHEMATICAL ASPECT OF SPECTROSCOPY.

Vorlesungen über teoretische Spektroskopie. By Prof. A. Garbasso. Pp. viii+256; illustrated. (Leipzig: Johann Ambrosius Barth, 1906.) Price 7 marks.

IN the printed report of the lecture delivered before the Royal Institution on March 30, 1906, on "Recent Progress in Magneto-optics," Prof. Zeeman concludes with the following remarks:—

"Maxwell has said, 'an intelligent student armed with the calculus and the spectroscope can hardly fail to discover some important fact about the interior structure of a molecule.' I think this statement remains as true now as it was thirty-two years ago.

"There can be no doubt, I think, that spectrum analysis, and especially the magnetisation of the spectral lines, will give us a clue to the inner structure of the atom.

"I hope that I have succeeded in imparting to you this my conviction."

Now Prof. Garbasso's book seems to us exactly to cover the ground contemplated by Prof. Zeeman when he wrote these concluding remarks. It is, in fact, a well-planned attempt to build up an electrodynamical theory of the phenomena of spectroscopy, using no more difficult mathematics than the ordinary calculus of mathematical physics.

In spite of the fact that the word "electrodynamical" has gone out of fashion, and that it is more proper nowadays to say "electromagnetic," the old word is here retained as representing more correctly the spirit of the present book. If the equations of the electromagnetic field are written down and the quantities in them are defined in the phraseology of the physicist, the study of these equations is rightly described as electromagnetism. By representing the quantities in question as generalised position coordinates and the corresponding generalised momenta in Lagrange's equations, the study is brought under the heading of dynamics. Inasmuch, however, as there is no hard and fast line of demarcation between the two methods, and it is a matter of convenience which interpretation is used, the name "electrodynamical" well describes the methods of a book in which both aspects are considered.

The book is divided into twenty lectures, and is based on a course delivered at the University of Genoa. Of these, the first four form the first section of the book, and consist chiefly of introductory matter, namely, a summary of the principal phenomena of spectroscopy, a description of certain electromagnetic and electro-optical models and their application to the explanation of optical resonance, and a mathematical lecture dealing with the well-known theory of small oscillations, transformations of line, volume and surface integrals, and similar "auxiliary propositions."

The second section deals with Cauchy's theory of dispersion, Helmholtz's theory of anomalous dispersion, and a lecture on mechanical models of compound molecules, based on work by Dr. Filippini, of Genoa, who uses various forms of compound pendulums for the purpose of representing the various degrees of freedom of the assumed molecules.

The subject proper of the book, namely, the building up of mathematico-physical theories, commences with the eighth lecture, and occupies the two remaining sections of the book. These two sections afford typical instances of what has been, and is likely to be, the most interesting and prolific field of research in dealing with complex physical phenomena. To "explain" such a phenomenon we formulate some system, dynamical or otherwise, the equations of motion of which are capable of being integrated, and the integrals of which when interpreted represent effects similar to those observed. The assumed system then constitutes a model of the given phenomenon. Dr. Garbasso has endeavoured to confine his treatise to the discussion of phenomena that are capable of being studied by means of models, adding that

"A theoretical exposition which does not take account of the properties or of the possibility of its model is for physicists no theory but only a chaos ('ein Unding')."

The models made use of in the third section are all electrical oscillators, each represented diagrammatically by two or more conducting spheres connected by wires. For one-dimensional oscillations, simple oscillators each represented by two spheres are chosen; for three dimensions the author mainly employs compound oscillators having their conductors parallel to the three coordinate axes. These are, of course, simplifying hypotheses; but, as the author points out, for example on pp. 124, 149, the character-

istic determinant is of a very high order in all but the simplest possible cases, and certainly the purpose of the investigation, that of judging the unknown from the known, is best served by keeping the mathematics as simple as possible. Even when this is done the author obtains theoretical confirmation of the known results regarding the spectra of metallic haloid salts (Lecture 14, § 1), Lockyer's long and short lines, and observations on the dissociation of the elements in the solar protuberances (Lecture 1, § 7, and Lecture xiv., § 6), Kayser and Runge's series of spectral lines, and the phenomena of surface colours ("Schillerfarben"), under which heading the colours of butterfly scales are discussed at some length, this application being illustrated by an excellent photograph of the scales of one of the "blues," in which the dimensions of the pigment granules are equal to the wave-length of blue light.

This section deals, then, with the electromagnetic theory of spectroscopy of which Lecture 14 forms a general summary. In the fourth and last section many of the same results are established in a different way, by what the author describes as the electrostatic theory. This theory is based on the study of moving charges, and regards the molecule built up of electrified moving particles. It is, in fact, the electron theory, and the first lecture contains a proof that in the cases considered the electromagnetic forces are negligible compared with the electrostatic ones. The succeeding chapters deal with Dr. Stoney's theory of double lines, J. J. Thomson's models of atoms, and conditions of stability with special reference to the periodic law. The last lecture (Lecture 20) is a summary of the electrostatic theory, and contains explanations of the phenomena referred to above, based on this theory.

In summing up, Dr. Garbasso expresses the opinion that the electromagnetic and the electrostatic theories, and in some cases even mechanical models, are equally competent to account for observed phenomena. The electrostatic method he considers to be the most complete, but the electromagnetic method possesses considerable advantages for teaching purposes; it possesses a peculiar heuristic value, and opens up the possibility of reproducing the electrical oscillations artificially.

The book makes no claims to being a text-book, or in any way a complete account of all that might be said on the subject. It contains, no doubt, many proofs that are open to criticism, but experience has shown that objections are very generally raised years after a book has been written, and very often on work which has been accepted unchallenged by a large number of readers. The main points we have now to consider are whether the author has stated his case well and carefully, whether the book is calculated materially to help us in unravelling the many curious puzzles revealed by the spectroscope, and whether the methods adopted are the best suited to the objects in view, and on each of these points we pronounce judgment in the affirmative.

G. H. B.

ORIGIN OF THE ENGLISH NATION.

The Origin of the English Nation. By H. Munro Chadwick. Pp. viii+352. (Cambridge: The University Press, 1907.) Price 7*s.* 6*d.* net.

THE title of this work really conveys a more accurate suggestion of its scope than the first sentence of the preface, which describes it as "an account of the early history of the English nation." There was certainly room for such a work, in which all the available evidence should be carefully considered, and Mr. Chadwick has done this with the greatest minuteness. In fact, his book suffers to some extent from over-minute discussion of questions which have at best a very faint bearing upon the main subject of his inquiry. This is especially the case with the later chapters in the volume, such as that on the "Cult of Nerthus."

Another general criticism which might be made is that Mr. Chadwick is rather too much given to the common, but very unsatisfactory, process of drawing a strong conclusion from a series of very weak premises. Unfortunately, much of the evidence relating to the Germanic conquerors of England during the time before the invasion is so fragmentary and contradictory that hypotheses can hardly be avoided. It is therefore the more necessary that they should be used as sparingly as possible, otherwise they are apt to obscure the recorded facts. In particular, it is of little service in the end to set modern supposition against ancient assertion; the former is at least as likely to be wrong as the latter, even when it appears to reconcile contradictions. The author, for example, seeks to cast doubt upon the express statement of Bede that the invaders came from three nations, the Saxons, Angles, and Jutes. On various grounds, such as similarity of language and customs, he comes to the conclusion that there is not sufficient evidence for separating the Saxons from the Angles, and that the invaders "belonged not to three but to two distinct nationalities."

That the distinction cannot be clearly perceived now does not prove very much; it may have been clear enough to themselves and to Bede. It may even to some extent have become obscured through the migration to a new country, just as national differences soon tend to disappear in modern colonies. Or the difficulties raised by Mr. Chadwick may simply lie in the meaning to be attached to "nation" or "people." In Scandinavia of the tenth century we find four very distinct peoples who did not differ from each other in any essential respect. It is no argument against the reality of the Saxon element that *Englisc* and *Angelcynn* became the usual designation of the language and the people. Where no great difference was felt, the convenience of a common name would soon be obvious. The use of national names is not stable enough to be valid evidence in doubtful cases. The lowland inhabitants of Scotland in the fifteenth century called themselves Scots and their language English; and Snorri Sturluson evidently saw nothing contradictory in

making Norwegian kings speak "the Danish tongue." These instances show how readily the name of the Angles might efface that of the Saxons even at an early date.

While such objections may be made to some of Mr. Chadwick's arguments, the method he has followed in tracing the origins of the English people is a sound one. He begins with what can be learned of the invading nations immediately after their settlement in Britain, and from this works back as far as possible into their previous history. A necessary result of the method, however, is that as the inquiry advances the evidence becomes more scanty, and the use of conjecture more and more obvious. For this there is no help, but it seems a little disproportionate to give only ninety pages to the English period and two hundred and fifty to the Continental, of which so little is known. These ninety pages contain four chapters, of which the first gives a survey of England in the sixth century, showing the extent of the conquest at that date. The West Saxon invasion, and that of Kent, are specially discussed in the following chapters, and the fourth is occupied with the question of the three nations referred to above. It includes some useful tables of early linguistic variations, and remarks on these, together with an account of the difference between Wessex and Kent in respect of the various classes of the community and their wergelds.

The very hypothetical character of Mr. Chadwick's inquiry does not do full justice to the great mass of interesting matter which he has brought together. A very wide range of reading and research underlies every chapter of it, and each point has evidently been the subject of much study and consideration. Many of his views are highly suggestive, and may yet lead to more certain results. In the meantime, the evidence produced does not seem sufficient to convict Bede of any essential error, or to modify in any important way the usual views on the subject.

W. A. CRAIGIE.

THE RAINFALL OF NORTH GERMANY.

Die Niederschläge in den norddeutschen Stromgebieten. By Prof. G. Hellmann. In three volumes. Vol. i., pp. vi+386+140; vol. ii., pp. viii+722; vol. iii., pp. viii+872. (Berlin: Dietrich Reimer, 1906.) Price 60 marks.

DR. HELLMANN'S three volumes contain a wealth of information relating to the rainfall and allied phenomena in the North German river basins. The principal observations are elaborately reduced, and in many aspects very fully discussed. The significance of this rainfall in its wider relation as part of the world weather, and, as such, its probable correlation with solar changes, are investigated with the advantage of well-marshalled data.

The area specifically dealt with in the volume is extensive, consisting practically of the great plain which extends without interruption from the chain of mountain ranges in south Germany to the North Sea and the Baltic. The direction of the river flow and the precipitation of the country are very largely determined by this chain of mountains, which is part of the great water-shed of Europe. The conditions of the rainfall problem over such an area would seem to be fairly simple, and capable of being dealt with in general terms. The local conditions, however, as is usual, exercise a considerable influence, the "actual" varying widely from any "mean."

The three volumes may be taken as a summary of the meteorological work of many years in the department of rainfall measurement within the district named. Its fulness and painstaking completeness is such as is expected from the efficient State-supported meteorological organisation of Germany. Much of the data is from the numerous and evenly distributed stations, daily returns from which are made immediate use of for short-date forecasting.

The first volume is general, describing and discussing the data and results. This volume is divided into five sections, of which the first, in dealing generally with the observation material and the manner in which it has been obtained, discusses the distribution of stations and the quality of the observations themselves. The recognition of the influence on these of the type and position of the gauges used is of value. Such considerations affect the credentials of the older observations, a knowledge of the standing of which allows the full length of the record to be used safely or to be rejected where untrustworthy. A long meteorological record is sometimes, like the curate's egg, merely good in parts. The ease of approximate rainfall measurement conduced to its early commencement, and very old records exist. Observations made at Breslau (1717–1727) gave an annual mean of 576 mm., which does not differ greatly from the modern value of 567 mm. A valuable bibliography of the history of rainfall measurement concludes this first part.

The amounts of rain and their reduction and intercomparison are next dealt with. The influence and value of smoothing curves by taking means is illustrated both by actual curves and by tables. Means for several stations, for periods varying from five to forty-five years, together with the "greatest differences" in each set of means, are obtained and compared. The standing of short-period means and the necessity of taking a long period to obtain a normal value become clear. A valuable table of monthly seasonal and annual means, both actual and percentage of mean year, is given in the text for nearly 100 stations. The distribution of rainfall in the year, from ten- and twenty-year means, is discussed and illustrated by curves for Königsberg and Stettin. Abnormal rains and thunderstorms are considered at some length, while material for further discussion is given in tables of great detail.

The reduction of the data is further extended in the next section of the volume to the problem of the determination of the expectancy of greatest rainfall and the probability of the number of rainy days of definite intensity. Various mean curves are used depending on periods of observation of from nineteen to forty-three years. Snowfalls are dealt with in re-

lation to snowy days, and their number and distribution throughout the year are illustrated, as usual, with compact tables of mean values for a large number of stations. Mean first and last snowfalls, here effectively tabulated, are important factors in the estimation of the climate of any place.

To this point the work deals with general conditions and mean values drawn from the long and trustworthy records discussed. In the sequel, that most obvious fact about rainfall, its variability, receives attention. The outstanding and apparently abnormal features are discussed, and a very complete list of dry and wet seasons from 1851–1900 is here available for critical investigation. The attempt to correlate these changes with larger variables, cyclic or otherwise, is a most important work. The rainfall, considered in relation to the well-known sunspot period, seems to indicate that periods of maximum precipitation are bound up with maxima of sun's spotted area. The author, however, is not able to consider these directly related as cause and effect, while he suggests that Sir Norman Lockyer's views as to the importance of prominences and allied phenomena may be nearer the true relation. The reader is specially referred to Sir Norman Lockyer's "Report on Simultaneous Solar and Terrestrial Changes" as best setting forth the general relationship between these two classes of phenomena.

The second and third volumes contain tables of data arranged under observing stations in the river basins.

The work is a monument to the value of scientific organisation and industry, and illustrates the high worth of collecting long, trustworthy, and continuous meteorological records.

OUR BOOK SHELF.

The Zoological Record. Vol. xlii. Being Records of Zoological Literature relating chiefly to the Year 1905. Edited by D. Sharp. (London: Zoological Society, 1906.)

WITH this volume ends, at any rate for the present, the series of this invaluable work with which we have been so long familiar, for next year the amalgamation with the zoological section of the International Catalogue of Scientific Literature is to commence. One effect of this change will be to make a radical alteration in the abbreviations employed for the titles of zoological serials, a change which, from the point of view of the working naturalist, is distinctly to be deplored. Whether the new arrangement will give that relief to the recorders to which the editor alludes so confidently in the preface remains to be seen.

In the main, the present volume follows the same lines as its predecessors, and displays the usual high level of excellence. By a rigorous system of cutting down, it has, however, been found practicable to make a considerable reduction in the number of papers in the general section.

Owing to the retirement of one old and experienced member of the staff, it has been necessary that a new recorder should undertake the sections dealing with reptiles (inclusive of amphibians) and fishes, and it is unfortunate that the editor has not apparently realised that this new member of his team required more attention than the old stagers. To allude to a tithe of the serious and misleading errors in these two sections would be impossible, and we can only indicate a few of the most glaring. Geography seems a very weak point with this recorder. In the fish section, for instance, the Rio Negro is placed in Africa, while the eastern seas of the Russian Empire are included in Europe. Arabia in the reptile section comes under the heading of Africa, while in the fish section Muscat and Oman are placed in Asia. "Ophidia," too, is so placed and printed on p. 27 of the reptile record as to convey the idea that it stands for a country. It should also have been explained that "Riu-kiu" is the Chinese equivalent of "Liu-kiu" or "Loo-choo."

As to misprints, it might almost be said that their name is legion; but, as examples, it must suffice to notice *Epiorates* for *Epicrates*, *gandryi* for *gaudryi*, *Hoodwell* for *Hordwell*, *Malaclemmys* for *Malaco-clemmys*, and *Tyrranosaurus* (repeated in the list of new genera) for *Tyranosaurus*. In the case of a large number of new species of reptiles the localities are omitted, while many papers quoted in the title-list are not referred to in the subject-index. None of the genera included in the Percidæ really belongs to that group.

The other recorders seem, for the most part, to have done their work well, although it would have looked better if the somewhat long list of corrigenda to the mammal record had not been required.

R. L.

The Principles of Horticulture. A Series of Practical Scientific Lessons. By Wilfred Mark Webb. Pp. 136. (London: Blackie and Son, Ltd., 1907.) Price 2*s*.

THE experience of the author as a former teacher and demonstrator in the Essex County Council School of Horticulture has served him in good stead. He puts a plant into the hands of the pupil, shows him how to study it, indicates to him what there is to be learnt from it, both as to external form and internal function, and having thus rendered help in the preliminary stages leaves the pupil to make himself master of further details by his own exertions.

