

centre of study and research in palæontology. Increasing interest in the Museum has been evinced by all classes of the citizens of New York. Every course of lectures has been attended by crowded audiences, and pupils of public and private schools, as well as students of science, have derived advantage from the library as well as from the collections.

SEVERAL new editions of scientific works have reached us during the past few days. The first volume of a new edition of Prof. Fleming's systematic treatise on "The Alternate Current Transformer," dealing with the induction of electric currents, has been published by the *Electrician* Printing and Publishing Co. The great progress made during the seven years which have elapsed since the appearance of the original work, has necessitated a thorough revision of the matter, and the volume as it stands now will be appreciated by all who are concerned with alternating-current practice or investigations. Another volume having practical electricity for its subject is "Electric Lighting and Power Distribution" (Whittaker and Co.), by W. Perren Maycock. The first volume of the third edition of this work has been issued in an enlarged form, after careful revision. The second edition of the first volume of Dr. Schlich's "Manual of Forestry" has been published by Messrs. Bradbury, Agnew, and Co. The original was reviewed in NATURE in December 1889 (vol. xli. p. 121), and quite recently (April 2, p. 510) was referred to in these columns. The second edition contains a new part on the State in relation to forestry, and a general review of the timber requirements of the British Empire. Messrs. Longmans, Green, and Co. have issued a second edition of "The Essentials of Chemical Physiology," by Dr. W. D. Halliburton. The chief alterations made are those rendered necessary by the advance of knowledge since 1893, when the first edition was published. The fifth edition of "Southall's Organic Materia Medica," by J. Barclay, has been published by Messrs. J. and A. Churchill. To quote the sub-title, the volume is "a handbook treating of some of the more important of the animal and vegetable drugs made use of in medicine, including the whole of those contained in the British Pharmacopœia." New editions of two volumes by the late Dr. J. E. Taylor, have been received from Messrs. W. H. Allen and Co. The books are "Nature's Byepaths," a series of recreative papers in natural history, and "The Aquarium," a popular manual on the history, construction, and principles of management of public aquaria. Dr. G. Herbert Fowler has edited the sixth edition of the late Prof. Milne Marshall's valuable work on the anatomy, histology, and embryology of "The Frog" (David Nutt). A few additions and alterations have been made, but the work remains substantially the same practical and educational handbook that it ever was. Finally, the recent changes in the Physiography Syllabus of the Department of Science and Art have resulted in the production of a new edition (the sixth) of "Earth Knowledge" (Part II.) by W. Jerome Harrison and H. R. Wakefield. The book follows the Department's Advanced Syllabus, and appears to fulfil the purpose for which it has been designed.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus*) from India, presented by Sir William Call; a Blue-bearded Jay (*Cyanocorax cyanopogon*) from Para, presented by Mr. H. C. T. Beadnell; four Puff Adders (*Vipera arietans*), two Ringhals Snakes (*Sepedon hemachates*), an Egyptian Cobra (*Naja haje*), three Cape Vipers (*Causus rhombeatus*), a Cape Bucephalus (*Bucephalus capensis*), two Infernal Snakes (*Boodon infernalis*), a Nilotic Monitor (*Varanus niloticus*) from South Africa, presented by Mr. J. E. Matcham; a Grey Ichneumon (*Herpestes griseus*) from India, deposited; two Indian Tree Ducks (*Dendrocygna javanica*) from India, purchased; a Japanese Deer (*Cervus sika*), born in the Gardens.

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OUR ASTRONOMICAL COLUMN.

