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 $2\frac{1}{4}$-inch aperture, mounted side by side with the $3\frac{1}{4}$-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.

[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.

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 vertebræ, 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 *Prosqualodon 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 Homalodontotheriidæ and the Astrapotheriidæ. 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 Proterotheriidæ 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.

Nearly half the second volume is devoted to the Glyptodontidæ. The author rejects the various subdivisions of this family suggested by Ameghino and adopted by Zittel, and refers all the species to six genera, some seventeen other generic terms being regarded as synonymous.

In this group the earlier forms are of comparatively small size, and it is only in the later (Pleistocene) deposits that such giants as *Glyptodon clavipes* and *Dædicurus clavicaudatus* are found. The same progressive increase in bulk is noticeable in other groups, *e.g.* in the Mylodonts and in the Litopterna among the Ungulates. It is not improbable that the great size of the Pleistocene species had much to do with their rapid extermination when some change in the environment took place.

The remainder of the memoir deals with the Dasypodidæ and Megatheriidæ; the latter family being given a somewhat wider scope than usual. The most interesting of the genera described is Eucholœcops, which is probably ancestral to the Mylodonts and in some respects approaches Myrmecophaga.

These memoirs are illustrated by more than a hundred magnificent photographic plates, undoubtedly among the finest of their kind yet published; and while lithographic drawings by a competent artist are to be preferred for the representation of detail, such figures as those of the skeletons of Toxodon and of many of the Glyptodonts will not easily be surpassed.

The text is printed in English and Spanish in parallel columns; the English portion is unfortunately disfigured by very numerous misprints, doubtless owing to the fact that the author was compelled to entrust the correction of the proof-sheets to some person unfamiliar with the language.

THE EVOLUTION OF MODERN SCIENTIFIC LABORATORIES.[1]

THE scientific discoveries of the present century have had such a profound influence upon inventions, upon industries, and upon the comfort, health, and welfare of the people in general, that there is widespread, even if not always adequate, appreciation of the value of scientific study and investigation. But it may be doubted whether there is any proper understanding, in the minds even of the educated public, of the material circumstances which surround scientific discovery and which make it possible. The average man, if interested at all, is interested that the discovery is made, not how it is made.

In America, where men of science rely mainly upon enlightened private beneficence, and not upon governmental aid, to furnish the pecuniary resources which are essential for scientific progress, it is important that there should be some general information not only regarding the results of scientific work, but also regarding the external material conditions necessary for the fruitful prosecution of such work.

At the present day the systematic study and advancement of any physical or natural science, including the medical sciences, requires trained workers who can give their time to the work, suitably constructed work-rooms, an equipment with all of the instruments and appliances needed for the special work, a supply of the material to be studied, and ready access to the more important books and journals containing the special literature of the science.

All of these conditions are supplied by a well-equipped and properly organised modern laboratory. Such laboratories are, with the partial exception of the anatomical laboratory, entirely the creation of the present century, and for the most part of the last fifty years. They have completely revolutionised during the past half-century the material conditions under which scientific work is prosecuted. They are partly the result, and in larger part the cause, of that rapid progress of the physical and natural sciences which characterises the era in which we are living.

The evolution of the modern laboratory still awaits its historian. It is not difficult to find incidental references to historical facts bearing upon this subject. The development of the chemical laboratory has been traced with some fulness. But it is curious that there is no satisfactory monographic treatment of the general subject of the historical development of scientific laboratories. The subject seems to me an attractive one. It would surely be interesting to trace the development of the teaching and the investigating laboratory back to its beginnings, to learn about the material circumstances under which the physicists, the chemists, the morphologists, and physiologists of former generations worked. What share in the development of laboratories had the learned academies of the Renaissance and of the subsequent centuries? What share had public and private museums and collections of instruments of precision? What share had the work of the exact experimentalists, beginning with Galileo, of physicians, of the alchemists, and of the apothecaries? What individuals, universities, corporations, and governments were the pioneers in the establishment of laboratories for the various physical and natural sciences? The detailed consideration of these and many other questions pertinent to the subject would make an interesting and valuable historical contribution.

There is evidence that in Alexandria, under the early Ptolemies in the third century before Christ, there existed State-supported institutes, in which students of man and of nature could come into direct personal contact with the objects of study, and by the aid of such appliances as were then available could carry on scientific investigations. The practical study of anatomy, physiology, pathology, and other natural sciences was here cultivated. We are very imperfectly informed as to the results and the material circumstances of this remarkable period in the history of science. We know that after about a century of healthy activity the Alexandrian school gradually sank into a place for metaphysical discussions.

Fifteen hundred years elapsed before we next find any record of the practical study of a natural science. In 1231, the great Hohenstaufen, Frederick the Second, who has been called the most remarkable historic figure of the Middle Ages, commanded the teachers at Salernum diligently to cultivate the practical study of anatomy. After the passage of this edict occasional dissections of the human body were made, but it cannot be said that there was any diligent cultivation of anatomy on the part either of teachers or of students during the following two centuries.

In the latter half of the fifteenth century there developed that active interest in the practical study of human anatomy which culminated in the immortal work of Vesalius, published in 1543. After this the study of anatomy by dissections gradually assumed in the medical curriculum that commanding position which it has maintained up to the present day.

For over six hundred years there has been at least some practical instruction in anatomy, and for over three hundred years there have existed anatomical laboratories for purposes of teaching and of investigation, although only those constructed during the present century meet our ideas of what an anatomical laboratory should be. It is a matter of no little interest, both for the history of medicine and for that of science in general, that the first scientific laboratory was the anatomical laboratory. Private laboratories for investigation must have existed from the earliest times. Doubtless Aristotle had his laboratory. But the kind of laboratory which we have on this occasion in mind is one open to students or investigators, or both. There was no branch of physical or natural science, with the exception of anatomy, which students could study in the laboratory until after the first quarter of the present century. Only in anatomy could students come into direct contact with the object of study and work with their own hands and investigate what lay below the surface.

The famous Moravian writer on education, Amos Comenius, over two hundred and fifty years ago, gave vigorous expression to the conception of living, objective teaching of the sciences. He said, "Men must be instructed in wisdom so far as possible, not from books, but from the heavens, the earth, the oaks and the beeches—that is, they must learn and investigate the things themselves, and not merely the observations and testimonies of other persons concerning the things." "Who is there," he cries, "who teaches physics by observation and experiment instead of by reading an Aristotelian or other text-book?" But how little ripe were the conditions then existing for the successful carrying out of ideas so far in advance of his times is illustrated by the very writings of the author of "Orbis Pictus" and "Lux in Tenebris."

It would lead too far afield to trace in detail on this occasion the development of physical and of chemical laboratories, but on account of the intimate connection between the development of physics and chemistry and that of medicine, especially of more

[1] An address delivered at the opening of the William Pepper Laboratory of Clinical Medicine, Philadelphia, December 4, 1895, by Prof. William H. Welch.