We rather doubt the advantage of beginning microscopical work at so early a stage, and should prefer to defer the investigation of the minute anatomy of a plant until the pupil has become familiarised with the facts of morphology. The search for sieve-plates and companion cells might well be left until the pupil has familiarised himself with morphology and classification. Stress is very properly laid on the importance of drawing, as every student soon finds the great help of sketches of even the roughest kind, provided that they show what the draughtsman saw or intended to see. Accuracy of detail rather than artistic effect is what should be aimed at, and it is a matter of surprise to see the excellent representations which pupils make after very little practice. The illustrations in the present book afford a good example of our meaning; they show what they are intended to show, though they are not pictures. A list of the natural families, arranged according to the system of Engler, is given. For the purposes of the beginner it would, we think, have been better to have picked out some dozen or score of the most important orders, and to have omitted a mass of detail not required by the average student and not full enough for those who desire more complete information.

A section is devoted to the insects which prey upon plants, and to the measures to be taken for the destruction of these pests, as well as of fungi. That the book is up to date may be gathered by the references to Mendelism and De Vries.

A copious index is given, as well as hints as to the way in which examination questions should be answered.

A little more information as to the "reason why" of digging, watering, striking cuttings, and other garden operations would have increased the value of the book, which nevertheless is one which can confidently be recommended to the attention of all those interested in gardening.

Dr. Schlich's Manual of Forestry. Vol. iv. Forest Production. By W. R. Fisher. Being an English adaptation of "Der Forstschutz," by Dr. Richard Hess. Second edition. Pp. xxiii+712. (London: Bradbury, Agnew and Co., Ltd.)

THIS volume is the second edition of Prof. Fisher's "Forest Protection," and is uniform with the third edition of vols. i., ii., and iii. of Dr. Schlich's "Manual of Forestry." The book is an English adaptation of Dr. Hess's "Forstschutz," that is, it is not a mere translation, as the author has exercised discretion in his selection of material in order to make the book more adapted to the use of British and Indian foresters. New illustrations have also been added which are not in the German edition. The subject of forest protection is of immense importance, and covers a wide field of knowledge, practically including every branch of scientific sylviculture. The author has arranged and presented the various protective measures to be adopted against inimical agencies, both in the organic and inorganic worlds, in a very clear and interesting manner. The volume also contains a useful index at the end. Prof. Fisher has done valuable work by rendering available to student and forester a vast store of information which has hitherto been accessible only to a few. The book is one which we can warmly recommend to all those who have forests or trees under their charge.

The Essentials of Histology, Descriptive and Practical. By Prof. E. A. Schäfer, F.R.S. Seventh edition. Pp. xi+507. (London: Longmans, Green and Co., 1907.) Price 10*s.* 6*d.* net.

THE fact that this volume has reached its seventh edition shows conclusively that it supplies a want. The features of the present edition are the introduction of colouring in the illustrations and a considerable increase in the part devoted to the nervous system. In this portion practically a new set of illustrations appears, which can only be described as admirably calculated to indicate the salient points which the elementary student must be familiar with. Either for the purely scientific or for the medical student this book will continue to be of the highest value.

Actualités scientifiques. By Max de Nansouty. Pp. 361. (Paris: Schleicher Frères, 1906.) Price 3.50 francs.

THE general character of this annual publication was described in noticing the issue for 1905 in NATURE of November 23, 1905 (vol. lxxiii., p. 76). The short essays on scientific subjects of current interest range over most branches of science, and should be useful as reading exercises in French classes in schools where the pupils also learn something of science.

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.*]

A Hydraulic Analogy of Radiating Bodies for Illustrating the Luminosity of the Welsbach Mantle.

THE device about to be described enables us to illustrate to a class the behaviour of different types of radiating bodies when introduced into a flame, and will be found especially useful in explaining the remarkable luminosity of the incandescent mantles used in modern gas-lighting. It is, of course, not intended to explain the mechanics of radiation, but merely to enable us to describe certain phenomena in terms of easily grasped notions.

Students are told that the more powerfully a body absorbs the more powerfully will it emit when heated, this relation holding for every individual wave-length. Black bodies, then, give out the most light when heated. The fact that a white block of lime is far more luminous than a carbon rod when heated in the oxyhydrogen flame is not usually cited in support of this law, while the fact that the most luminous body of all, the Welsbach mantle, is also quite white, is equally unsatisfactory as an illustration, for white bodies are in reality transparent, that is, they are made up of masses of small transparent particles, and transparent bodies ought not to emit at all. It is, of course, necessary to define just what we mean by transparency in this case, and it may be well to consider first a somewhat analogous case. The absorption which is accompanied by high emissivity is true absorption, and not selective reflection, which is sometimes confused with absorption. A highly reflecting polished metal surface is a poor radiator, but by properly constructing its surface we may give it the power to absorb and emit. A bundle of polished steel needles with their points all turned towards the source of light reflects scarcely any light at all, the rays undergoing multiple reflections between the conical ends of the needles. Such a bundle of needles should emit much more powerfully than a polished steel surface, and it is easy to see just why it should do so. Each needle, seen end on, sends not only emitted light to the eye, but reflects rays coming from its neighbours. The surface formed by the points of the needles can be regarded as an absorbing surface, which absorbs in virtue of its structure; it is analogous to the hollow "black bodies" with which we are now familiar. The point which I wish to emphasise is that such a surface, which absorbs not at all in virtue of its molecular nature, is also a powerful radiator, the mechanism by which its radiating power has been increased being as indicated above.

Suppose, now, we take a perfectly transparent body, which, like a perfect reflector, has no emitting power. A bead of microcosmic salt (sodium pyro-phosphate) heated in a blast lamp is a good example. Though the platinum wire which supports it glows with vivid incandescence, the bead remains perfectly dark. A glass bead, however, emits a good deal of light, doubtless from the fact that its transparency is much less at high temperatures, a very common behaviour of transparent substances. The microcosmic salt on cooling becomes traversed by hundreds of cleavage planes, which give it a milky appearance. On re-heating it it emits light strongly, until it finally fuses into a transparent drop, when it instantly becomes dark again. The reason for this behaviour is not quite so apparent as in the case of the needles. In fact, I am not quite sure that I understand it at all. Quartz behaves in the same way. A drop of clear fused quartz, heated in the blast, emits little or no light, but if it contains spots made up of an emulsion of quartz and air, these spots emit strongly. In other words, an opacity resulting from a pulverisation of the transparent medium seems to be accompanied with a strong emitting power. Apparently we cannot apply the same reasoning as in the case of the needles, and it looks rather as if the radiation was largely a surface effect. If this is so, it is obvious that an

increase of the surface, by enclosures of air, will increase the radiating power. It is my intention to make some measurements of the intensity of the light radiated from the ends of long and short cylinders of red-hot glass.

The hydraulic analogy of radiating bodies which we will now consider occurred to me during a lecture on radiation, and proved quite useful in explaining the different behaviour of various types of radiators.

The radiator is represented by a tall hollow cylinder, open at the top and closed at the bottom, provided with a number of outflow pipes of different sizes as shown in Fig. 1. Water flows into the cylinder at a certain definite rate from a horizontal pipe or flume, the height of which above the base of the cylinder (T_2) represents the temperature of the flame. Obviously the level of the water in the cylinder will rise until the rate at which the water flows out exactly equals the rate at which it flows in. This height (T_1) is the temperature which the radiator acquires in the flame. The jets of water which issue from the tubes represent radiation of different wave-lengths, the small jets representing the short waves.

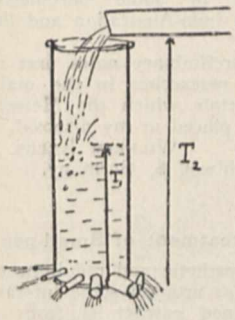

FIG. 1.

We will first suppose our hydraulic radiator to represent a black body, say a lump of carbon. In this case all the pipes at the bottom are wide open, and we have the maximum outflow of all wave-lengths for any given temperature, *i.e.* for any given height of the fluid within the cylinder. If we take the cylinder empty and plunge it into water, jets will squirt into it through the pipes, that is, it is a perfect absorber for all wave-lengths. With all the pipes open, however, the level of the water within the cylinder will not rise to any great height, owing to the limited rate at which water flows in from the horizontal pipe. This means that the lump of carbon in the flame does not rise to a very high temperature because it radiates energy at a high rate. At the low temperature there is comparatively little visible light in the radiation, for the shorter waves only appear in quantity at high temperatures. We can imitate this condition in our hydraulic model if we choose by putting valves on the inside of the tubes, those on the small tubes opening only at high pressures.

To make our model imitate the bead of microcosmic salt we plug up all the pipes. The cylinder now represents a transparent body. If immersed in water it absorbs nothing through the pipes, and no matter how high the level of the water rises in it there is no emission of fluid, in other words, no radiation. The body rises in temperature until the temperature is equal to that of the flame, but there is no radiation. Take next the case of the lime in the oxyhydrogen flame. It is a partially transparent substance, and we can imitate it by plugging the tubes with glass beads or cotton. Owing to the lesser rate at which the water now flows out through the tubes, the level rises much higher than when the tubes are all open, and owing to the greater pressure (temperature) we have liquid jets through the small tubes (short wave-length radiation). The inferiority in the emissivity is more than made up for by the higher temperature which the body can acquire. We are now ready for the Welsbach mantle.

It has been conclusively shown by Rubens that the peculiar brilliancy of the thorium mantles, caused by a small trace of cerium, is due to the fact that the cerium makes the thorium selectively absorbing for the short waves at high temperatures. If we wave a Bunsen flame over a mantle in a brilliantly lighted room, it will be seen to turn yellow at a temperature a little below a red heat. In other words, it becomes a strong absorber for the short waves. It is, however, transparent for the long waves, consequently it does not emit energy at anything like the rate at which a black body does, and in consequence can rise to a high temperature in the flame, exactly as a pure thorium mantle. Its band of absorption in the blue region enables it to pour out visible radiations nearly as powerfully as those which a black body at the same temperature would emit, hence its enormous brilliancy. Our hydraulic model, with its tubes all plugged with cotton, represents the mantle of pure thoria, while to transform it into the Welsbach mantle we have only to pull out the porous plugs from some of the smaller tubes. In this condition, owing to the impeded flow in the large tubes, the water will rise in the cylinder to a great height, and we get very powerful jets from the small tubes which we have opened, much more powerful than in either of the previous cases considered. Of course, with all the tubes open we could get equally intense small jets if we poured the water in at the top at a sufficient rate. There is a limit to this rate, however, for it is obvious that the rate at which the water is poured in at the top corresponds to the rate at which the flame can pour energy into the radiating body, a circumstance which depends on the conductivity of the body for heat and other things.

It is not necessary to make the hydraulic apparatus, of course, for its action is so easily understood that a diagram answers every purpose. Its utility lies in the fact that it fixes in the mind of the student the behaviour of different types of radiators when plunged into a flame.

It could be made, perhaps, to illustrate the displacement of the point of maximum energy in the spectrum which accompanies a rise in temperature, but it is doubtful whether any such complications would prove beneficial. It seems best, on the whole, not to try to illustrate too much with it, as its relation to a radiating body is at best rather far-fetched.

R. W. WOOD.

Johns Hopkins University, Baltimore.

Retardation of Electroscopic Leak by means of recognised Radio-active Substances.

IN a communication made to the Royal Society on April 5, 1906, and subsequently published in the "Archives of the Middlesex Hospital," vol. vii., I described certain experiments which I regarded as showing that substances exist which retard the leak of an earthed metal electroscope. I further asserted that an aluminium plate which had been kept in proximity to, but not in contact with, uranium, thoria, or pitchblende, also retards the electroscopic leak. This retardation does not necessarily occur immediately after introduction of the modified aluminium plate into the electroscope, for after proximity to thoria there is a period, lasting three or four days, during which the leak is accelerated, and after proximity to radium I failed to find any evidence of retardation whatever. My results were received with scepticism, except by Sir William Ramsay, who had independently observed the same phenomenon in his laboratory. It is impossible to occupy your space with details, but it may be stated that gold-leaf electroscopes made of $\frac{1}{8}$-inch lead were used, that the earthing of electroscopes and aluminium was complete, that effects of induction and alteration of capacity of the electroscope were eliminated, and that the general conditions were kept as constant as possible.

Since reading the paper I have repeated the experiments in the most stringent way of which I am capable in a pathological laboratory, and have obtained identical results. Further, using the same apparatus, I have exposed the aluminium plates to X-rays for a period of three hours, and have found a complete absence of any change in the rate of leak, whether in the direction of retardation or of acceleration. Full details of these experiments will be published in the forthcoming number of the Archives of the Middlesex Hospital. Below I give the salient points of an experiment which was carried on continuously from August 10 to December 24, with the exception of intervals August 27 to September 11, and September 19–30, during both of which the electroscopes were left undisturbed. The values given represent percentages of the mean leak of the electroscope during twenty-four hours under normal conditions corrected by the leak of the control electroscope on the day for which the observation is given.

Lowest corrected percentage during period August 10 to

October 12 (standardisation period)=84·8. On nine out of thirty-five observations during this period the corrected percentage was below 90.

Lowest corrected percentage during two blank experiments, each lasting twelve days=89·1. On one out of twenty observations during these two periods of blank experiment the corrected percentage leak was below 90.

Lowest corrected percentage during period November 7–17, after two days' proximity of the aluminium plate to pitchblende=81·9. On ten out of eleven observations during this first period of true experiment the corrected percentage was below 90.

Lowest corrected percentage during the period November 21 to December 24, after a two days' re-approximation to pitchblende=79·5. On thirty-one out of thirty-five observations during this second period of true experiment the corrected percentage leak was below 90.

W. S. LAZARUS-BARLOW.

Cancer Research Laboratories, The Middlesex Hospital, W., April 3.

Atmospheric See-Saw Phenomenon and the Occurrence of Typhoon Storms.

IN January last there was a very noteworthy barometric change agreeing in a high degree with the results of those synodal pressure periods which have been affirmed for European latitudes by the statistical investigations of two German meteorologists, Captain K. Seemann and Dr. G. Meyer. These results require high pressure at the time of the first quarter and low pressure at the time of the full moon, especially in the months from September to January. Last January was also in a synodal respect marked by its elliptical character; so it agrees accurately with those requirements, the first date (January 21) nearly coinciding with a record of high pressure in northern, central, and eastern Europe, and the latter date (January 29) with a decidedly low pressure. The conditions on the following first quarter (February 20) were completely reversed, for on this date there was a remarkable record of low pressure in the above parts of the earth-atmosphere.

This direct reversal of the pressure conditions of January was sufficient to excite the suspicion of a kind of see-saw phenomenon. This suspicion has been confirmed by a synoptic investigation of the barometric conditions over the whole earth, so far as information is at present available. The isobar of 760 mm. surrounded on February 20 the greater parts of Europe, the North Atlantic, and North America. The whole area contains more than 50,000,000 square km., nearly one-tenth of the whole surface of the earth; but it soon became possible to prove that an area of very high pressure also existed on February 20. This area had its centre over Transbaikalia. The weather report of St. Petersburg records on that day barometric observations from Chita of 789·8 mm., from Nerchinsk of 785·0 mm., and from Irkutsk of 783·4 mm. In Chita and Nerchinsk the barometer was ascending from February 19 to February 20. It is possible, too, that those tabulated barometric readings were too low. In the same reports the maps of January 22–23 show areas of more than 800 mm.; but in the tables the readings of all stations, including the stations situated in those areas, are below 800 mm.

This record day of high pressure, examined in the same manner, shows a much more widely spread area of pressure over 760 mm. than the area in which the readings of February 20 were under 760 mm. The high-pressure area of January 23 seems to contain nearly the whole of Europe, the greater parts of Asia and America, the Northern Atlantic, the Chinese and Indian Seas. Mostly below 760 mm. apparently were the continents of Australia and Africa and south-western Asia. The whole area of high pressure contained about 157,000,000 square km., nearly one-third of the surface of the earth.

To the east of the Japanese islands, from Formosa to Yeso, there were some depressions below 760 mm. and 763 mm. which had shown on the previous days more or less a typhoon character. Zikawei recorded on January 23 an area below 754 mm. between 22° and 30° N. lat. and east of 140° E. long. The very lowest barometric reading of the same day is recorded—so far as there is information—in South Argentina, C. Virgenes in N.E. Tierra del Fuego showing a pressure below 750 mm.

The atmospheric conditions prevailing on January 23 over the N.W. Pacific point to a possible connection of the pan-atmospheric see-saw phenomenon with typhoon storms. Indeed, the extreme depressions of these storms seem able to exercise an influence on the common atmospheric situation. Further, the most frequented typhoon areas nearly coincide geographically with the two areas of contrary see-saw, as these areas are ascertained by my method of qualitative analysis of some barometric diagrams. The two areas are the Indo-Australian and the Central American regions.

I feel bound to publish these preliminary notes first in an English journal, because my researches in the main were made possible by the materials which the Meteorological Office in London liberally placed at my disposal.

WILHELM KREBS.

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Early Reference to Red-light Treatment of Small-pox.

THE use of blue light as an anæsthetic and red light to prevent marking from small-pox has aroused some interest within recent times. The subjoined extract is from a footnote in Miss Strickland's history of Queen Marguerite of France, and was first published in 1839. According to this quotation from Gaddesden, the red-light treatment would seem to have been known in the days of Edward the First.

ALFRED SANG.