TEMPERATURE ERRORS IN MERIDIAN OBSERVATIONS.—M. Hamy has applied his method of interference fringes to a study of the errors caused in meridian observations by the radiations of the sources of light usually employed in observatories, as well as those due to the presence of the observer himself (*Bull. Ast.*, vol. xiii. p. 178). The researches have completely demonstrated that the unequal distribution of light sources may produce errors in the measures amounting to several seconds of arc, while the heat from the observer may affect the results to the extent of several tenths of a second. It is evident therefore that the subject is one of great importance, and the interferential method is specially adapted for its investigation. M. Hamy has arrived at his conclusions from experiments made with the Gambey meridian circle of the Paris Observatory. In the case of an ordinary gas flame at a distance of 0.83 metre from the telescope, the mean angular displacement of the optic axis with respect to the meridian amounted to 2".1, the flame being lit for ten minutes. Other observations indicate that the deviation is sensibly in inverse proportion to the square of the distance of the flame from the optic axis. The effects of different sources of light were also compared at one metre distance, and the practical outcome is that gas flames provided with chimneys are to be studiously avoided, the variation in collimation amounting in this case to 4".4. The errors due to the heat of the human body are greatest in the case of declination measures, owing to the greater heating of the under side of the telescope tube. It is evident that these errors will depend to some extent upon the materials of which the instrument is constructed, and M. Hamy is of opinion that the best possible material is a metal of high conductivity, such as copper, in which case inequalities of temperature would be almost impossible.

SEARCH EPHEMERIS FOR COMET 1889 V.—The following is a continuation of Dr. Bauschinger's search ephemeris for the return of Brooks's periodic comet (1889 V) (*Ast. Nach.*, No. 3350).

	R.A.	Decl.	Bright- ness.
	h. m. s.	° ' "	
May 28 ...	22 2 38	- 19 44	0.44
June 1 ...	7 17	19 29	0.48
5 ...	11 43	19 14	0.52
9 ...	15 54	19 1	0.56
13 ...	19 49	18 49	0.61
17 ...	23 26	18 39	0.66
21 ...	26 44	18 30	0.71
25 ...	22 29 44	- 18 22	0.77

The unit of theoretical brightness is that on 1889 July 8, the date of the first accurate observation. The comet was last seen in January 1891, at the Lick Observatory, when the calculated brightness was only 0.08. During June the computed path lies in the southern part of Aquarius, so that observations can only be made in the early morning.

CONSTANTS FOR NAUTICAL ALMANACS.—At a convention of Directors of Nautical Almanacs, held at Paris after the recent congress of the International Photographic Chart, Dr. Gill's value of the solar parallax (8".80), resulting from heliometer observations of minor planets, was adopted, and consequently the constant of aberration becomes 20".47. Dr. Gill's value for the mass of the moon, leading to 6".21 for the nutation, was also adopted, and Newcomb's value was accepted for the precession.

THE PLANET MERCURY.—A postcard from Dr. Kreutz, Kiel, contains the information that Mr. Leo Breaner, of the Manora Observatory, saw the dark part of the planet Mercury sharp and distinct on May 18, at 23h. Manora time.

STELLAR PHOTOGRAPHY WITH SMALL TELESCOPES WITHOUT DRIVING-CLOCKS.

STELLAR photography has now become such an important branch of astronomy, that anything which will encourage possessors of small telescopes to turn their energies in this direction will tend towards the advancement of the celestial sciences. It is proposed to show here that useful work may be done by amateur astronomers with their ordinary small refractors, and with none of the mechanical contrivances which are essential for such large telescopes as are used in the international photographic survey of the heavens, which are driven by elaborate and

costly machinery in order that the camera shall follow the apparent motion of the stars.

The accompanying photographs were taken with a $3\frac{1}{4}$ -inch refracting telescope of 29 inches focus, totally unprovided with any driving mechanism, not even a tangent screw and slow-motion rod, the guiding having been performed entirely by hand. The correct rate of angular motion was secured by constant visual observation of the image of a star, much out of focus, as seen in a $2\frac{1}{4}$ -inch guiding telescope, carrying an eyepiece magnifying fifty times. This was mounted side by side with the telescopic camera, and moved with it.

