report is illustrated by maps, photographs, and diagrams; and the statistical tables are admirably compiled.

THE January number of the *American Geologist* contains an account of the late Prof. J. D. Dana, with a portrait and bibliography. Mr. Warren Upham discusses the flow of glacial ice, with especial reference to the views of Messrs. Fletcher and Deeley, mentioned in these columns about a year ago. A description of cases of the flotation of sand, by Mr. F. W. Simonds, and an essay on the use of Palæontology as "The Timepiece of Geology," by Prof. Claypole, are among the other contents.

THE *Annuaire* of the Municipal Observatory of Montsouris for this year has just come to hand; the observations—meteorological, chemical, and bacteriological—tabulated and discussed in it, refer to the year 1894. Another *Annuaire* which we have received is that of the Belgium Académie des Sciences, des Lettres, et des Beaux-Arts. A full notice of the life and mathematical works of Eugéne Charles Catalan, with a portrait, appears in this annual of the Brussels Academy.

WITH the motto *Magnus magnes ipse est globus terrestris*, the new international quarterly journal, *Terrestrial Magnetism*, the forthcoming publication of which was announced in these columns a few weeks ago, has made its appearance. The articles in the journal are: "On electric currents induced by rotating magnets, and their application to some phenomena of terrestrial magnetism," by Prof. A. Schuster; "Die vertheilung des Erdmagnetischen Potentials in Bezug auf Beliebige Durchmesser der Erde," by Dr. A. Schmidt; and "Halley's Earliest Equal Variation Chart," by Dr. L. A. Bauer, the map being reproduced in facsimile. There are also letters, notes, and reviews dealing with terrestrial magnetism and cognate subjects. The journal is published under the auspices of the Ryerson Physical Laboratory, University of Chicago.

WE have had upon our table for some time a copy of Napier's celebrated and rare work on the construction of logarithms—"Mirifica Logarithmorum Canonis Constructio"—reprinted in facsimile by M. A. Hermann, 8 Rue de la Sorbonne, Paris. Napier's discovery of logarithms was announced in his "Mirifici Logarithmorum Canonis Descriptio," published in 1614; but the explanation of the method by which the logarithms were calculated appeared in the "Constructio," a posthumous work not issued until 1620. To this work, which M. Hermann has now reprinted, Henry Briggs, who was one of the first to recognise the value of logarithms, appended some notes. The reprint will be valued by all students of the history of mathematics.

THE Geological Society of London has just published a list of the geological literature added to its library during the year 1895. As compared with the only previous issue in this form, we note that while the price remains unaltered, the volume has swollen to nearly threefold—an increase only partly accounted for by the fact that the present list represents a whole year's additions as against a half-year's in the previous one. The omission of maps from the list, to which we drew attention when the previous list was published, has been repaired; maps are entered under the names of the authors responsible for them in the general list, but there are cross-references under "Maps" in the subject-index. The publication will be found a most useful one by all geologists.

THREE papers were read at the recent meeting of the Institution of Mechanical Engineers, viz.: "Telemeters and Range-Finders for Naval and other Purposes," by Profs. Barr and Stroud; "Calculation of Horse-power for Marine Propulsion," by Lieut.-Colonel Thomas English; "Notes on Steam Superheating," by Mr. William H. Patchell. The paper by Profs. Barr and Stroud was confined to a description of two instruments, viz. (1) the range-finder which is now in use in the navies of this and many other countries; and (2) a small hand instrument, identical in principle with that for naval use, but much more portable and much simpler in its details. Lieut.-Colonel English's paper called attention to a method of calculating, from the results of a single sea-trial of one ship, the horse-power necessary to propel another ship, of the same type, at any required speed. By this method it becomes practicable, with the ordinary appliances of a shipyard, to approximate closely to results which could otherwise be obtained only by the use of the refined apparatus of a model tank. Mr. Patchell described a number of superheaters, and gave the results of tests with them.

THE additions to the Zoological Society's Gardens during the past week include a Klippspringer (*Oreotragus saltatrix*, ♂) from Nubia, presented by Commander Alfred Paget, R.N.; an Indian Wolf (*Canis pallipes*, ♂) from India, presented by Mr. Duncan Darroch; a Barn Owl (*Strix flammea*), British, presented by Mr. Bernard R. White; a Gould's Monitor (*Varanus gouldi*) from Australia, presented by Mr. Arthur R. H. W. Leach; a Sharp-nosed Crocodile (*Crocodilus acutus*) from Jamaica, presented by Mr. Arthur P. Cohen; a West African Love Bird (*Agapornis pullaria*) from West Africa, presented by Mrs. Roberts; an Alpine Marmot (*Arctomys marmotta*), European, a Yellow-headed Conure (*Conurus jendaya*) from South-east Brazil, deposited; a Crested Grebe (*Podiceps cristatus*), a Curlew (*Numenius arquata*), British, purchased; a Malaccan Parrakeet (*Palæornis longicauda*) from Malacca, received in exchange; two Rufous Rat Kangaroos (*Hypsiprymnus rufescens*, ♂ ♂), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