Garland Nut and Rivet Co., Pittsburg, Pa.

WHILE music and sculpture had attained some degree of perfection in England at this time, other arts and sciences were in a strange state of barbarous ignorance. The earliest notice of medical practice is to be found, at this era, in the Latin work of Gaddesden, physician at the court of Queen Marguerite. This learned doctor, describing his treatment of Prince Edward in the small-pox, thus declares his mode of practice:—"I ordered the prince to be enveloped in scarlet cloth, and that his bed and all the furniture of his chamber should be of a bright red colour; which practice not only cured him, but prevented his being marked." More by good luck than good management; assuredly, it may be supposed that Gaddesden wished to stare the red inflammation of the small-pox out of countenance, by his glare of scarlet reflections! He adds in his Rosa Anglorum that "he treated the sons of the noblest houses in England with the red system, and made good cures of all." In this childish state was the noble art of healing at the court of Marguerite.

The Lyrid Meteors.

THERE are other nights besides the usual ones of April 20–22 on which it is desirable that a watch should be maintained for these meteors, and in the present year there are three dates that call for special attention in this respect, viz. those of April 14, 18, and 23, as from calculations made by the present writer showers become due on these nights, though it will not be possible, owing to the hours of their occurrence, to observe them all from the same station. Probably, so far as direct observation is concerned, the general Lyrid maximum will fall on the night of April 23, as its special periods of activity will favour more observers than in the case of the other two displays.

The following are the computed times of the various maxima of the anticipated showers:—

April 14, 7h. and 9h. 30m. G.M.T.
April 18, 3h. 30m. and 7h. G.M.T.
April 23, 8h. 30m. and 14h. G.M.T.

The moon will hinder observations most on the night of April 23, but if this night turns out clear, some fine meteors will probably be observed.

JOHN R. HENRY.

GYROSCOPIC APPARATUS FOR STEADYING SHIPS.

IN our account of the recent meeting of the Institution of Naval Architects (NATURE, March 28, p. 522) reference was made to the paper read by Sir William White in which he gave particulars of certain experiments carried out on the estuary of the Elbe by means of a torpedo-boat, the *Seebar*, in which Dr. Otto Schlick's gyroscopic apparatus was fitted. In our report of the meeting we stated that we should return to the subject, and this we now proceed to do.

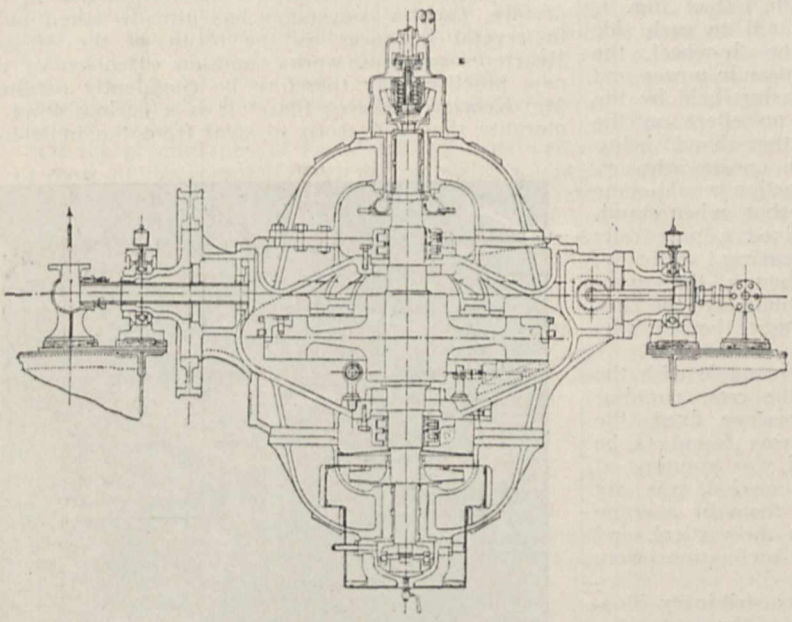


FIG. 1.—Details of steadying apparatus on s.s. *Seebar*. Scale about 1/25th full size.

It may be remembered that three years ago Dr. Schlick read a paper at the spring meeting of the same institution on the gyroscopic effect of fly-wheels on board ship, and at the same period he illustrated, by means of models, the system of steadying vessels which he had brought forward. The models were, as Sir William White pointed out, of small inertia compared to the inertia of the gyroscopes mounted in them, and the steadying effect was, therefore, more marked than it would be under the conditions of ordinary working with ships or boats. In these circumstances it is perhaps hardly surprising that a good many persons connected with seafaring looked on Dr. Schlick's apparatus as outside the region of useful application; in fact, it would not be an exaggeration to say that the idea was largely considered to be a very pretty scientific "fad."

Dr. Schlick, though a man of science, is by no means a "faddist"; as the position he holds in the German mercantile marine, and the substantial contributions he has made to the advancement of marine engineering practice sufficiently show, and he determined to prove the soundness of his theoretical investigations by experiment on a practical scale. To this end he acquired the *Seebar*, formerly a first-class torpedo-boat, 116 feet long, 11·7 feet wide, 3·4 feet draught, and of fifty-six tons displacement. Her metacentric height was 1·643 feet, and her period of oscillation (double roll) 4·136 seconds. Into this vessel was fitted the gyroscopic apparatus, of which we give a sectional elevation in Fig. 1. The following are the main particulars:—the outside diameter of the fly-wheel was 1 metre, the weight, without the spindle, 1106 lb., and the peripheral velocity at which it was run 274·8 feet per second, the number of revolutions being 1600 per minute. The fly revolved on a vertical spindle, and was of forged steel; it was enclosed in a cast-iron case, the latter being supported by two hollow trunnions, the common axis of which was in a 'thwartships direction, as shown in Fig. 1. It would have been preferred to have used electric power to revolve the fly-wheel, but as generating machinery was not fitted it was determined to use steam direct, and for this purpose blades were fitted to the periphery so as to work the fly-wheel as if it were a turbine, steam being admitted through the hollow trunnions. For this reason the peripheral speed was less than it would have been had electricity been the motive power, and the weight was consequently greater for the production of an equal gyroscopic effect.

It will be assumed for the purpose of this description that the principle of gyroscopic action is known so far as it is generally understood, but those who wish to refresh their memories on this matter would do well to refer to Dr. Schlick's paper in the Transactions of the Institution of Naval Architects for 1904. The common centre of gravity of the whole apparatus was, in the *Seebar*, below the axes of the trunnions with the vessel at rest, and the spindle therefore vertical. On rolling motion being set up the spindle would be free to become inclined from the vertical in a fore and aft direction, and, as rolling proceeded, the gyroscopic effect of the fly-wheel would produce longitudinal oscillations of the apparatus having a period depending upon the distance of the centre of gravity below the axes of the trunnions and upon the moment of inertia of the apparatus

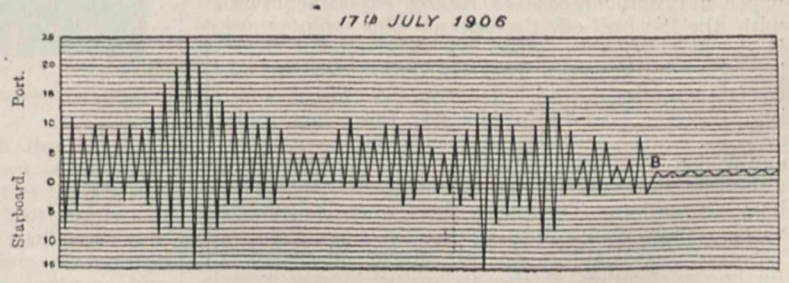


FIG. 2.—Diagram of Oscillations of s.s. *Seebar*.

about the axis. The amplitude of oscillation of the gyroscope, as Sir William White proceeded to point out, depends upon many conditions, among which the period of oscillation and its ratio to the period of rolling of the vessel are important.

In order to utilise the gyroscopic effect in checking rolling it is necessary to have a means of braking the apparatus so as to check movement on its trunnions and the rotary motion of the fly-wheel. To control the swinging motion a simple band-brake was fitted, the drum for which is shown on the left of Fig. 1. In addition to this a socket was fitted on each side of the gyroscope casing below the fly-wheel, the braking effect being supplied by hydraulic power and regulated by a valve. With the casing held by the brake the gyroscope would have no effect on the rolling motion, but on the friction band being loosened the casing would oscillate on its athwartship trunnions, and the gyroscopic action would come into play. Sir William White says that, when standing upon the deck, which maintained a practically horizontal position, the vessel heaving vertically, it was curious to notice that though the gyroscope might be oscillating longitudinally the impression was conveyed that the vessel herself was pitching.

Still-water rolling experiments were made with the *Seebar*, rolling being set up by the crew running from side to side. With the gyroscope fixed, the period of a complete double roll was found to be 4·136 seconds. When the fly-wheel was running at 1600 revolutions per minute, the period was six seconds. The boat was next hove down by a crane to an inclination of 10° to 15° from the vertical, and when let go the successive extreme inclinations were noted until they fell to about ½°.

The still-water rolling experiments strikingly illustrated the enormous extinctive effect of the gyroscope, as shown by a diagram given by the author of the paper. Selecting two experiments for illustration, it was found that with "an initial angle of inclination of 10° with the gyroscope at rest 20 single oscillations took place before the extreme inclination to the vertical was reduced to half a degree; whereas the same amount of extinction was obtained with little more than two single oscillations when the gyroscope was free to oscillate and the fly-wheel was rotating at 1600 revolutions per minute."

In Fig. 2 we reproduce from Sir William White's paper a graphic record of rolling experiments made with the *Seebar* off Cuxhaven. The point marked B denotes the time when the brake band was released, the gyroscopic wheel becoming free to swing on its trunnions, and the extinctive forces coming into action. The revolutions were 1600 per minute, and, as will be gathered, the practical result was to extinguish the rolling motion almost immediately, although the vessel was naturally still subject to heaving motion. The inclinations were insignificant, varying from about ½° to 1°.

Sir William White in his paper discussed the further application of the apparatus to war vessels, and though he did not commit himself to any definite opinion, it may be said that the impression given was decidedly of a hopeful nature. In connection with this subject the experiments of Sir John Thornycroft with his steam yacht, the *Cecile*, and those of the late Mr. Beauchamp Tower with his hydraulic steady gun platform controlled gyroscopically, will doubtless be remembered. Particulars of both series of investigations are to be found in the Transactions of the Institution of Naval Architects.

G. R. DUNELL.

BRITISH NESTS AND EGGS.[1]

THIS handsome and exquisitely illustrated volume (which is practically a new work, so greatly does it exceed its predecessor in bulk and in wealth of illustration) makes its appearance, no doubt purposely, at an opportune time, and if it induces but half-a-dozen collectors in the coming season to devote their attention to photographing the nests of our native birds in place of robbing their eggs, it will have done a great service to British ornithology. According to the letter of an admirer quoted in the preface, such a conversion has already taken place in several instances as the result of the Messrs. Kearton's previous works, and an extension of the new practice may therefore be confidently awaited. Mr. Kearton observes that "it is a curious kind of morality that will scorn to steal from the individual

Ptarmigan on Nest. From "British Birds' Nests."

and yet rob the community without compunction. Wild birds are national property, and no individual has a right to harm one of them without the sanction of the law to do so." Although this is, no doubt, to a great extent true, it must be remembered that by nature we are all essentially hunters and spoilers, and as many of us, at any rate, have not yet fully imbibed the socialistic spirit, it would not do for the present to be too hard on the egg-collector if he conducts his operations with moderation. *Festina lente* is an admirable motto in this and many other matters.

As regards the book itself, a critic is frequently embarrassed as to what he should write from the intrinsic badness of the work set before him; in the present instance the reverse of this is the case, and

[1] "British Birds' Nests, How, Where and When to Find and Identify Them." By R. Kearton. New edition, revised and enlarged. Pp. xii+520; illustrated. (London: Cassell and Co., Ltd., 1907.) Price 21s. net

the reviewer scarcely knows how to control his pen so as not to appear unduly laudatory. To say that the book is practically perfection is a mild way of putting it, for, as a matter of fact, it is one that can never be equalled or rivalled so long as the copyright of its illustrations holds good, since no other man is likely to undertake the labour and expense necessary to produce a similar series of pictures from nature, even if he had the energy and patience necessary to the task. How great a debt ornithologists and bird-lovers generally owe to the Messrs. Kearton (for a large number of the photographs have been taken by the author's brother, Mr. Cherry Kearton) it is, indeed, impossible to estimate, and a part of their reward, at any rate, must consist in the pleasure they afford to, let us hope, an ever-widening circle of readers.

Of the photographs of nests and eggs, as well as of those of the parent birds, it is impossible to speak too highly, and where all are on such a high level of excellence it would be almost invidious to select any for special commendation. The one here reproduced has been chosen on account of its size rather than from any other consideration. The plates of eggs are admirable examples of the best style of three-colour process. Taken as a whole, the volume (which is a marvel of cheapness) will probably prove the most attractive natural history book of the year.

THE ORIGIN OF "BOTTOM WATERS" IN THE NORTHERN SEAS.

A SERIES of valuable tables and charts, in which the results of a great series of observations made in 1901 by Captain Roald Amundsen in the Arctic Seas are summarised, is contained in a monograph recently published.[1] These observations are supplemented by, and compared with, results published by other observers, chiefly Russian and Norwegian, and as a collection of facts the little volume is certain to prove of great value to all students of oceanography. Dr. Nansen's main purpose in the discussion of the observations has been the scientific explanation of the origin of the intensely cold and heavy "bottom waters" found in the basins of the Norwegian seas and North Polar Ocean. In discussing the scientific results of the Norwegian North Polar Expedition of 1893–6, Nansen had already dealt with this subject, and reached the provisional conclusion "that the cold bottom water of the Barents Sea is divided into two portions; the northern cold water coming from the sea to the North, North East, and East; and the southern cold water having two or three sources, namely bottom currents from the East and North East, and the surface of the sea itself which is cooled during the winter." In the light of more recent and extensive observations, Nansen has revised his opinion, and puts forward a different explanation of the origin of bottom water. This explanation accords with the facts observed, and may be briefly summarised.

The conditions required for the formation of bottom water are that near the surface water shall be found having a salinity of about 34·9 per cent., and that during winter this water may be cooled down to −1°·3 C. or 1°·4 C. Its density may thus be between 28·11 and 28·13, and possibly greater, so that it becomes sufficiently heavy to sink. The assumed salinity of surface water Nansen thinks will only exist in places where Atlantic water has mixed with Arctic water. Further, he considers that when bottom water is being formed there must be no rapid horizontal circulation which would bring in new supplies of relatively warm water. As the surface water becomes heavier it sinks, and will be replaced by somewhat warmer water of higher salinity, which in its turn will be cooled until it becomes heavier than the previous surface water, when it will sink still deeper, and be replaced by warmer water of still higher salinity from below. The uppermost strata will by this process be gradually increased in salinity, and approach that of the bottom water—about 34·9 per cent. The depth of vertical circulation will increase until it reaches down into the typical bottom water, and at that stage all strata from the surface downwards will have attained nearly uniform temperature, salinity, and density. Subsequent cooling at the surface will produce water so heavy that it may sink far down into the bottom water, or even to the bottom of the sea.

The heaviest sea-water of which Nansen has any knowledge was found at a depth of 120 metres—8 metres above the bottom—off the coast of Nova Zembla in May, 1900; the temperature of bottom water has in some cases approached −2° C., with a salinity exceeding 35 per cent. and a density of 28·33. The observations made extended to depths of 3000 metres, where the temperature was −1°·1 C. Amundsen reached 2000 metres, at which the temperature was −1°·3 C.

The circulation of bottom water in the Norwegian Sea Nansen describes as follows:—The bottom water is chiefly formed and sinks towards the bottom during the winter and spring in the regions between 73° and 76° north latitude, and between 4° west longitude and 4° east longitude. From this region it moves along the bottom and spreads out laterally, producing cyclonic movements in the deep strata of the Norwegian Sea. During this circulation the bottom water is slowly heated from the underlying warmer sea bottom and from the overlying warmer water. In this manner its temperature near the bottom is gradually raised from about −1°·3 C. to about −1° C. Nansen estimates that at least two-thirds of the whole basin of the Norwegian Sea is filled with cold bottom water. The renewal of the cold bottom water in the basin of the Norwegian Sea must be an extremely slow process, and it has been established by actual observation that the bottom water does not extend across the ridge anywhere between Iceland and Norway, where the temperature is nowhere below zero. Further, he thinks that it is very improbable that any bottom water with a temperature below −1° C. ever gets across the ridge between Iceland and Greenland.