Fig. 1 shows the instruments mounted on a firm equatorial stand which is supported on a home-made brick pillar. The $2\frac{1}{4}$ -inch guiding telescope, by Cooke of York, is seen on the left, provided with its total reflection prism and eyepiece, and just above it is a small "finder." On the extreme left is a counterpoise which balances the $3\frac{1}{4}$ -inch photographic telescope, which is on the opposite side of the declination axis, and is mounted in a home-made wooden tube of square section, with dew-cap and diaphragms of the same material. At the lower end the dark slide is seen, and behind is a smaller camera which carries an ordinary portrait lens of $2\frac{1}{4}$ -inch aperture, which is used for obtaining a duplicate photograph, on a smaller scale, simultaneously with the larger one. The whole is so evenly balanced by the two

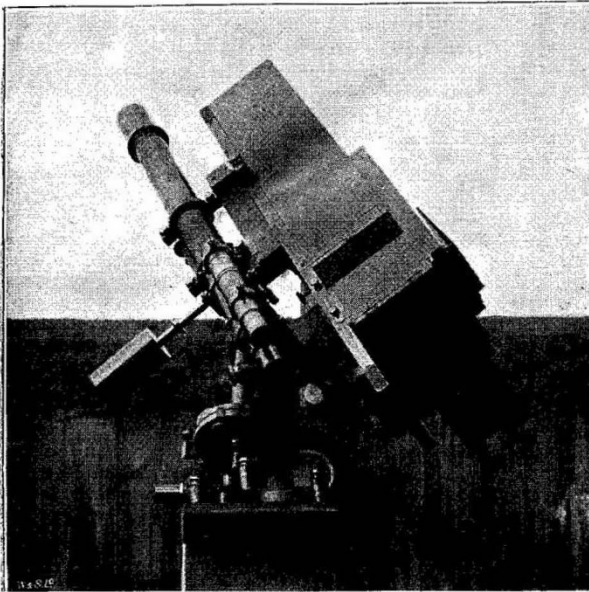


FIG. 1.— $3\frac{1}{4}$ inch Equatorial Photographic Telescope (as used for hand driving).

counterpoise weights—one of which is seen low down on the right—that when unclamped it remains at rest in any position. Adjusting screws are provided in order to move the telescopic camera slightly in right ascension or declination whilst the guiding telescope remains stationary. This enables one to use the nearest bright star for guiding purposes when the centre of the photographic field contains no conspicuous stars. Absolute parallelism of the two telescopes is of no importance, but their rate of angular motion must be identical. Interesting results can be obtained with such a telescopic camera without any guiding whatever. The camera remaining fixed, the images of the stars travel along on the plate and leave "trails," which appear on the negative as straight or curved parallel dark lines.

By placing a small ink dot at one end of each of these lines, the relative positions of the stars can be indicated. It was found that the faintest stars visible to the naked eye, leave trails on negatives taken with such a $3\frac{1}{4}$ -inch camera, and accurate charts of stars down to the sixth magnitude can be very easily secured in this manner.

These trails can also be usefully employed in certain cases to secure records of the changes of brightness of "variable" stars, as faint stars give very fine lines, and brighter stars leave thicker and denser ones on the negatives. Variations in brightness are thus recorded in the varying thickness and density of the lines,

which are compared with the trails of other standard stars near. From what has been said about trails, and seeing that the image of a star moves more than its own diameter on a stationary plate in a few seconds, it is evident that all the naked-eye stars can be photographed with such an instrument with an exposure of a few seconds. As an illustration of this, a photograph taken with an exposure of only fifteen seconds, when the crescent moon was



FIG. 2.—Orion's belt. (Exposure 30 min.)

close to the Pleiades, showed not only the crescent, but also the "old moon in the new moon's arms," due to earth-shine, and twelve of the stars in the Pleiades. Accurate hand driving for such a short period is a matter of comparative ease.