THE ASTROPHOTOGRAPHIC CATALOGUE.—At the last meeting of the Royal Astronomical Society, the Astronomer Royal gave some particulars relating to the progress at Greenwich of the international photographic star catalogue. A special staff for dealing with this work has been organised under Mr. Hollis, and already 130 of the plates taken for the catalogue have been measured. It is estimated that about 180 plates can be measured, and 160 of them reduced in the course of a year, so that at this rate the section allotted to Greenwich, comprising about 150,000 stars, will be completed in five or six years. Assuming that the other sixteen co-operating observatories are proceeding equally well, the world will soon be in possession of a colossal catalogue, comprising between two and three million stars.

ORBIT OF α CENTAURI.—Dr. Doberck, of the Hong Kong Observatory, has revised the elements of the orbit of α Centauri, which he determined in 1877, with the following results (*Ast. Nach.*, No. 3330).

Ω	...	25° 25′	T	...	1876·02
λ	...	52° 53′	*e*	...	0·51184
γ	...	79° 14′	P	...	79·123 years
μ	...	4°·54987	*a*	...	18″·450

The sum of the masses, as determined from these elements, is 2·3780 times the mass of the sun. Taking the parallax as 0″·75 the major semi-axis is 24·60 times the earth's distance from the sun, so that the distances between the components are about the same as those of the outer planets from the sun in our own system. If the diameters of the stars are not very different from that of our sun, each would appear from the other as a mere star to unaided vision, the distance being too great to show a disc. An ephemeris up to 1920 is given in the paper, as well as a comparison of observations with the places calculated from the adopted orbit.

COMETS OF SHORT PERIOD.—From an interesting article on comets of short period, by Mr. W. E. Plummer (*Knowledge*, February), we extract the following table, indicating the comets which may with reasonable certainty be expected to reappear.

They are arranged in the order of the mean distances from the sun.

Name.	Period in years.	Date of last Perihelion passage.	Approximate date of next return.
Encke	3·303	1895, Feb. 4	1898, May 26
Tempel	5·211	1894, April 23	1899, July 10
Tempel-Swift ...	5·534	1891, Nov. 14	1897, May 28
Winnecke	5·818	1892, June 30	1898, April 25
Finlay	6·627	1893, July 12	1900, Feb. 26
D'Arrest	6·691	1890, Sept. 17	1897, May 27
Wolf	6·821	1891, Sept. 3	1898, June 30
Faye	7·566	1896, March 19	Now visible.

The mean distances of the comets from the sun range from 2·218 to 3·854, but the aphelion distances do not vary so greatly in proportion—a fact which suggests the controlling influence of Jupiter. It is remarkable that such a small number of regularly returning comets seem to be permanently attached to our system.

EFFECT OF SPOTS ON SUN'S DIAMETER.—Observations of the sun's diameter, made in the latter half of last year by J. Sykora, of the Charkow Observatory, have led to a result which may be of considerable importance if established by further investigations (*Ast. Nach.*, No. 3330). The observations were made with a 6-inch refractor by projecting the image of the sun together with that of the micrometer wires. The diameter measured in the direction of the points of appearance or disappearance of spot groups was found in the great majority of cases to be greater than the diameters in neighbouring parts of the sun as measured on the same days. Some of the results are as follows, the first column giving the diameter in the direction of spot groups, and the other two showing adjacent diameters:

	m. s.	m. s.	m. s.
June 22 ...	2 8·62 ...	2 8·38 ...	2 7·97
July 5 ...	8·37 ...	8·04 ...	8·21
,, 12 ...	8·30 ...	8·27 ...	8·27
Sept. 5 ...	8·52 ...	8·25 ...	8·44
,, 9 ...	8·41 ...	8·29 ...	8·36

It is concluded that although the spots themselves may be depressions, they produce an elevation of the surface of the sun in the regions where they are formed.

THE SPECULATIVE METHOD IN ENTOMOLOGY.