For the North Polar basin Nansen considers the minimum temperature to be between −0°·8 C. and −0°·9 C., the salinity being about 35·1 per cent. If existing observations are confirmed, in his judgment the possibility of a communication between the deep North Polar basin and the deep basin of the Norwegian Sea, as well as of their bottom waters, will be finally excluded. In that case he thinks that there are two regions where the bottom waters of the North Polar basin might originate by being cooled down directly through radiation from the sea surface, namely, in the seas north of Spitsbergen and near northern Nova Zembla. Nansen is further of opinion that the renewal of the cold bottom water of the enclosed North Polar basin will occur even more slowly than the corresponding renewal in the Norwegian Sea, so that a much smaller quantity of water

[1] "Northern Waters: Capt. Roald Amundsen's Oceanographic Observations in the Arctic Seas in 1901, with a Discussion of the Origin of the Bottom-waters of the Northern Seas." By Fridthjof Nansen. Pp. 154; 11 plates. (Christiania: Jacob Dybwad, 1906.)

will be required yearly to feed the circulation of the cold bottom water in the North Polar basin.

This brief outline of the contents of this interesting memoir will give some idea of the thoroughness of its scientific methods and the great labour that has been bestowed upon them.

THE COMMEMORATION OF LORD LISTER'S EIGHTIETH BIRTHDAY.

THE eightieth anniversary of the birthday of Lord Lister occurred on Friday last, April 5. Many scientific men have had the good fortune to discover the causation of phenomena of immediate practical importance, but to few have been vouchsafed the privilege of seeing the results of their discoveries become in a few years of such enormous benefit to their fellow men as those of Joseph Lister. No man alive has by a single discovery conferred upon the whole of mankind a greater boon than did the surgeon who discovered the causation of the direful but not unusual *sequelae* of a surgical operation, viz. suppuration, septicæmia, secondary hæmorrhage, erysipelas, and hospital gangrene, and who showed that by preventing the access of bacteria to wounds all these diseases could be avoided.

It is just forty years since the first papers of Lord Lister dealing with his discoveries were published in the *Lancet*. How the best skill of the surgeon was baffled by these wound infections and the whole development of surgery prevented may be realised by a quotation from a leading article in the *Lancet* written at the time of the publication of one of Lister's earliest papers in 1867.

> The mortality of compound fractures, of amputations and operations and of lithotomy in our larger hospitals, both provincial and metropolitan, is something frightful. And the occurrence of death with symptoms of blood-poisoning is, unfortunately, not confined to cases of serious operation, but happens ever and anon in operations in themselves slight. The risk of blood-poisoning is indeed now the one great opprobrium of surgery. There is no limit to the operative feats of surgeons, but there is a miserable and serious risk in every case, especially in hospitals, of the occurrence of fatal after-consequences, against which—until now at least—we have had little or no power of resistance.

The story of the discovery of antiseptic surgery was briefly told by Lord Lister himself in the third Huxley lecture delivered in 1900. In this lecture Lord Lister explained how by the time he became a house-surgeon at University College he was already endowed with a love of physiology and a first-rate microscope. The former he owed to the inspiration of Prof. Sharpey and the latter to his father, who did so much to raise the compound microscope from little better than a toy to the powerful engine for investigation which it then was. As a young surgeon his attention was immediately turned to the study of those scourges of surgery, suppuration, pyæmia, and hospital gangrene. During the next ten years he made a number of investigations upon the early stages of inflammation and the healing of wounds. He was early led to the conclusion that suppuration and septic diseases were due to a poison acting locally, and again and again he searched with the aid of the microscope the discharges from wounds in the hope of discovering some *materies morbi* of an organised kind.

The idea that wound infections were of parasitic origin, although the parasite escaped detection, was early in his mind, so that when the epoch-making discoveries of Pasteur on the nature of fermentation and putrefaction were published, Lister was prepared to appreciate the analogy between these phenomena and those of wound infection. Guided by this analogy, he devised methods to prevent the entrance of germs to wounds, and was immediately successful in obviating the evil effects hitherto so generally attendant upon the simplest operation.

The actual methods employed have undergone some modifications and simplification in accordance with the development of knowledge during the last fifty years, but the principle to protect wounds from the access of germs "by means which shall disturb the tissues as little as is consistent with the attainment of the essential object" retains its full value at the present time.

Lord Lister has been the recipient of many honours, bestowed upon him by every civilised community, but it was widely desired that his eightieth birthday should be suitably commemorated. It was considered by some of his admirers that this could best be done by the re-publication, by subscription, of his collected work in suitable form. Invitations were accordingly issued to a number of scientific and medical men, both at home and abroad, to form themselves into a committee for this purpose. The invitations have met with a warm response, and the committee may be described as an international one.

A meeting of this committee took place on Thursday, April 4, at the Royal College of Surgeons, which was presided over by Mr. Henry Morris, the president of the college. It was unanimously resolved to ask Lord Lister to allow the committee to re-publish his scientific papers, and a small editorial committee was chosen to carry out this object. The following letter was sent to Lord Lister from the committee:—

DEAR LORD LISTER,

A desire having been widely felt that the eightieth anniversary of your birthday should be marked in some special manner, a committee of your professional brethren both at home and abroad was formed to consider in what way this could best be done.

This committee met to-day at the Royal College of Surgeons, when it was unanimously resolved to ask you to allow them to commemorate the occasion by collecting and publishing your various scientific papers in book form. In anticipation of your acquiescence, an editorial committee was appointed to carry out such publication.

At the same time, those present at the meeting wished to convey to you their warmest congratulations on this occasion, and gratefully to acknowledge the debt which the medical profession, and, indeed, the whole world, owe to you for the work which you have done. That you have lived to see such enormous advances in surgery and medicine flow from your work must be a source of great gratification to you, and the committee hope that you may be spared to see still many further advances follow therefrom.

I remain, dear Lord Lister,
Yours sincerely,
(Signed) HY. MORRIS.
President, Royal College of Surgeons, Chairman.

Lord Lister replied to the letter as follows:—

DEAR MR. MORRIS,

I duly received your letter yesterday informing me of the decision of the general committee to ask me to allow them to commemorate the occasion of my eightieth birthday by collecting and publishing my various scientific papers in book form.

This proposal is almost overwhelming in its kindness, and I expressed to the deputation which met here in the morning my profound sense of gratitude. This surpassingly generous offer is extremely gratifying to me.

Believe me,
Very sincerely yours,
(Signed) LISTER.

It is proposed to issue the collected papers in two quarto volumes of about 450 pages each. The volumes will contain a portrait of Lord Lister, and will be prefaced by a short account of the development of Lister's ideas and work and their relation to the growth of knowledge of infectious processes. They will be published at a subscription price of one guinea for the two volumes.

NOTES.

SIR JAMES DEWAR has been appointed a corresponding member of the Royal Academy of Sciences, Denmark.

THE U.S. Congress has voted 20,000*l.* for the erection of a monument to Christopher Columbus at Washington.

PROF. S. P. THOMPSON, F.R.S., has been elected a member of the Athenæum Club under the provisions of the rule which empowers the annual election by the committee of three persons "of distinguished eminence in science, literature, the arts, or for public services."

MR. J. DE GRAAF HUNTER, assistant in the physics department of the National Physical Laboratory, has been nominated by the India Office to the post of mathematical expert to the Survey of India.

THE monument erected by subscription in the garden of the Paris Institut national agronomique to Eugène Risler, the director of the institute from 1879 to 1900, was unveiled by M. Ruau, the French Minister of Agriculture, on March 24.

THE *British Medical Journal* states that a laboratory for the study of human nutrition is to be built by the Carnegie Institute of Washington on a site adjacent to the Harvard Medical School. The work will be under the direction of Prof. F. G. Benedict, of Wesleyan University.

IN many places the rainfall measured already this month is greatly in excess of the aggregate measurement for the whole of March. On the night of April 6–7 there was a somewhat heavy fall of snow over the south of England, and at Warlingham, in Surrey, the ground was covered to the depth of 6 inches. In London, snow fell for some time in the early morning of Sunday, April 7, and the rainfall as yet this month already exceeds an inch. Thunderstorms have also occurred in different parts of the country. Notwithstanding that the aggregate rainfall at Greenwich for the first three months of the year was deficient by 1·63 inches, the total for the six winter months, October–March, was 0·75 inch in excess of the average for the past sixty years.

THE earthquake at Bitlis on March 29, briefly recorded in last week's NATURE, appears to have been of unusual severity, and was registered by seismographs at several distant stations. The earthquake occurred at 10 a.m. on March 29, no fewer than fourteen severe shocks being felt on that day. Shocks stronger than the first were felt at Bitlis all night on March 31, resulting in fresh casualties and further destruction of houses. Violent shocks of earthquake were felt on April 2 in the island of San Miguel, Azores, particularly in the town of Villa Franca, which was formerly destroyed by earthquake.

THE two Royal medals of the Royal Geographical Society have been awarded, with the King's approval, to Dr. Francisco Moreno, who for more than twenty years has been personally occupied in the work of South American exploration, and Captain Roald Amundsen, the Norwegian explorer, who recently completed the North-west Passage for the first time in a ship, and made observations in the neighbourhood of the North Magnetic Pole. The Murchison bequest of the society has been awarded to Captain G. E. Smith, for his various surveys in British East Africa; the Gill memorial to Mr. C. Raymond Beazley, for his work in three volumes on "The Dawn of Modern Geography"; the Back bequest to Mr. C. E. Moss, for his researches on the geographical distribution of vegetation in England; and the Cuthbert Peek fund to Major C. W. Gwynn, C.M.G., R.E., for the geographical and cartographical work carried out by him in the Blue Nile region and on the proposed Sudan-Abyssinian frontier.

TO the long list of eminent men of science that have lately been lost to France by death must be added the name of Colonel Laussedat, for many years the director of the Conservatoire des Arts et Métiers. More than sixty years ago he began his public career in the École Polytechnique, and his long life was one of successful achievement. He served his country both in the field and in the study. During the siege of Paris he had charge of the optical contrivances for maintaining communications with the outside world, and later, at the close of the war, he was a member of the commission for arranging the new frontiers of the country. Besides filling the office of professor of geodesy, he was at different times member of many committees and numerous commissions, where his experience, knowledge, and ingenuity were gratefully acknowledged. But it is in the department of photography and in its applications to scientific purposes that he will be longest remembered. If he did not originate the application of photography to surveying and photogrammetric inquiries, he so encouraged its employment, improved its methods, and demonstrated its usefulness that he won for it a foremost place in the training of every modern topographer. Colonel Laussedat was a member of the French Academy and of many learned societies in his own and other countries.

AS previously announced, the annual meeting of the Iron and Steel Institute will be held on May 9 and 10. At the opening meeting, the retiring president, Mr. R. A. Hadfield, will induct into the chair the president-elect, Sir Hugh Bell, Bart., the Bessemer gold medal for 1907 will be presented to Mr. J. A. Brinell (Stockholm), and the president will deliver his inaugural address. Among the papers to be submitted on May 9 and 10 are the following:—The use of steam in gas-producer practice, Prof. W. A. Bone, F.R.S., and R. V. Wheeler; the influence of process of manufacture on some of the properties of steel, F. W. Harbord; the ageing of mild steel, C. E. Stromeyer; carbon-tungsten steels, T. Swinden; the nomenclature of iron and steel, report of a committee of the International Association for Testing Materials. Reports on research work carried out during the past year will be submitted by C. A. F. Benedicks (Sweden), O. Stutzer (Germany), E. F. Law (London), E. Hess (United States), P. Breuil (Paris), H. C. Boynton (United States), L. Guillet (France), W. H. Hatfield (Sheffield), A. Campion (Glasgow), E. G. L. Roberts (London), E. A. Wraight (London), and W. Rosenhain (Teddington), Carnegie research scholars. The annual dinner of the institute will be held in the Grand Hall of the Hotel Cecil on May 10, under the presidency of Sir Hugh Bell, Bart. The council has accepted an invitation to hold the autumn meeting of the institute in Vienna on September 23–25. After the meeting there will be alternative excursions to

Bohemia and Styria, by invitation of the Prague Iron Industry Company and the Austrian Alpine Mining Company respectively. An invitation has also been received from the Witkowitz Mining and Ironworks Company to visit their works.

IN an elegant little pamphlet entitled the "Birdland Booklet," Messrs. Sanders and Crowhurst direct the attention of amateur photographers to the advantages of their reflex birdland camera.

MOST of the articles in Nos. 5 and 6 of the *Bulletin International de l'Académie des Sciences de Cracovie* for 1906 relate to physiological and chemical subjects, but Mr. Vl. Kulczynski contributes a continuation of an account of certain arachnid groups, dealing in this instance with the European representatives of the genus Amaurobius. The article, which is in Latin, is illustrated with two plates, and contains descriptions of twenty species, one of these being new.

A SPECIMEN of the so-called "sea-mignonette" (*Primnoa reseda*), dredged in the Færöe Channel, has enabled Prof. J. A. Thomson, in the Proceedings of the Royal Physical Society of Edinburgh, vol. xvii., No. 2, to state that this gorgonian is one of the most gorgeously coloured members of the British fauna, being naturally a brilliant salmon-pink, although the tints rapidly fade after exposure to light. Prof. Thomson has also discovered that this species, the only member of its genus, is viviparous.

THE appearance of the first part of a work entitled "The Book of the Open Air," edited by Mr. Edward Thomas and published by Messrs. Hodder and Stoughton, may apparently be taken as an indication of an increasing appetite on the part of a considerable section of the public for anything connected with country life and popular natural history. The illustrations, of which fifty are promised, are all to be coloured, and the work is to be completed in a dozen shilling parts. The illustrations of scenery in this part are simply exquisite, and, even though the naturalist may consider those of animals a little too "artistic" in colouring, if the present standard is maintained the volume will be a marvel of cheapness. The names of Messrs. W. H. Hudson and J. C. Tregarthen are alone sufficient to indicate that the letter-press will not be deficient in interest.

THE list of New Guinea mammals published by Dr. F. A. Jentink in vol. xxviii. (pp. 161 *et seq.*) of Notes from the Leyden Museum presents a remarkable contrast in point of extent to those in most text-books, comprising no less than 127 species and subspecies. The number recognised by Dr. Wallace in his "Malay Archipelago" (1869) is, for instance, only seventeen, while even so late as 1897 Dr. K. M. Heller could enumerate not more than seventy species from the whole of the Papuan Islands. Probably a few of the forms entered in Dr. Jentink's list are not entitled even to subspecific rank, but, discounting this, the length of the list is sufficient to refute the old idea that New Guinea is very poor in mammals. As to the future, the author is of opinion that exploration of the practically unknown mountain interior of New Guinea —a country larger than Borneo, and double the size of Great Britain—will probably yield a number of new forms.

THE latest issue (vol. iv., parts xiv. and xv., published together) of *Spolia Zeylanica* contains an illustrated account by Dr. Günther Enderlein of a large number of new minute insects belonging to the same group of Neuroptera as the European book-lice and death-watches. The few Ceylonese forms previously known were chiefly those described by Hagen in the years 1858 and 1859, but Dr. Enderlein has been enabled to reveal the existence of quite a host of these tiny insects, referable to a number of new generic types. In place of grouping all these "scaly-winged Copeognatha" in the single family Psocidæ, as is done by Dr. David Sharp, the author refers them to three distinct families, confined almost exclusively to the tropics, the only exceptions being one species from Japan and two from North America. Of the nineteen recognised genera, fourteen are named by Dr. Enderlein. In general appearance and the beauty of the pattern and colouring of their scale-clad wings (exquisitely shown in the coloured plates illustrating the memoir), these insects recall the Microlepidoptera. The use of the term "woodlice" as their popular designation is, as the editor of *Spolia Zeylanica* points out, barred by the employment of that name in another sense.

A VERY important paper, by Profs. J. T. Wilson and J. P. Hill, on the fœtal dentition of the Australian duck-bill, or platypus (Ornithorhynchus), is published in the February issue, vol. li., part i., of the *Quarterly Journal of Microscopical Science*. The authors announce the discovery of tooth-germs belonging to at least two distinct dentitions. What may be called the second dentitions seems to comprise five pairs of teeth in each jaw. Of these, the last three clearly have deciduous predecessors, and they may therefore be regarded as molars, while if such predecessors are absent in the two anterior teeth (a point not yet definitely ascertained), these will be premolars. It is noteworthy that of the three functional teeth in the upper jaw, the first, and smallest, pair belongs to this presumed premolar series, which is unrepresented in the functional lower teeth. Very noteworthy is the discovery that the vestigial precursors of the large functional molars take the form of a much more numerous series of dental rudiments, each corresponding approximately with one of the cusps of their complex successors. "The mode of development of the successional molars . . . is decisive against the occurrence of any fusion-process; but the relation of the two series in the molar region cannot but be regarded as suggestive of some sort of phylogenetic substitution of a small number of compound teeth for a large number of simple teeth—a process which must be reckoned as covering the fundamental idea of concrescence."

THE Board of Agriculture and Fisheries has published a new edition of the leaflet on the black currant mite, in which information on the treatment of this pest with lime and sulphur has been incorporated. Fruit growers whose bushes have been attacked with the mite are advised to experiment with this process. Copies of the leaflet may be obtained gratis and post free on application to the Secretary of the Board of Agriculture and Fisheries, 4 Whitehall Place, London, S.W. Letters so addressed need not be stamped.