Fig. 2 shows a photograph of Orion's belt taken with an exposure of thirty minutes. The negative on close examination shows stars down to the tenth magnitude. In the region represented,



FIG. 3.—The Pleiades. (Exposure 60 min.)

only about eight stars can usually be seen with the naked eye. The photograph shows that amateurs can obtain, by half an hour's exposure, a chart of any region of the sky, much more accurate and revealing a far larger number of stars than are shown in the star atlases usually in their hands. These photographs, obtained by such simple means, can always be used as records, and might easily serve for the detection of "new" and "variable" stars

when repeated at intervals and compared. The scale of these photographs is 3·4 times as large as that of Klein's Star Atlas, and the area of any region is 11·5 times larger. This is somewhat smaller than Argelander's charts.

The multiple star δ Orionis, a single star to the naked eye, is well shown as three stars, one of which is much elongated, showing the duplicity of that component; a curious S-shaped group of stars is clearly seen between δ and ϵ . These are quite invisible to the naked eye.

Fig. 3 represents the Pleiades as photographed with sixty minutes' exposure. In the region shown, ordinary keen eyes see only seven stars. On the negative seventy-eight stars can be counted in a space of 3° square in the centre of this region. These include stars of the eleventh magnitude.

As regards the actual driving of the telescopes, very little practice is needed; a gentle pressure of the finger at the lower end of the base-board carrying the objective and plate, is sufficient to move the telescope at the proper rate, and the co-operation of hand and eye during guiding seems soon to become almost automatic in character. When the instruments are stationary, the image of the star used for guiding, apparently travels many times faster than does the image of the star on the plate, owing to the magnification by the eyepiece; and for this reason any tendency to error in driving can be readily seen, especially with the enlarged star disc divided into four quadrants by crossed hairs in the eyepiece—long before such an error would be appreciable on the plate itself.

With the lens used, which was made by Hilger, and is uncorrected for photography, a field of good definition 5° square could readily be obtained.

An ordinary portrait lens of 2¼-inch aperture, mounted side by side with the 3¼-inch refractor, gave very good results. One photograph of the Hyades, taken by its means, showed Neptune very distinctly.

The wooden dew-cap was found remarkably effective in keeping the object-glass clear, even when that of the guiding telescope, provided with a metal dew-cap, became bedewed.

When amateurs come to recognise that, with their small instruments, such a fruitful field for investigation is open to them, astronomy will probably be enriched by many discoveries which would otherwise be missed or delayed.

JOSEPH LUNT.

THE EXTINCT VERTEBRATES OF ARGENTINA.¹

THE fossil vertebrata of South America are of peculiar interest to English palæontologists, since much of our earlier knowledge of the extinct mammals of that region is due to collections sent to this country by Sir Woodbine Parish and Darwin, and described by Owen, Clift, and others. These collections, however, valuable as they were, gave no idea of the extraordinary variety and abundance of the extinct fauna, the full importance of which has only been recognised of late years.

The terrestrial Mammalia of South America are, perhaps, the most remarkable and most strictly autochthonous in the world. If we except some marsupials as possibly Australian types and some comparatively recent immigrants, the whole of the mammals are peculiar. The American Edentata form a distinct order (for there is no reason for associating the Old World Manidæ and Orycteropidæ with them), and until the Upper Miocene (Loup Fork), they are entirely confined to the southern half of the continent. The other great divisions of the Mammalia are either represented by peculiar sub-orders or families, or, as in the case of the Insectivora, are entirely absent. Remains of this remarkable fauna are found in deposits of several horizons, which, in the wealth of species and individuals they contain, can only be compared to the Tertiary lake-basins of North America. In some cases the series seems to be sufficiently complete for the history of certain of the groups to be, at least partly, worked out, and it is to be hoped that the study of the development of these isolated types, taken in conjunction with the already clearly determined phylogenetic history of many North American groups, may lead to important generalisations as to the laws in accordance with which mammalian evolution has advanced. Unfortunately, up to the present, much less

attention has been paid to points of morphological interest than to the making of new genera and species, many of which are founded on quite insufficient evidence, the result being that the nomenclature has been brought into an almost unparalleled state of confusion. It was with the intention of clearing up some of this confusion that, at the invitation of Dr. Moreno, Mr. Lydekker, in 1893-94, paid two visits to the La Plata Museum. The brief time at his disposal rendered it impossible for him to carry out his object with complete success, but he has nevertheless produced a work of the highest value, both from the purely original matter it contains, and also because it renders easily accessible descriptions and good figures of many little-known forms. Moreover, he has earned the gratitude of all students of mammalian palæontology by relegating to the synonymy a large number of imperfectly defined genera and species.