THE annual general meeting of the Entomological Society of London was held on January 15, the President, Prof. R. Meldola, F.R.S., being in the chair. After referring to the affairs of the Society and to the great literary activity of English entomologists during the past year, the President called attention to Mr. Oswald Latter's discovery of the secretion of potassium hydroxide by *Dicranura vinula*, &c., and to Mr. F. Gowland Hopkins's researches on the pigments of Pierine butterflies. The address then proceeded as follows :—

The association of chemistry and biology in researches such as those to which I have drawn attention, has suggested a comparison between the methods of research in vogue in the two great departments of science of which these two subjects are respectively typical. All science necessarily begins with observation or experiment, *i.e.* with ascertained facts, and it is perhaps unnecessary to assert that no mere collection of facts can constitute a science. We begin to be scientific when we compare and coördinate our facts with a view to arriving at generalisations on which to base hypotheses or to make guesses at the principles underlying the facts. Having formed the hypothesis we then proceed to test its accuracy by seeing how far it enables us to explain or to discover new facts, and if it fails to do this to our satisfaction we conclude that our guess has been a bad one and requires modification or replacing by a better one, *i.e.* by one more in harmony with the facts. I take it that the course of progress is the same in so far as these fundamental methods are concerned in both departments of science, the physical and the biological. It is possibly a matter of individual opinion as to how large a body of facts should be accumulated before we attempt to draw any general conclusions. There can be no doubt that the requirements of one branch of science cannot be measured by those of another branch to which it has no near relationship. But however large the number of facts, and however cautious or conservative the worker may be, it is an established doctrine taught by the whole history of science, that real progress only begins when we go to seek for facts armed with at least the suggestion of a principle if not with a complete theory based on facts already accumulated by observation or experiment. This is the whole difference between scientific observation or experiment and mere random or haphazard observation. A naturalist of the old school, William Swainson, writing in 1834,[1] speaks of the "observance of nature, without making any attempt to generalise the facts so acquired," as "a mere amusement, fascinating indeed, and even useful, but totally disconnected with the objects of philosophic science." Now I venture to think that entomology in this country has been retarded in its development for want of a little more of this "philosophic science"; by an unwillingness on the part of our most active workers to give rein to the imagination—by an overcautiousness which is damping to the speculative faculty. There are no doubt many present who will not agree with this view, but I claim indulgence while I state my case in its support. It will, I think, be conceded that we have passed beyond the mere fact-collecting stage. It appears to me that in entomology we have arrived at a state where we are suffering from a plethora of facts; if we are not in a position to explain everything connected with the development, life-histories, instincts, classification and distribution of insects as a class of animals, we are at any rate in a position, speaking paradoxically, to know what we want to know, and I do not see how we are going to advance unless a more generous use is made of hypothesis as a scientific guide. It is this point which I desire to urge and to show that there is no real danger in boldly facing what the late Dr. Romanes aptly calls the bugbear speculation.

In the first place, with respect to the physical sciences, there is abundant justification for the view which I am advocating. We have there long ceased to collect random facts; observations and experiments are suggested by hypothesis. That prince among experimental philosophers, Michael Faraday, was wont to say: "Let us encourage ourselves by a little more imagination prior to experiment." The state of affairs is well summed up in one of the latest works on chemistry in which the author, in introducing the fundamental principles of modern investigation says:

"The history of the exact sciences teaches us that we may discover new laws of nature in two essentially different ways, one of which may be designated as the empirical, the other as the theoretical. Thus in one way by suitable observations, one collects abundant material . . . and then by a repeated and purely empirical grouping of the data so obtained, he seeks to approach the desired goal. . . . The second way, on the other hand, leads from suggested conceptions regarding the nature of certain phenomena, through pure speculation to new information, the correctness of which must be determined by a subsequent research."[2] One other recent utterance by my colleague, Dr. W. M. Hicks, the President of Section A at the last Ipswich meeting of the British Association, will serve to give us a glimpse into the spirit of progress in pure physics: "By our imagination, experience, intuition, we form theories; we deduce the consequences of these theories on phenomena which come within the range of our senses, and reject or modify and try again. It is a slow and laborious process. The wreckage of rejected theories is appalling; but a knowledge of what actually goes on behind what we can see or feel is surely, if slowly, being attained. It is the rejected theories which have been the necessary steps towards formulating others nearer the truth."[3]

And now let us consider how far these methods, recognised as valid in the physical sciences, are applicable to the biological sciences, of which entomology constitutes a branch. Of course, I am not claiming for our subject the position of an exact science, and to suppose that it could be advanced by purely deductive methods would be absurd. But I am endeavouring to hold the balance between a more liberal use of the speculative method, on the one hand, and the deadening influence of refusing to speculate at all, on the other hand. I am putting forward a plea for an increased use of the imagination, because I hold that

[1] 'Preliminary Discourse on the Study of Natural Science," p. 51.
[2] "Theoretical Chemistry," by Walter Nernst, translation by Prof. Palmer, 1895, p. 2.
[3] Address to the Mathematical and Physical Section of the British Association, Ipswich 1895.