THE general conclusions derived from former attempts to grow the opium poppy with a view to the production of alkaloids have been adverse to the profitable cultivation of the plant in Europe. A recent experiment made by Dr. H. Thoms at Dahlem, near Berlin, of which an account is published in *Berichte der deutschen pharmazeutischen Gesellschaft*, vol. xvii., promises no better. The fruits of German varieties gave considerably higher yields than the

fruits of plants raised from imported Asiatic seed, but the cost of labour proved prohibitive; further, the yield was found to be uncertain.

WHETHER it is regarded as an exposition of the new rules for botanical nomenclature or as an authentic revision, the thanks of the botanical community are due to the trustees of the British Museum for publishing, and to Dr. A. B. Rendle and Mr. J. Britten for compiling, a list of British seed plants and ferns to conform with the decisions adopted at Vienna in 1905. The sequence of orders follows Bentham's "Handbook"; the limitation of species is based on Messrs. Groves's revised edition of Babington's "Manual," while additional insertions correlate the names given in Bentham's "Handbook," Hooker's "Student's Flora," and the previous edition of Babington's "Manual." The form is similar to that of the London Catalogue, which it presumably will supplant.

WHILE studying the subject of polymorphism in the Hymenomycetes, a basidiomycetous subclass of fungi, Mr. G. R. Lyman has added to our knowledge of subsidiary spore-forms. It was found that oidia are commonly developed upon the mycelia in the Polyporaceæ and Agaricaceæ, but rarely or never in the lower orders. Chlamydospores previously recorded for a few agarics and many of the Polyporaceæ were produced under cultivation on the mycelia of species of Corticium and some of the Hydnaceæ. Conidia were most frequently observed in the Thelephoraceæ. Peculiar reproductive structures not unlike immature ascocarps, receiving the name of bulbils, were discovered in *Corticium alutaceum*, this being the first record for a basidiomycetous order. The paper is published in vol. xxxiii., No. 4, of the Proceedings of the Boston Society of Natural History.

THE issue of *Irish Gardening* for the current month contains an article by Dr. G. H. Pethybridge on the American gooseberry-mildew in Ireland. This mildew (*Sphaerotheca mors uvae*) was the subject of an article in these columns on December 13 last (vol. lxxv., p. 160), and of a letter from Mr. E. S. Salmon in our issue for January 10 (vol. lxxv., p. 247). Dr. Pethybridge says that everyone who has come into working contact with the disease in Ireland admits its destructive nature. Last year nineteen counties out of Ireland's thirty-two had records of the disease, and the ninety-eight localities in which it has been reported since the first case in 1900 are indicated on a map accompanying the paper. There are now about 100 cases of the mildew in Ireland, and to state that the disease exists "in hundreds of gardens" in Ireland is an unnecessary exaggeration. The greatest stronghold of the disease is at present in the north-east of Ireland, more or less in the neighbourhood of the first outbreak, and many of these cases have undoubtedly arisen by the transference of the spores by natural agencies from one garden or plot to neighbouring ones. Corresponding to the increased number of cases during last summer, there has been an increased effort to eradicate the disease, especially by spur pruning and burning, and it is to be hoped that systematic spraying with potassium sulphide solution will be carried out in every garden or plot in which the disease existed last summer. In order to settle the question as to whether spraying is of use or not in combating the disease in Ireland, what is wanted is a carefully carried out set of experiments with the necessary controls, and Dr. Pethybridge understands that the Irish Department of Agriculture has such experiments in hand for the coming season.

THE Home Office reports on the Wingate Grange colliery explosion on October 14, 1906, have been issued as a Blue-book (Cd. 3379). It is shown that the explosion, which caused forty-four deaths, was due to coal dust and not fire-damp, and that the cause of the explosion was a charge of geloxite, a permitted explosive, fired by means of a fuse. It is evident that, as coal mines are becoming deeper and drier, and larger areas are being worked from a pair of shafts, care should be taken to mitigate the dangers arising from the presence of coal dust. For this purpose steps should be immediately taken to make obligatory the removal of all coal dust from the in-take air ways and mechanical haulage roads of collieries. Attention is directed to the Blue-book by Mr. John Wilson, M.P., in his circular to the Durham Miners' Association, and also by Mr. Thomas Burt, M.P., in his monthly circular to the Northumberland Miners' Association.

THE increasing application of electric power to mining operations was clearly shown in two papers by Mr. M. Kellow and Mr. A. H. Preece read before the Institution of Civil Engineers on March 26. Mr. Kellow described a hydroelectric plant containing many features of novelty installed at a Welsh slate mine. The scheme has been carried out in the Croesor and Cwmfoel valleys, in the vicinity of Snowdon, and includes all the essentials of a complete power system, it being the first example of so high a head of water as 860 feet being utilised in the United Kingdom. The advantages of the three-phase system as applied to slate mining were summarised, and the plant installed for mill-driving, winding, haulage, pumping, and lighting at the Croesor slate mine was described. In the second paper Mr. Preece dealt with electrically driven winding gear, and referred to various points relating to the cost of electric power in mines.

THE Geological Survey of Canada has issued the annual report of the section of mines (No. 928), giving the completed and revised information descriptive of the mineral industries of Canada for 1904. The report has been drawn up by Mr. E. D. Ingall. The Geological Survey has also issued reports on the Chibougamau mining region in the northern part of the province of Quebec, by Mr. A. P. Low (No. 923), and on the Rossland mining district, British Columbia, by Mr. R. W. Brock (No. 939). The former, which covers sixty-one pages and is accompanied by a coloured geological map on a scale of four miles to the inch, records the discovery of an area of serpentine rocks containing asbestos of excellent quality, and the finding of a large vein of gold-bearing quartz and numerous indications of copper ore. The latter report, which is of a preliminary nature, clearly shows the development and progress of gold, copper, and silver mining in the Rossland district. We have also received a somewhat belated report (No. 908, Ottawa, 1905) on recent mineral discoveries on Windy Arm, Tagish Lake, Yukon, by Mr. R. G. McConnell. The deposits consist of quartz veins, the principal values in which are in silver.

A VALUABLE paper on the testing of electric machinery and of materials for its construction, read by Prof. Epstein before the Institution of Electrical Engineers, is published in full in the last issue (vol. xxxviii., February) of the journal of the institution. The paper was the direct outcome of the information supplied to one of the Engineering Standards Committees during the last eighteen months by the author, and is exceptionally interesting from both the purely scientific and practical engineering points of view. Prof. Epstein describes fully the various methods of testing the materials used in the manufacture of

electrical machinery, and the uses to which the results obtained in the laboratory are put in practical design. That these results must not always be blindly followed is shown by the fact that in some cases where the efficiency obtained in a laboratory test is very high, when the material tested is taken for practical use it is of no value for manufacturing purposes, owing perhaps to porosity or other defect. Consequently the paper is of special value in that the results of many years' work are given, thus providing what is probably the most accurate data for the design of modern electrical machinery. Every material used in the construction of the dynamos, motors, transformers, &c., of the present day has been scientifically tested, and the results are now classified. The various classes of iron, copper, carbon, and insulating material have been thoroughly sifted, so that efficient and commercial combinations have been secured.

FROM Messrs. Adam Hilger, Ltd., we have received a brief description of the 1907 model of their well-known wave-length spectroscope. The growing demand for these spectroscopes by education authorities, research workers, and technical experts has enabled the makers to add numerous improvements, and, from the description, the present model appears to be mechanically and optically ideal. The telescope and collimator have a focal length of 11¾ inches and an aperture of 1¼ inches. The prism-train effectively consists of two 30° prisms and one 90° reflecting prism, but is actually made in one piece. The bearing part of the screw on which is fixed the helical drum on which the wave-lengths are engraved is especially worked and hardened, and presses against a hardened steel plug the surface of which is optically polished; thus imperfect contacts and periodic errors are eliminated. These improvements have necessitated slightly increased prices, the present cost of the spectroscope with a prism of 1·65 refractive index, for D, being 25*l*., and for a refractive index of 1·74 27*l*. 15*s*.

THE Perkin memorial committee has issued as an attractive volume, appropriately bound in mauve, an account of the proceedings in connection with the International Celebration of the Coal-tar Colour Jubilee, with which we dealt in an article in our issue for August 2, 1906 (vol. lxxiv., p. 318), and in numerous notes published from time to time. The jubilee volume contains the special report by the *Times*, the whole of the telegrams, letters, and addresses received by Sir W. H. Perkin, F.R.S., several of the speeches made at the Royal Institution and at the dinner at the Hôtel Métropole, and a report of the celebrations held in America. It is illustrated by reproductions of the portraits of Sir W. H. Perkin and of his father and brother, views of the Greenford Green Works, and photographs of the oil portrait and marble bust presented to Sir W. H. Perkin by international subscription. The volume forms a fitting memento of an important and interesting event.

THE coefficient of expansion of fused quartz is the subject of a paper by Mr. Howard Minchin in No. 1 of vol. xxiv. of the *Physical Review*; the determinations were made by the interference method over ranges of temperature between +16° C. and +1000° C., and the conclusion is drawn that between these limits expansion is uniform, the mean coefficient α having the value $0{\cdot}449\times10^{-6}$. In No. 1 of vol. ix. of the *Verhandlungen* of the German Physical Society, Dr. Karl Scheel publishes a communication from the Physikalisch-Technischen Reichsanstalt dealing with the expansion of crystalline quartz in the direction of the axis, and of platinum, palladium, and quartz glass between the temperatures of −190° C. and +100° C. These determinations were also made by the optical method. The coefficient of expansion of quartz glass is given by the equation

$$l_t=l_0(1+0{\cdot}217.10^{-6}.t+0{\cdot}002379.10^{-6}.t^2),$$

and it is seen that, between the interval −190° C. and +16° C., instead of an expansion occurring, a contraction of 41 μ per metre is observed. The curve of expansion of quartz glass thus shows a minimum at a temperature of about −46° C.

A CORRESPONDENT suggests that the passing allusion made to the collection of ship models in the Victoria and Albert Museum, in the review of Sir George Holmes's book in NATURE of March 28 (p. 506), may lead readers to suppose that no models of warships are contained in the collection. As a matter of fact, there is a section devoted to warships, and including a number of models lent or given by private firms.

THE first part of the third edition of Prof. M. Lévy's well-known work on "La Statique graphique et ses Applications aux Constructions" has been published by MM. Gauthier-Villars, Paris. Although some changes have been made, in details the work remains substantially the same. The part just received deals with the principles and applications of pure graphic statics, and is published in two volumes—one containing the text (pp. xxx+598) and the other (Plates xxv.) the figures.

IN the second revised edition of "Die Spiele der Tiere," just published by Mr. Gustav Fischer, Jena, Prof. K. Groos has made numerous changes. The book is full of interesting incidents and explanations relating to the play of animals, and appeals both to the naturalist and psychologist. A translation of the original edition into English appeared in 1898, and was described in these columns (vol. lviii., p. 410).

EIGHT new volumes (Nos. 151–8) of Ostwald's scientific classics have been received from Mr. W. Engelmann, Leipzig. The volumes contain papers, in German, by Poinsot (1809), Cauchy (1811), J. Bertrand (1858), Cayley (1859), Grotthuss, on electricity and light (1808–1819), Hankel (1870), Dutrochet (1824), Zambonini, Sella, Jacobi, and Toepler (1866–7). Each volume includes editorial notes, as well as reprints or translations of original papers, so that students of science familiar with the German language are provided by Prof. Ostwald's series with a ready means of referring to the works of the old masters and receiving inspiration from them.

THE Country Press, of Kensington, London, W., has issued two more packets of nature-study post-cards. One packet includes facsimiles of six British trees in winter; the other provides natural figures of boles of the same trees. The packets are issued at 6*d*. each.

MESSRS. J. AND A. CHURCHILL have published a fifth edition of "Elementary Practical Chemistry," by Dr. Frank Clowes and Mr. J. B. Coleman. The book is published in two parts, the first dealing with general chemistry and the second with qualitative and quantitative analytical chemistry. In the present edition the whole of the matter has been revised, and alterations and additions have been made.

WE are indebted to the publisher, F. Tempsky, of Vienna, for a copy of the fifth edition of Graber's "Leitfaden der Zoologie," edited by Dr. Robert Latzel. This well-known illustrated text-book is intended primarily for use by the higher classes of the middle schools.

OUR ASTRONOMICAL COLUMN.

COMET 1907*a*.—No. 4165 (March 26) of the *Astronomische Nachrichten* contains a new set of elements and an ephemeris for comet 1907*a* (Giacobini), calculated by Herr M. Ebell from places observed on March 9, 12, and 16. According to the elements, the perihelion passage took place on March 26, and, as shown by the ephemeris, the comet's brightness is decreasing, now being less than half what it was at the time of discovery. The position of this object for April 11 is $\alpha = 6h.\ 14m.$, $\delta = +4^\circ\ 47'$, and the comet is travelling in a nearly due northerly direction, its calculated position for May 6 being 6h. 10m.+13° 42′.

THE BRIGHTNESS OF THE SKY NEAR THE SUN'S LIMB.—With an apparatus described in No. 4164 (March 25) of the *Astronomische Nachrichten*, Prof. Ceraski, at Moscow, determined the relative intensities of the light at the sun's limb and the atmospheric illumination very near the limb on November 3 and 4, 1906. On the former date the mean value of the ratio $\frac{\text{edge of } \odot}{\text{atmosphere}}$ at the east and west limbs was 31·4, and on November 4 it was 38·4, values far below those which Prof. Ceraski expected to find.

Prof. Ceraski points out that this ratio might be employed as a term of comparison in evaluating the relative intensity of the corona. Using the method described by him in No. 4106 of the *Astronomische Nachrichten*, the coronal light could be compared with that of a standard lamp, which might, after the eclipse, be measured against the illumination of the atmosphere at a determined point in the sky. Thus the illumination of the sun's edge could be compared indirectly, in graduated steps, with that of the corona.

RADIAL VELOCITY OF η PISCIUM.—This star was announced by Mr. Lord as a possible spectroscopic binary having a long period, but Prof. Campbell was unable to find any variation in the line-of-sight velocity. The binary character is now confirmed by plates secured at the Dominion Observatory at Ottawa, the range of velocity so far detected being from +5·4 km. to +21·4 km. per second, and there are indications that the period is a comparatively short one.

α Draconis has also been observed, and the velocity curve practically completed; the period is between fifty and fifty-one days, and the velocity ranges from −53 km. to +35 km. per second.

In the case of ι Orionis, a considerably larger range of velocity than that announced by the discoverers was found, that already observed extending from −50 km. to +100 km. (the Journal R.A.S. Canada, No. 1, vol. i.).

SIMULTANEOUS OBSERVATIONS OF JUPITER.—In the *Bulletin de la Société astronomique de France* for December, 1905, it was suggested that simultaneous observations of Jupiter should be made by as many volunteer observers as could be obtained, and that the results, obtained with many different kinds of instruments and under varied conditions, should be communicated to and coordinated by the society.

One hundred and seventy-two observers made observations at prearranged hours on various dates between January 2 and 20, 1906, and the first batch of results is now discussed by M. Mascart in the April number of the *Bulletin*, the general conclusions derived from all the observations on one day being given, together with reproductions of the original drawings for January 2, 3, 4, and 5, 1906.

THE SUN AS A VARIABLE STAR.—At the meeting of the Royal Astronomical Society held on March 8 Prof. Turner briefly discussed the light curves of a number of variable stars, and showed that there existed a sequence in their forms. In most cases the minimum falls later than midway between two maxima, in others earlier, and on arranging the curves of thirty-one variables it was found that the sun falls into the sequence. Seeking some explanation for this arrangement, Prof. Turner has evolved the interesting suggestion that the form of the curve may, to some extent, depend upon the position of the star's axis in regard to the line of sight; thus we view the sun from a point lying nearly in the plane of its equator, but the poles of other stars may be turned towards us, whilst in other cases we may be looking normally at mid-latitudes.

An analysis, from this point of view, of the suitable data given in Chandler's catalogue of variable stars led to the tentative result that whilst the stars where we look directly at the equator are distributed in all galactic latitudes, those of which we see the polar regions are absent from the neighbourhood of the galactic poles. As a purely speculative interpretation of this difference, Prof. Turner suggests that the axes of the stars may be nearly parallel to the plane of the Milky Way, an arrangement which would, of course, account for the result found (the *Observatory*, No. 382, April).

EFFECTS OF PRUNING ON FRUIT TREES.

THE scientific work carried on at the Woburn Experimental Fruit Farm, by the Duke of Bedford and Mr. Spencer U. Pickering, F.R.S., is of great value to horticulturists, who usually follow rule-of-thumb methods in much the same way as the British farmer cultivates his crops. The fifth report of the Woburn Fruit Farm, noticed in NATURE of September 7, 1905 (vol. lxxii., p. 461), showed that several cherished ideas as to the proper treatment of fruit trees need modification, and that operations which are generally supposed to be beneficial to growth and fruit-bearing are really prejudicial to both. Measurements of leaves, trees and fruits, and weighings of the fruit, led to the conclusions that heavy thinning of the fruit is of no advantage; hard pruning is unprofitable; summer pruning is undesirable; and root pruning injurious. An explanation was also found of the fact that carelessly planted trees, though weak at first, ultimately make more growth than trees carefully planted.