The first of the two volumes contains three memoirs, two of which consist of descriptions of new material, while the third is occupied by a revision of the Ungulata. The second, with the exception of a few supplementary pages on the Ungulates, and descriptions of two new species of Carnivora, is entirely devoted to the Edentata.

In the first memoir are described some Dinosaurian remains from Patagonia, the first recorded from South America. The most completely known form is a member of the Sauropodous group; it is referred to the genus *Titanosaurus*, species of which also occur in the Wealden of the Isle of Wight and in the Lameta beds of Central India; but since these are only known by caudal vertebrae, it seems very doubtful whether there is sufficient evidence to establish the generic identity of the South American species with them. Nevertheless the existence of a gigantic Sauropodous Dinosaur in Patagonia is certain; and this fact, together with the recently recorded discovery of a member of the same group in Madagascar, shows that these reptiles had extremely wide range during Jurassic and Cretaceous times in both the northern and southern hemispheres.

The second memoir deals with a number of Cetacean skulls from Patagonia. These are of great interest, both on account of the light some of them throw on the history of the group, and also because they show that the Santa Cruz beds are certainly later than the Eocene (to which they are assigned by the Argentine writers), and are probably Miocene. *Physodon*, a genus previously known only from teeth occurring in the Miocene and Pliocene of Belgium and England, and probably ancestral to the sperm whales (*Physeter*), is represented by *Physodon patagonicus*, which possessed a series of teeth in the upper jaw; these have entirely disappeared in the recent form. Another interesting species is *Prosqalodon australe*, a Squalodont remarkable for the small number of its molars and for its comparatively well-developed nasals, characters in which it approaches the Eocene Zeuglodonts more nearly than any toothed whale previously known. A primitive type of the Platanistidæ is also described. This memoir is an important addition to the history of the Cetacea, for although, as might have been expected from the age of the deposits, no light is thrown upon the difficult question of the origin of the group, the author is to be congratulated on having helped to fill some of the gaps in our knowledge of it.

The South American Ungulates appear to suffer from an extraordinary superfluity of names. Mr. Lydekker regards no less than ten generic terms as synonymous with *Nesodon*, and states that the number of specific names that have been applied to *Nesodon imbricatus* is countless. In the classification of the order the most important innovation is the establishment of a new sub-order, the Astrapotheria, for the reception of the Homalodontotheriidae and the Astrapotheriidae. It is suggested that the European genus *Cadurcotherium* may belong here; this seems very improbable, but if true is one of the most remarkable facts of distribution known. In the description of Astrapotherium there seems to be some doubt as to the nature of the immense upper tusks, since in one place they are said to be canines, while in the dental formula given they are put down as incisors. The sub-order Litopterna, adopted for the reception of the Protheriidae and Macraucheniidæ, is regarded by the author as being intermediate between the Astrapotheria and the Perissodactyla, though not ancestral to the latter. Indeed there can be no doubt that the peculiar foot-structure of the Litopterna was acquired quite independently of the Perissodactyla, and that such points of resemblance as exist between them are merely due to parallelism of their lines of evolution, a cause of similarity often neglected.

¹ "Contributions to a Knowledge of the Fossil Vertebrates of Argentina." Parts I. and II. By R. Lydekker, F.R.S. (*Anales del Museo de la Plata*, Palæontologia Argentina, II. and III.) Folio, La Plata. 1893-4.