The observations described in the fifth report of the Woburn Fruit Farm have since been extended, and the new results and conclusions are dealt with in the seventh report recently issued.[1] As the conclusions are based on experimental evidence, they are, of course, of far greater value than mere expressions of opinion; and though they apply only to particular trees in a particular soil, they suggest that the ways of the practical gardener are not always wise. The empirical horticulturist believes that "growth follows the knife," but by measuring and weighing trees it has been found that the less a fruit tree is pruned the larger and heavier it becomes, even when allowance is made for the amount of wood removed in the annual pruning of the normal trees. The fruit crops of trees are also increased as the amount of pruning is diminished, so it appears that the less pruning done the better is the result both as regards growth and fruit.

These conclusions, however, apply only to healthy and established trees. Transplanted, injured, or ailing trees may be regarded as prematurely old trees which tend to form an excessive number of fruit-buds and increased wood formation. The obvious way to prevent this is to prune hard; and the experiments at Woburn show clearly that if transplanted trees, that is, trees which have been checked in their development, are cut back at once, the operation results in the starting of many dormant buds followed by a clean, vigorous growth. Hard pruning also results in increased branch-formation in the case of mature trees, the effect being thus the opposite to what is found when the pruning is on young trees in the full vigour of growth.

The experiments show, in fact, that with trees, as with animals, there are certain periods in their life-history characterised by certain distinct differences of behaviour. All the results obtained at Woburn can be explained by remembering that any cause which disturbs the balance between the root and branch systems at any period of growth is followed by an effect which will adapt the organism to the new condition. The observations are thus not only of importance to practical horticulturists, but are also of scientific interest. The summary of the report, re-

[1] Seventh Report of the Woburn Experimental Fruit Farm. By the Duke of Bedford, K.G., and Spencer U. Pickering, F.R.S. Pp. 56. (London: Eyre and Spottiswoode, 1907.) Price 1*s*. 6*d*.

printed below by permission of the authors, presents the results in a convenient form, but a study of the report itself is necessary to appreciate the value of the experiments upon which the conclusions are based.

Records have been kept during the last twelve years of the behaviour of apple trees when pruned to different extents. The trees were chiefly dwarf trees on the paradise stock, and the main series of experiments were made on three varieties, possessing very different habits of growth. Measurements of the height of the trees, the spread of the branches, and the diameter of the stems led to the conclusion that the less the tree was pruned the larger did it become, and this conclusion has now been confirmed by lifting more than half the trees and ascertaining their weight. At the end of twelve years (the trees then being fifteen years old), those which had not been pruned at all were 20 per cent. heavier than those which had been moderately pruned, whilst those which had been hard-pruned were 16 per cent. lighter. The difference in weight between the unpruned and moderately pruned trees was too great to be accounted for by the weight of wood removed in the pruning, so that pruning not only does not increase the actual size of a tree, but it results in less new wood being formed.

These results were further established by pruning to different extents similar branches on the same tree. The less the pruning done the greater was the number, length, and weight of the new shoots formed, and the greater, also, was the increase in girth of the original branch.

From every point of view, therefore, the pruning of a healthy, growing tree seems to be inimical to wood-formation.

It is as regards the crops, however, that a reduction of pruning shows to greatest advantage. With the dwarf apple trees, the crops during the first five years were more than twice as great from the unpruned trees as from the moderately pruned ones, and more than three times as great as from the hard-pruned ones; in the second period of five years the differences were still greater, and in the twelfth year (when, however, one variety only was in bearing) the unpruned trees yielded nearly three times as much as the moderately pruned ones, and the hard-pruned trees had practically no crop at all. Similar results were obtained during the past season with trees of fifty-three and eighty varieties on the crab and paradise stocks respectively, the crops from moderately and hard-pruned trees being in the proportion of three to one in both cases. There was no appreciable difference in the size of the fruit from trees pruned to different extents, so that the values of the crops were proportional to the weights. The trees, however, were not allowed to overbear, the fruits being thinned to two to the truss.

Confirmatory evidence of the antagonism of pruning to fruiting was obtained by counting the fruit-buds formed on similar branches of the same tree, which had been cut back to different extents.

All these results refer to healthy trees which are still young enough to be growing vigorously. With a tree which is older, and has attained maturity, the results are somewhat different, not as regards fruiting, but as regards branch-formation. With a tree of this age, branch-formation, under natural conditions, has ceased, but if it be pruned new branches are formed to supply those removed, but they are formed only at the expense of the fruit. Most of the dwarf apple trees (now fifteen years old) used in these experiments seem to have reached this stage; hard pruning in their case now results in an increase of the new wood formed, though the reverse was the case when they were younger, but the crops are still reduced by the pruning, and even more so than in former years.

What applies to a tree which has passed the age of active growth, and has reached maturity, applies also to a tree which has become stunted, or has had its growth arrested by root-injury, as, for instance, when it has been transplanted. The deficiency of vigour of a freshly planted tree is shown by the small size of the leaves and the tendency to form fruit-buds instead of wood. The correction for fruiting is, as has been shown, hard pruning, and it is, therefore, most important that freshly planted trees should be cut back hard so as to prevent precocious fruiting, which would generally result in permanent stunting. To delay this cutting back until the end of the first season would appear to be a very wrong procedure. It has been found that with trees which were not cut back the size of the leaf was, on the average, 24 per cent. less, and the new wood formed 45 per cent. less, than with similar trees which were cut back; such vigour as the tree possessed went to form fruit-buds, which, when the cutting back was eventually performed, were removed altogether, or suppressed in favour of growth. A year's growth is practically lost by thus deferring the cutting back, and the ultimate result was found to be that the trees thus treated continued to form wood in subsequent years, whilst those which had been cut back at once were fruiting; so that the crop borne by them during the first ten years was only one-third of that borne by the latter.

Experiments on apples, pears, and plums show that the date of cutting back a freshly planted tree is immaterial so long as it is done before growth begins, that is, before about the middle of April. If delayed until the middle of July, the season's growth is much reduced, and the tree will probably suffer in subsequent years. This point was investigated more fully in the corresponding case of the hard cutting back, or lopping, of older trees (plums), which had become slightly stunted. The operation increased the amount of new wood formed by the tree, and the results were the same so long as the lopping was done during the dormant season. Lopping towards the end of May resulted in less growth during the year, but this was more than compensated by an additional growth during the succeeding season. It is doubtful, however, whether anything is really gained by anticipating the autumn lopping (as is sometimes possible), and doing it in the preceding early summer, for it was found that the trees thus treated did not appear to be so healthy in foliage as those which were cut back subsequently. This was especially so where the cutting back was postponed until July, for trees cut back then made very little growth during the remainder of that season, and were deficient in growth in the following season as well.

Apart from the cutting back of freshly planted trees, the present results are emphatic in showing that the less pruning is done the better. But this does not imply that no pruning at all should be done. The removal of branches which cross or rub each other, as well as that of any unripened wood, is evidently desirable, and no doubt a certain amount of pruning, in order to obtain a compact and shapely tree, should be done during the first few years after planting. But a tree which is growing freely, and is properly tended in other respects, will require very little pruning to keep it in shape. With precocious or weak-growing varieties more pruning will be necessary, and more is required with standards than with dwarfs, for in the former case it is very desirable that a compact head and strong stem should be obtained before any heavy crops are borne.

STANDARDS AND EXACT MEASUREMENT.

THE inaugural address delivered by Dr. R. T. Glazebrook, president of the Institution of Electrical Engineers—the full text of which is published in the current number of the Journal of the society (vol. xxxviii., No. 181, p. 4)—is likely to be remembered as one which stands apart among the various addresses which have been delivered in past years, owing to the fact that the subject treated is so rarely discussed or dealt with in ordinary engineering papers.

The subject in question, that of standards and exact measurement, is one which does not appeal to all, but is of special interest at the present time, when so much has been done of late by the Engineering Standards Committee to bring about more efficient work and more uniform results in the various branches of engineering. Dr. Glazebrook, in opening his address, gave a brief account of the history of standardisation from the first report of the Electrical Standards Committee of the British Association in 1862 down to the present day. This first

early report summed up the entire connection between the various units as follows :—

"A battery or rheomotor of unit electromotive force will generate a current of unit strength in a circuit of unit resistance and in the unit of time will convey a unit quantity of electricity through the circuit and do a unit of work or its equivalent."

Mr. Duddell's report on the proceedings at the St. Louis Conference brought up the question of electrical standards in its present-day phase. Mr. Duddell referred to two important resolutions passed at St. Louis, and the question of giving effect to these was considered. Since then matters have progressed considerably, and a conference was held at Charlottenburg at which representatives from America, Austria, Belgium, France, Germany, and Great Britain were present, and the following resolution was adopted :—

"In view of the fact that the laws of different countries in relation to electrical units are not in complete agreement, the conference holds it desirable that an official conference should be held in the course of a year with the object of bringing about this agreement."

The result of the above resolution is that a future conference will be held this year in London, when the question of the fundamental electric units will be brought up. Only two electrical units will be chosen as fundamental ones, and these will in all probability be the international ohm, defined by the resistance of a column of mercury, and the international ampere, defined by the deposition of silver.

The international volt will depend on the above two definitions. Experiments have been going on in all countries since October last to determine with extreme accuracy the quantity of silver deposited in a given time and the best method of constructing practical standards having a resistance of one ohm, and these results will be considered at the conference to be held in London this autumn, when we may hope that definitions of the international ohm and ampere will be finally settled.

Not only is it necessary that the fundamental units of electrical science should be the same throughout the world, but the conviction has grown stronger that the extension of this principle would be of enormous assistance to the welfare of nations in general, and consequently international standardisation has become of the greatest importance.

At the St. Louis Congress two years ago Colonel Crompton introduced this question, with the result that it was unanimously agreed that the cooperation of the technical societies should be secured in order that the questions of the standardisation of the nomenclature and ratings of electrical apparatus and machinery might be thoroughly discussed. The Institution of Electrical Engineers appointed an executive committee for this purpose, and practically all the civilised nations of the world cooperated.

In this way the International Electrotechnical Commission was formed, and the central offices are for the present in London, at the offices of the Institution of Electrical Engineers.

The task before the commission is a large one, as the nomenclature alone will probably occupy its attention for a considerable period if one may judge by the labour entailed in the work of the electrical committees of the Engineering Standards Committee, which have been sitting lately.

Standardisation has its dangers as well as its advantages, and it is in the avoidance of the one and the utilisation of the other that the great difficulty attendant on the work of such a commission will consist. It is to be hoped that a happy mean may be found, which, while reducing the number of types of machinery which the responsible consumer or the consulting engineer can order, will not stultify the inventive faculties of engineers towards future developments.

Dr. Glazebrook further gives details of the reports of the Engineering Standards Committee on the various sections of engineering work on which it has already reported, the reading of which is of the greatest interest. The work appears to have been done in a way that is thorough and complete, and every endeavour has been made throughout to increase the facilities for obtaining greater output per machine and to reduce the multiplication of patterns.

It is gratifying to know that the work is already bearing fruit, and the recommendations have been adopted by the Government Departments, Lloyd's Registry, the British Corporation, and several other registry societies in regard to ship and boiler specifications. With regard to rails, the Railway Engineers' Association are adopting the standards, and with but few exceptions every new tramway system in this country and many in the colonies which are under construction are being provided with these standard rails. It is estimated that the saving to the British manufacturer by standardisation of iron and steel sections alone will amount to some millions sterling, and we do not think that this figure is exaggerated when we take into consideration the fact that the frequent changing of the rolls to produce in small quantities the many "special" sizes asked for would be done away with.

Although dealing with an infinitesimal part of this vast subject, the address opens out a most important question which will have to be considered, not only by the various branches of the engineering profession, but by every Government that has the welfare of its nation in view. Dr. Glazebrook is to be heartily thanked for the clearness with which he has dealt with his subject, and there is no doubt that his presidential address to the Institution of Electrical Engineers will long be remembered by those who were fortunate enough to hear it. J. L. M.

THE INFLUENCE OF PARASITES ON THEIR HOSTS.

SCIENCE of February 8 contains the report of an interesting and suggestive address on this subject delivered by Prof. H. B. Ward before the Section of Biology of the American Association for the Advancement of Science at the New York meeting held in December last. (For other presidential addresses see NATURE of February 7, p. 352.)

After certain preliminary remarks, Prof. Ward mentioned that some parasites, such as the distome Heterophyes, found in the intestine of Egyptian fellahin, seem to have no appreciable effect on their hosts. The African eye-worm (*Filaria loa*), except when it actually enters the sclerotic of the eye, affords another instance. Many encysted worms likewise come under the same category.

As a rule, single parasites leave no lasting effects on their hosts; it is rather the multiplication of parasites which should be dreaded. The most serious effects occur when this multiplication takes place within the host. On the other hand, when multiplication takes place during successive generations in other hosts, it is unlikely that the parasites, when in the proper stage, will reach the original host in sufficient numbers to cause serious mischief. The real danger lies in a multiple infection through the numerical increase which such a species often undergoes in the intermediate host, or within a limited external area, so that by the intake of a single object a swarm may be introduced.

As a rule, the harm caused by a parasite bears some proportion to its size as compared with that of its host; when, however, parasites occupy positions in connective tissue or between muscular fibres they may be relatively harmless, no matter what their size.

Some parasites cause harm in a mechanical manner, by blocking, for instance, natural passages, or, as in the case of the Egyptian blood-fluke, by the ova entering the capillaries, when serious trouble is bound to ensue. Embryos, in the case of filariæ, may likewise infest the lymphatic vessels, to the great detriment of their host.

The migrations of parasites, as when *Ascaris lumbricoides* passes along the natural gangways from the intestine to the liver, may also cause serious harm, as abscess of the latter organ. But parasites do not always confine themselves to such natural lines of movement; they may drive

tunnels for themselves, when still more disastrous results may accrue. The abrasion and destruction of surfaces and cells and the opening up of abnormal communications are not, it is urged, of such serious importance of themselves; it is rather the secondary results from such lesions that are to be feared, such, for example, as the admission of bacteria from the alimentary canal into the blood and tissues. For it is held by many that the normal mucous surface is impenetrable by bacteria, and the germs of cholera and typhoid depend to some extent upon diminished resistance, functional or structural, for their entrance into the tissues.

No one, for instance, doubts that Eberth's bacillus is the active agent of typhoid, but there is strong reason to believe that before it can give rise to the disease there must be lesion of the intestinal mucous membrane. The very fact that out of numbers who drink contaminated water but comparatively few are infected is strong confirmation of this.

Parasites are likewise the inducing cause of changes which lead to multiplication, or proliferation, of cells and tissue, this being the case with both protozoa and bacteria. The most common morphological change in the host is, perhaps, the development of a cyst round the parasite. An example of this is afforded in the case of pearls. In the Ceylon pearl-oyster the production of the best pearls is due to one particular cestode larva which passes part of its existence in the mollusc itself.

On the other hand, the attempt to attribute cancerous and other abnormal growths to the action of parasites does not appear to be supported by the available facts.

As regards such proliferation of tissues as is undoubtedly due to parasitic action, Prof. Ward advances the hypothesis that this may be largely owing to poison generated by the intruder. An inert body, like a grain of sand, will not give rise to the formation of a cyst, or at all events to the proliferation of tissue, and it is probable that pearls cannot be produced by such means. Parasitic bodies, on the other hand, feed and excrete, and nothing is more probable than that the excreta are toxic.

This, however, is not all, for the supply of nutriment to the parasites—nutriment frequently consumed in a wasteful manner—inflicts a severe strain on the host in a large number of instances. The drain on the resources of the latter is, indeed, practically three-fold, owing to the rapid growth of the parasite itself, the production by the latter of a large amount of reserve material (glycogen), and the great reproductive activity of the unbidden guest.

A curious phase of parasitic infection is the frequent loss of reproductive power in the host, due in some instances to destruction of the genital organs themselves, but in others to secondary influences. The tendency for one sex to acquire the sexual characteristics of the other is a marked feature in this parasitic castration.

The destruction of tissue by parasites, as in the case of that of the liver by the liver-fluke, although in one sense a mechanical injury, is really more than this. As the substance removed by the liver-fluke is replaced by connective tissue, a most important organ of the body becomes to a greater or less degree degenerate.

Among the physiological effects of parasitic infection, none is more remarkable than the power possessed by species living upon blood of secreting a substance which prevents the coagulation of that fluid. In regard to what has been stated above as to the development of toxic elements by parasites, the hæmosporidia of malaria undergo development in the red blood-corpuscles, and when they break up into spores the corpuscles are destroyed, with the probable discharge of poison into the blood. As many corpuscles break up at once, the effects are serious. The trypanosomes of sleeping sickness probably have a very similar physiological effect. The existence of a toxic principle affords also the most satisfactory explanation of the phenomena of the progressive, pernicious anæmia present in some cases of bothriocephalid infection. Anæmic conditions are also produced by direct blood-suckers, such as leeches and fish-lice. There remain, however, other forms of anæmia, such as that due to infection by the fish-tapeworm *Dibothriocephalus latus*, the physiology of which cannot at present be satisfactorily explained.

THE BELGIAN INTERNATIONAL BALLOON SERVICE.

THE investigation of the higher regions of the atmosphere by means of unmanned balloons, which has been carried on by some countries for several years, generally on the first Thursday in each month, has already revealed some important facts, among which may be mentioned the inversion of temperature at various heights and the determination of the direction of the flow of the upper air-currents over land and sea. The success hitherto attained well repays the expenditure of time and money incurred, and gives good reason for hoping that the study of aggregate results may lead to the ultimate solution of the problem of the general circulation of the atmosphere.

At the instigation of the aëronautical conference held in St. Petersburg in August, 1904, the Belgian Meteorological Service has taken part in this important work since the end of March, 1906, and M. Lancaster has sent us preliminary notes of the results of the monthly ascents from Uccle between April, 1906, and February, 1907, published in *Ciel et Terre*, and in a note to the Belgian Academy in November, 1906. We have previously referred to the ascents in April and May, but include the data in the following general summary.

The balloons are of india-rubber, coupled in tandem, having generally diameters of 1900 mm. and 1350 mm. respectively, and are inflated with hydrogen gas. The meteorograph is made by Bosch, of Strassburg, and consists of barometer (Bourdon tube), two metallic thermometers (Hergesell and Teisserenc de Bort's models), and hair hygrometer. A full description of the apparatus is given in *Ciel et Terre* for May, 1906. In this paper the values quoted are from Dr. Hergesell's thermometer. The starting place of the balloons at Uccle is 100 metres above sea-level, and the ascents were made from about 7h. to 7h. 30m. a.m. Greenwich time.

General Results of the Ascents.

Date	Wind	Temperature at starting	Lowest temperature recorded	Height	Direction in which balloons fell
1906		°C.	°C.	metres	
April 5...	S.	1·9	−57·2	13,500	S.S.E.
May 3...	S.S.W.	12·1	−62·6	10,160	E.N.E.
June 7...	N.E.	13·7	−65·7	11,460	S.S.W.
July 5...	N.E.	16·6	−58·0	9,829	S.
Aug. 2...	S.S.E.	22·0	−59·8	13,764	E.
Oct. 4..	Calm	11·9	−65·3	11,524	E.S.E.
Nov. 8...	N.N.E.	9·0	60·8	10,504	N.W.
Dec. 6...	S.S.W.	0·8	−51·6	9,168	S.S.W.
Jan. 14...	W.S.W.	5·2	−70·2	12,361	S.E.
Feb. 7...	E.S.E.	−6·7	62·0	15,346 and 17,073	S.S.E.

The following details, not included in the above table, are of interest:—

April.—An inversion occurred between 14,000 metres and 15,000 metres.

May.—A large inversion occurred above 10,160 metres; at the maximum height, 16,970 metres, the temperature had risen to −42°·0 C. Humidity fell to 18 per cent. at 10,330 metres, during the descent.

June.—Above 11,460 metres an inversion occurred up to the greatest height, 15,690 metres, where the thermometer read −54°·5 C. Humidity, 22 per cent., at 2520 metres.

July.—Inversion occurred between 9800 metres and the maximum height, 15,682 metres, where the thermometer read −50°·0 C.; humidity, 19 per cent.

August.—At the maximum height, 18,835 metres, the temperature was −50°·3 C.; between 13,800 metres and 18,000 metres there was an inversion in a layer about 4000 metres in depth.

September.—The meteorograph was broken by collision with buildings at starting.

October.—An isothermal zone occurred at about 11,500 metres, and an inversion between 1900 metres and 2000 metres. The minimum humidity was exceptionally low, being 9 per cent. at 4640 metres, and at the highest point (13,971 metres) 13 per cent.

November.—At 12,798 metres the temperature was −53°·0 C.; an inversion commenced at about 10,500 metres.

December.—At the maximum height, 11,935 metres, the thermometer read −51°·1 C. An isothermal zone commenced at about 6660 metres, and continued, with some fluctuations, until the bursting of the balloon.

January.—The greatest height reached was about 16,545 metres; temperature, −62°·3. An inversion commenced at about 12,360 metres. Humidity, 19 per cent. at about 13,000 metres during the descent.

February.—The minimum temperature (−62°·0 C.) was also recorded at 13,994 metres during the descent. An isothermal zone occurred between 15,346 metres and 17,073 metres (temperature, −62°·0 C.); an inversion then set in; at the maximum height (18,472 metres) the thermometer read −57°·5 C.

These isolated observations confirm the general existence of a stratum of air having a considerable increase of temperature, usually between 10,000 metres and 15,000 metres, referred to by Prof. Hergesell, M. Teisserenc de Bort and others, and the opinion that it constitutes a distinct current in the upper regions of the atmosphere.

TERRESTRIAL PHYSICS IN THE UNITED STATES.[1]

IN the first of the publications described in the footnote we have an investigation of the figure of the earth as determined by operations in the United States. The deflection of the vertical at each station, due to all known topography within 4126 kilometres of the station, has been computed. Least-square solutions, based on all the observations, were made (1) on the supposition that the earth is rigid; (2) solutions on the hypothesis of isostacy corresponding to three different assumed depths at which the isostacy is supposed complete; (3) a similar solution on the usual hypothesis, that there is no relation between the observed deflection and the topography.

The authors direct the attention to the "particular method of attack," first, of those whose chief interest is in the figure and size of the earth; secondly, of those who believe that the condition of isostacy exists; and, thirdly, of those who may, for any reason, have positive belief that cannot be reconciled with the existence of isostacy; inviting an investigation of the methods used.

Isostacy is thus defined:—"The excess of material represented by that portion of the continent which is above sea-level will be compensated for by a defect of density in the underlying material," the ocean being regarded as a defect of mass, and the corresponding compensation as effected by an excess of density in the underlying material.

The conclusions reached have been:—

(1) For the United States, the equatorial radius of the earth is 6,378,283 metres; the polar semi-diameter, 6,356,868 metres; the reciprocal of flattening, 297·8.

(2) Extreme rigidity is far from the truth. Isostacy is a comparatively close approximation. The States are in the main "buoyed up, floated, because of deficient density."

The isostatic adjustment made use of in the report is simply $\delta h = -\delta_1 h_1$, where h is the height of the surface above sea-level, δ its density, h_1 the depth of compensation below sea-level, and δ_1 the defect of density, h_1 being assumed a constant for each of the solutions in (2). This assumption is, of course, a crude one, though it facilitates the calculations; but it is sufficient to bear out the main contention that isostacy must be taken account of in determining the figure of the earth, and that the hypothesis of rigidity is untenable.

In the second of the above publications Mr. Hayford gives a general summary of the results of the survey as regards isostacy. He tells us that the evidence shows clearly and decisively that complete isostatic compensation within a depth of seventy-one miles is near the truth. The main impression which he endeavours to make upon his audience is that the earth is "a failing structure." The idea that the permanence of continents is due to elastic expansion of all the underlying material, as viewed in the light of geodetic evidence, he regards as extremely absurd, "whereas the earth is apparently inelastic to a high degree, even near the surface, and is apparently failing continuously," as shown by the ready adjustment of the figure to the effects of denudation. The author attributes the diminution of density beneath elevated regions to chemical changes, caused by increase of pressure, but there is no allusion in either of these publications to the theory due to Airy, and described in Clarke's "Geodesy," that elevated tracts are hydrostatically supported by a protuberance of the crust, dipping down into a denser medium below—a mode of isostatic compensation much in accordance with the compressed condition of most mountainous districts.

1 (1) "Geodetic Operations in the United States, 1903–6. A Report to the Fifteenth General Conference of the International Geodetic Association." By G. H. Tittman and John F. Hayford. Pp. 45. (Washington: Government Printing Office, 1906.)

(2) "The Geodetic Evidence of Isostacy, with a Consideration of the Depth and Completeness of the Isostatic Compensation, and of the bearing of the Evidence upon Some of the Greater Problems of Geology." By John F. Hayford, C.E. (Proceedings of the Washington Academy of Sciences, May 18, 1906.) Pp. 40. (Washington, D.C.: Published by the Academy, 1906.)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

IT is reported from Ottawa that the engineering building of McGill University, Montreal, was completely destroyed by fire on April 5, the loss thus involved amounting to 150,000*l.*

THE Carnegie Institute at Pittsburg is to be dedicated this afternoon, and the ceremonies in connection with the event will continue until Saturday, when honorary degrees will be conferred by the University of Pennsylvania on a number of the foreign visitors. The *Times* correspondent at New York states that the gift of 1,200,000*l.* for an additional endowment and building fund for the institute, announced by Mr. Carnegie last week, makes the total sum given by him for the institute and for technical schools in Pittsburg more than 3,400,000*l.*, while the technical schools can draw on him for 1,400,000*l.* more as money is needed. Mr. Carnegie's total contributions to Pittsburg and Allegheny now amount to more than 6,400,000*l.* So far as is known, his total donations for public purposes in America and Europe amount to the stupendous sum of 33,300,000*l.* Of this total, 10,800,000*l.* have been given in the last four years.

THE *London University Gazette* announces several courses of lectures for advanced students of science by university teachers. Among these may be mentioned eight lectures on "The Ancestry of Angiosperms," by Miss Ethel Sargant, at University College, on Mondays, beginning on April 29. Nine lectures on "Psychological Research in Schools" will be given on Fridays, beginning on April 26; lectures i.–iii. and vii.–ix. will be given by Miss B. Edgell, lecture iv. by Dr. A. D. Waller, F.R.S., and lectures v. and vi. by Mrs. Reid. Four lectures on "The Pineal Sense Organs and Associated Structures in the Vertebrate Brain," by Prof. Arthur Dendy, on Tuesdays, beginning on May 7, in the physiology lecture theatre, King's College. Twenty lectures in protozoology at the Lister Institute, Chelsea, by Prof. E. A. Minchin, on Mondays, Wednesdays, and Fridays, beginning on Wednesday, May 1; each lecture will, when possible, be followed by exhibits of microscopic preparations illustrative of the subject of the lecture. Dr. W. N. Shaw will resume his lectures on dynamical meteorology on Monday, April 29, in the physics theatre, University College. The course will be continued on Fridays and Mondays until Friday, May 17, inclusive.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, December 13, 1906.—"Experiments on the Length of the Kathode Dark Space with Varying Current Densities and Pressures in Different Gases." By F. W. **Aston**. Communicated by Prof. J. H. Poynting, F.R.S.

This paper deals with experiments on the length of the "Crookes" dark space under steady currents in air, oxygen, nitrogen, and hydrogen, and its relation to pressure, current density and potential in a cylindrical glass discharge tube, the electrodes of which are large aluminium discs closely fitting the tube. Under these conditions it is found that so long as the current is kept above a certain value, *i.e.* sufficient to cover the kathode with glow and to cause the complete disappearance of the positive light on the anode, the distance between the electrodes has quite a negligible effect upon the dimensions of the dark space, the current, and the potential. The current ceases abruptly, however, when the length of the dark space becomes the same as that distance; also the negative glow terminates sharply (in the case of oxygen amazingly so) over the greater part of its area at a plane exactly parallel to the kathode at a distance from it (D) accurately measurable by means of a simple sighting arrangement. In order to eliminate edge effects and to get a more exact measure of current density, the kathode used was in the form of a disc and guard-ring, that current passing through the disc only being measured. If P = pressure, c = current density, V = potential between electrodes, then very approximately

$$D=\frac{A}{P}+\frac{B}{\sqrt{c}} \qquad V=\frac{F\sqrt{c}}{P}+E,$$

A, B, F, and E being constants for a given gas, the last being very nearly the same as the accepted values of kathode fall with aluminium electrodes in the gas.

These empirical relations, together with other observations, led to the conclusion that *the dark space may be regarded as a region of positive electrification travelling towards the kathode, in which the total positive charge exactly balances the negative charge on the kathode*. The theoretical fall of potential across such a region in which the density of negative electrification is assumed negligible is shown to be $\left(\frac{8\pi c}{\lambda}\right)^{\frac{1}{2}}\frac{2}{3}D^{\frac{3}{2}}$, where λ is the velocity of a positive ion in a unit field and c is the density of the current carried by the positive ions, so that if the latter bear a constant relation to the whole current density passing through the tube, we should expect cPD^3V^{-2} to be a constant for any gas. This is found to be the case for all values of the dark space between 0·5 cm. and 2·0 cm. in the gases under investigation. From the values so obtained the velocities of positive ions at the very low pressures (of the order of 0·2 mm. mercury) employed are calculated, and shown to be of the order expected from the values at atmospheric pressure determined by Zeleny. The stream of positive ions may be strikingly shown by a rotatory mica mill mounted *inside* the dark space, which rotates violently in the *opposite* direction to the familiar ones designed to show the motion of kathode rays away from the electrode. Suggestions are put forward to account for the almost incredible "sharpness" of the edge of the negative glow in oxygen, the most remarkable phenomenon of the investigation.

Mineralogical Society, March 19.—Prof. H. A. Miers, F.R.S., president, in the chair.—The silver deposit or Sedgman lode in the Perran Mine, Cornwall: F. H. **Butler**. The lode runs through killas in an approximately north and south direction. The silver ore, consisting almost solely of cerargyrite, occurs in compact masses or finely disseminated in a gossany limonite. Splintery and ferruginous quartz, the "cab-course," is always a well-developed feature in the richest parts of the lode. The distribution of the cerargyrite, to the depth of 18 fathoms to which the mine has been worked, is roughly in accordance with the surface contour of the land, but segregations have also taken place along a series of lines running from above downwards. The source of the chlorine, the author suggests, might be sea water that has reached abyssal regions.—The minerals of the Silvermines District, co. Tipperary: A. **Russell**. The mines extend along an east and west line of fault in which Silurian, Old Red Sandstone, and Carboniferous rocks are brought into juxtaposition. Along its course in certain places mineralisation has taken place, resulting in contact lodes and metasomatic deposits. In the Ballygowan South mine is an interesting occurrence of hemimorphite, the only one of the kind known in the United Kingdom. The mineral is found in brilliant crystals lining cavities in limonite. The gossan also contains irregular masses of argentiferous galena, partially altered to cerrusite. At the Ballynoe mine, copper pyrites, galena, and barytes form a lode between walls of Silurian and Carboniferous limestone. At the Gortnadyne mine argentiferous tetrahedrite is found with copper pyrites and cerrusite ("cat-tooth ore"). An extensive series of old open workings of galena can be seen at the Shallee East mine.—Baddeleyite from Ceylon: G. S. **Blake** and G. F. Herbert **Smith**. Three brilliant crystals of the mineral were picked out from a number of specimens of the heavy minerals from the gem district of Ceylon which were sent to the Imperial Institute in 1905. Of the three crystals, one possessing only the prism zone was used for analysis, and found to contain nearly 99 per cent. of zirconia. On the other two crystals, one of which was a twin, were observed eleven forms, including one new one (210).—Zinciferous tennantite from the Binnenthal: R. H. **Solly** and G. T. **Prior**. Crystals of tennantite, one of which was a large cube, with faces deeply striated parallel to small tetrahedral faces, were found on analysis to contain nearly 8 per cent. of zinc.—Strüverite, a new mineral: F. **Zambonini** and G. T. **Prior**. This new mineral was found in detrital masses of pegmatite near Craveggia, in N. Piedmont. Crystallographically it is very similar to rutile and tapiolite, with axial ratio $a:c=0{\cdot}6456$. Some of the crystals are elongated along the pyramid edge, and are probably twins similar to those of ilmenorutile. The mineral is black and opaque, and has a specific gravity of 5·59. It contains titanic acid, zirconia, oxide of iron, and niobic and tantalic acid. The result of analyses suggests the formula

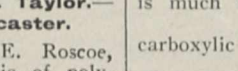
$$3FeO.(TaNb)_2O_5.4ZrO_2.9TiO_2,$$

which may be written as a mixture of the three molecules $Fe(TaNb)_2O_6$, $FeZr_2O_5$, and $TiTi_2O_6$ in the proportion of 1 : 2 : 3. Chemically it is very similar to ilmenorutile, but contains about 28 per cent. of ZrO_2 replacing part of the TiO_2.

Zoological Society, March 19.—Dr. Henry Woodward, F.R.S., vice-president, in the chair.—Recently discovered subfossil Prosimiæ from Madagascar, and their affinities with extant lemurs and with the higher Primates: H. F. **Standing**. The remains were obtained in the muddy bed of a swamp formed by the blocking up of the river Mazy by a lava flow, at from a few inches to 3 feet or 4 feet below the surface. They consisted of a large number of skulls and limb-bones of lemurs and lemur-like animals. This great amount of material enabled the author to corroborate the view, previously put forward by Dr. Forsyth Major, that the extinct lemurs of Madagascar were, in many respects, intermediate between existing lemurs and monkeys, and to express his belief that the New World monkeys and the Lemuridæ, as well as the Malagasy Indrisinæ, had a common origin. He also stated his opinion that it was not possible to separate the Primates, as hitherto, into the two suborders Lemuroidea and Anthropoidea.—Animal parasites: Dr. L. W. **Sambon**. Three new species were described:—*Wellcomia mitchelli*, gen. et sp. nov., habitat, small intestine of *Pedetes caffer*; *Sparganum baxteri*, sp.n.? habitat, connective tissue of man; *Schistosomum mansoni*, sp.n., habitat, blood-vessels of man. Dr. Sambon also described five new Hæmogregarines discovered by Dr. C. G. Seligmann and himself in snakes.—A collection of mammals, the seventh of the series, made by Mr. C. H. B. Grant at Coguno, Inhambane, and presented to the National Museum by Mr. C. D. Rudd: Oldfield **Thomas** and R. C. **Wroughton**. The collection consisted of 212 specimens belonging to thirty-nine species, of which six were described as new.

Entomological Society, March 20.—Mr. C. O. Waterhouse, president, in the chair.—Dr. F. A. **Dixey** exhibited several species of Phrissura and Mylothris, illustrating the remarkable parallelism between different forms of the two genera, a correspondence believed by the exhibitor to have a mimetic significance, the mimicry being probably of the Müllerian kind.—The following papers were communicated:—Studies of the Tetriginæ in the Oxford Museum: J. L. **Hancock.**—A list of the Coleoptera of the Maltese Islands: M. **Cameron,** R.N., and A. **Camana.**—The life-history of *Spindasis lohita*, Horsf.: J. C. **Kershaw.**—The egg cases and early stages of some South China Cassididæ: J. C. **Kershaw** and F. **Muir.**—The life-history of *Tessaratoma papillosa*, Thunb., with notes on the stridulating organ and stink gland: F. **Muir** and J. C. **Kershaw.**—The vinegar fly (*Drosophila funebris*): E. E. **Unwin.**—The structure and life-history of the holly fly: Prof. L. C. **Miall** and T. H. **Taylor.**—Note on *Xanthorhoë ferrugata*, Clerck: L. **Doncaster.**

Chemical Society, March 21.—Sir Henry E. Roscoe, F.R.S., past-president, in the chair.—Synthesis of polypeptides: E. **Fischer.** Continuing his work on the synthesis of polypeptides, the author has prepared an octadecapeptide containing fifteen glycocoll and three *l*-leucine residues.—Organic derivatives of silicon, part iii., *dl*-benzylmethylethylpropylsilicane and experiments on the resolution of its sulphonic derivative: F. S. **Kipping.** *dl*-Benzylmethylethylpropylsilicane is sulphonated by sulphuric acid at about 130°, yielding a mixture of acids, of which two, benzylethylpropylsilicol-sulphonic acid and *dl*-benzylmethylethylpropylsilicane-sulphonic acid, were isolated in the form of their *l*-menthylamine salts.—The reduction of carbon dioxide to formaldehyde in aqueous solution: H. J. H. **Fenton.** By the action of metallic magnesium on an aqueous solution of carbon dioxide, recognisable quantities of formaldehyde can be obtained, and the amounts formed are considerably increased in the presence of weak bases.—The mechanism of the rusting of iron: G. T. **Moody.** An experiment was described and shown which proved that in the formation of iron rust the metal must actually first pass into solution, and hence confirmation is obtained of the view that an acid, *e.g.* carbonic acid, is an essential factor in the rusting of iron.—Influence of non-electrolytes and electrolytes on the solubility of sparingly soluble gases in water. The question of hydrates in solution: J. C. **Philip.** The influence of non-electrolytes and electrolytes on the solubility of gases may be interpreted by supposing (1) that the non-solute takes no part in the absorption, and (2) that hydration of the non-electrolyte or electrolyte may occur, and the solvent thus attached is no longer free to absorb the gas.—A new class of organo-metallic compounds. Preliminary notice. Trimethylplatinimethyl hyroxide and its salts: W. J. **Pope** and S. J. **Peachey.** The chlorides of iron, cobalt, nickel, ruthenium, rhodium, palladium, osmium, iridium, platinum, and gold react vigorously with magnesium methyl iodide; trimethylplatinimethyl iodide, the corresponding hydroxide, nitrate, chloride, bromide, and cyanide have been prepared by this means.—Some compounds of guanidine with sugars, part i.: R. S. **Morrell** and A. E. **Bellars.**—The action of aluminium chloride on naphthalene. Formation of ββ-dinaphthyl, tetranaphthyl, and tetramethylerythrene; Miss A. **Homer.**—Mercurous hyponitrite: P. C. **Rây.**—The decomposition of mercurous and silver hyponitrites by heat: P. C. **Rây** and A. C. **Gañguli.** From the results obtained the authors are of opinion that these salts have both an oxylic and imidic constitution.—Studies in optical superposition, part iii.: T. S. **Patterson** and J. **Kaye.** The results of observation of the rotation of *l*-menthyl diacetyl-*l*-tartrate, both in the homogeneous state and in solution in ethyl alcohol, benzene, and nitrobenzene, taken in conjunction with those previously published (Trans., 1905, lxxxvii., 33; 1906, lxxxix., 1884), furnish thoroughly valid evidence as to the untenability of van 't Hoff's assumption regarding optical superposition.—An extension of the benzoin synthesis: R. W. L. **Clarke** and A. **Lapworth.** Benzylideneaniline hydrocyanide condenses with carvone and with benzylideneacetophenone to form respectively phenylimino-β-benzoyldihydrocarvone and γ-cyano-α-benzoyl-γ-anilino-βγ-diphenylpropane. — Interaction of starch and carbon disulphide. Xanthogenic esters of starch: C. F. **Cross,** E. J. **Bevan,** and J. F. **Briggs.** Starch moistened with the disulphide and then treated with a sodium hydroxide solution is brought into the condition for quantitative reaction and conversion into the xanthogenic ester (sodium salt).—The estimation of small quantities of nitrogen peroxide: R. **Robertson** and S. S. **Napper.** The method depends on the changes observed in the characteristic absorption spectrum of nitrogen peroxide as its concentration in dilute mixtures is increased.—The evolution of nitrogen peroxide in the decomposition of guncotton: R. **Robertson** and S. S. **Napper.**—An isomeric change of dehyracetic acid: J. N. **Collie** and T. P. **Hilditch.** If sulphuric acid of about 85 per cent. instead of about 90 per cent. is allowed to act on dehydracetic acid, the yield of triacetic lactone is much diminished. The by-product formed is pyrone-carboxylic acid,



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PARIS.

Academy of Sciences, March 25.—M. A. Chauveau in the chair.—The approximate theory of the flow over a vertical weir, with sharp edge, without lateral contraction and in a free sheet: J. **Boussinesq.** A further approximation of a formula arrived at in a previous paper. The results are in accord with the experimental figures of M. Bazin.—Contribution to the study of phosphorescence: Henri **Becquerel.** The images of two specimens of the same phosphorescent salt, one being at the ordinary temperature and the other at the temperature of liquid air, were thrown simultaneously on the slit of a spectroscope. The changes thus noted for several uranium salts in the phosphorescent spectra are given in detail. The increased sharpness of the bands at the lower temperature enabled the polarisation effects to be studied. Those salts of uranium which can be obtained in well-defined crystals, cooled to the temperature of liquid air, and illuminated with violet light, show no change in the spectrum when the incident light is polarised, but a change in the spectrum is observed if a Nicol is interposed between the phosphorescent crystal and the spectroscope.—A generalisation of the movement of Ponsot: L. **Lecornu.**—The coefficient of resistance of air to be adopted in calculations regarding aëroplanes: F. **Ferber.**—Rotatory magnetic polarisation in the neighbourhood of absorption bands. The magnetic rotatory power of crystals at the temperature of liqui air: Jean **Becquerel.**—The theory of the radiation of incandescent mantles: M. **Foix.** It is shown that the sole function of the thorium oxide is to form a support for the cerium oxide.—The influence of the surrounding temperature on the luminous intensity of an incandescent electric lamp: F. **Laporte** and R. **Jouaust.** A theoretical investigation of the effect of increase of temperature on the luminous intensity of an electric lamp shows that for a rise of 100° C. in the temperature of the lamp an increase in the luminosity of 0·4 per cent. might be expected. Direct experiment showed that the light remained constant for a rise of 100° C., and as the experimental error was of the order of 1 per cent., this is in agreement with the theoretical figure.—The supplementary channelling of spectra produced by parallel gratings: Georges **Meslin.**—The function and the nature of the initial discharge in the electric spark: G. A. **Hemsalech.**—The formation of ammonia gas from its elements under the influence of the electric spark; the influence of pressure: E. **Briner** and E. **Mettler.** The concentration of ammonia gas formed by electric sparks in a closed vessel attains a limit of about 3 per cent. to 4 per cent. at the ordinary temperature. If, however, the reaction vessel has its lower end placed in liquid air, the ammonia is condensed as fast as it is formed, and the reaction becomes complete. Working in this way, and starting with a mixture of nitrogen and hydrogen in the correct proportions, a nearly total vacuum can be obtained in the apparatus. A curve is given showing the effect of pressure on the yield; a pressure of 100 mm. of mercury was found to be the most favourable, the yield being 0·17 gram of

ammonia per kilowatt hour.—The age of the calcareous strata in the neighbourhood of Athens: Const. A. **Ktenas.**

April 2.—M. A. Chauveau in the chair.—The calculation of the inferior contraction of the sheet flowing over a weir with sharp edge and moderate height, and fitted with a horizontal plate above: J. **Boussinesq.**—An extension of the summation method of M. Borel: A. **Buhl.**—The nature of the body extracted from certain rich alloys of nickel and tin: Em. **Vigouroux.** Following the methods described in a previous paper, the substance NiSn has been isolated as a crystalline powder, showing brilliant facets under the microscope. It is non-magnetic, and has a density of 8·44, the density calculated from its composition on the assumption of no contraction being 7·93.—The influence of manganese salts on alcoholic fermentation: E. **Kayser** and H. **Marchand.** The increased yield in alcohol resulting from the addition of minute proportions of manganese salts has been shown in a previous paper; it is now shown that yeast thus treated preserves its acquired properties through several generations, and the practical applications of this fact are indicated.—Rectal gills in the larvæ of *Simulium damnosum*. The adaptation of a larva of Simulium to life in the streams of equatorial Africa: E. **Roubaud.**—The nephro-poïetic activity of the blood and of the kidney in the course of the renal regenerations: P. **Carnot** and A. **Lelièvre.**—The evolution of carbon, water, and ash as a function of the age in plants: J. **Tribot.**—Some seismic constants deduced from the earthquake of April 4, 1904: E. **Oddone.**

DIARY OF SOCIETIES.

THURSDAY, APRIL 11.

ROYAL INSTITUTION, at 3.—The Birth and Affinities of Crystals: Prof. Henry A. Miers, F.R.S.

MATHEMATICAL SOCIETY, at 5.30.—A Theorem in the Theory of Functions: Dr. H. F. Baker.

FRIDAY, APRIL 12.

ROYAL INSTITUTION, at 9.—Conservation of Historic Buildings and Frescoes: Prof. A. H. Church, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—An Engineer's Visit to Japan and Canada: R. W. Allen.

MALACOLOGICAL SOCIETY, at 8.—Notes on New Zealand Polyplacophora, with Descriptions of Five New Species: H. Suter.—Descriptions of New Mollusca from New Caledonia: G. B. Sowerby.—Some New Species of Drymæus from Peru, Mexico, &c.: S. I. Da Costa.—A New Species of Vallonia from India: G. K. Gude.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—*Continued discussion*:—Petrol Motor-Omnibuses: W. Worby Beaumont.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Early and late Perseids: W. F. Denning.—Determinations of Personal Equation depending on Magnitude, made with the Transit-Circle and the Heliometer at the Royal Observatory, Cape of Good Hope: Sir D. Gill and S. S. Hough.—Determination of the Secular Perturbations of the Minor Planet Ceres, arising from the Actions of the Eight Major Planets: C. J. Merfield.—The Electric Arrangements of an Observatory: W. E. Cooke.—*Probable Papers*: The Perturbations of Halley's Comet: P. H. Cowell and A. C. D. Crommelin.—On the Value of the Solar Parallax from the Greenwich Photographs of Eros, 1899–1900: Royal Observatory, Greenwich (Communicated by the Astronomer Royal).

SATURDAY, APRIL 13.

ROYAL INSTITUTION, at 3.—Studies in Magnetism: Prof. Silvanus P. Thompson, F.R.S.

MONDAY, APRIL 15.

SOCIETY OF ARTS, at 8.—Detergents and Bleaching Agents used in Laundry Work: Prof. Herbert Jackson.

TUESDAY, APRIL 16.

ROYAL INSTITUTION, at 3.—Wings and Aëroplanes: Prof. G. H. Bryan, F.R.S.

SOCIETY OF ARTS, at 8.—Joinery and Furniture Making: A. Romney Green.

ROYAL STATISTICAL SOCIETY, at 5.

ANTHROPOLOGICAL INSTITUTE, at 8.15.—Note on some Palæolithic and Neolithic Implements from East Lincolnshire: S. H. Warren.—Exhibition of Flints from Cornwall: A. L. Lewis and S. H. Warren.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Pyrmont Bridge: P. Allan.—Swing Bridge over the River Avon at Bristol: W. H. B. Savile.

WEDNESDAY, APRIL 17.

GEOLOGICAL SOCIETY, at 8.—The Toadstones of Derbyshire: their Field-Relations and Petrography: H. H. Arnold-Bemrose.—Data bearing on the Age of Niagara Falls: Prof. J. W. W. Spencer.

ROYAL MICROSCOPICAL SOCIETY, at 8.—On the Podura Scale: E. M. Nelson.—Exhibition of Slides of Foraminifera: A. Earland.

SOCIETY OF ARTS, at 8.—Aërial Navigation: Major B. F. S. Baden-Powell.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Phenomenal Rainfall in Suva, Fiji, August 8, 1906: R. L. Holmes.—Temperature around the British Islands in Relation to the Gulf Stream: R. Strachan.—Weather regarded as a Function of Climate: L. C. W. Bonacina.

THURSDAY, APRIL 18

ROYAL SOCIETY, at 4.30.—*Probable Papers*: On Reciprocal Innervation of Antagonistic Muscles: Tenth Note: Prof. C. S. Sherrington, F.R.S. Fatty Degeneration of the Blood: S. G. Shattock and L. S. Dudgeon.—(1) The Rate of the Assumption of Chloroform by the Blood during Anæsthesia; (2) Function of the Red Corpuscles in Chloroform Anæsthesia: G. A. Buckmaster and J. A. Gardner.—The Fermentation of Glucosides by Bacteria of the Typhoid-coli Group, and the Acquisition of New Fermenting Powers by *Bacillus Dysenteriae* and other Micro-organisms: F. W. Twort.

ROYAL INSTITUTION, at 3.—The Birth and Affinities of Crystals: Prof. Henry A. Miers, F.R.S.

LINNEAN SOCIETY, at 8.—On the Œcologic Functions of Stolons and Cleistogamous Flowers: J. C. Shenstone.—On the Œcologic Aspect of Constitutional Variation in Fruit-culture: A. O. Walker.—On an Aberrant Form of Coccidæ: Hugh Scott.—Some Results of Inoculation of Leguminous Plants: Prof. W. B. Bottomley.—*Exhibits*: Nepal Barley and other Cereals cultivated at High Altitudes in Tibet: Dr. George Henderson.—Photographs of Sections of Woods: J. A. Weale.—Lantern Slides of Witches' Brooms: J. Saunders.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Flexibles: with Notes on the Testing of Rubber: A. Schwartz.

CHEMICAL SOCIETY, at 8.30.—The Magnetic Rotation of Hexatriene, $CH_2:CH.CH:CH.CH:CH_2$, and its Relationship to Benzene and other Aromatic Compounds, also its Refractive Power: Sir W. H. Perkin.—Aromatic Azoimides, Part i., *p*-Hydroxyphenylazoimide: M. O. Forster and H. E. Fierz.—The Action of Hydrogen Peroxide on Potassium Cyanide: O. Masson.—The Action of Ethyl Oxalate on Thioacetanilide and its Homologues: S. Ruhemann.—Measurements of the Velocities of Saponification of the *l*-Menthyl and *l*-Bornyl Esters of the Stereoisomeric Mandelic acids: A. McKenzie and H. B. Thompson.—Indican: Preliminary Notice: A. G. Perkin and W. P. Bloxam.—Cupric Nitrite: P. C. Rây.—The Constituents of the Essential Oil of American Pennyroyal: Occurrence of a Dextro-Menthone: M. Barrowcliff.—The Action of Tribromopropane on the Sodium Derivative of Ethyl Acetoacetate: T. E. Gardner and W. H. Perkin.

FRIDAY, APRIL 19.

ROYAL INSTITUTION, at 9.—Nerve as a Master of Muscle: Prof. C. S. Sherrington, F.R.S.

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