COMPARATIVE TABLE OF CARBONIFEROUS FORMATIONS.

	Age.	Mississippi Province.	Southwestern Province.	Ural Province.
Carboniferous	Late	Cimarronian Wanting?	Cimarronian Guadalupan	Tataran (Upper P.) L. and M. Permian
	Mid	Oklahoman Missourian Des Moines Arkansan	Maderan Manzanan Wanting Ladronesian	Artinsk Upper Carboniferous } Middle Carboniferous
	Early	Mississippian	Socorran	Lower Carboniferous

thorities on the Russian Permian formation, and who has visited the Kansas localities, places the Marion beds, which are immediately beneath the Red Beds, on a level with the Russian Artinsk terrane. Personal observations in both fields point strongly to the correctness of this correlation. The Artinsk formation is older than any terrane of the original Permian sequence. Girty, who quite recently has also rather critically examined the Guadalupan section in Trans-Pecos Texas, concludes that if this fauna is Permian then certainly that of Kansas is not.

It would seem then that our conceptions of the American Permian formations must undergo very radical changes. Our scheme of comparison with the original Permian section of Russia would then be about as in the table given above.

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QUOTATIONS.

PROFESSOR M'KENDRICK AND THE PROGRESS OF PHYSIOLOGY.

The valedictory address delivered by Professor J. G. M'Kendrick, at the close of the summer session of the University of Glasgow, on the occasion of his resignation of the professorship of physiology, provides a striking account of the progress of physiological science during the past thirty years. In 1861, when Professor M'Kendrick attended a course of lectures at Aberdeen, there was no attempt at demonstration except by diagrams and a few microscopes on a side-table. There were no experiments, and the only instrument displayed was a sphygmograph. But a little later Goodsir, of Edinburgh, brought from continental schools of physiology to the University of Edinburgh such instruments as myographs, kymographs, electrical appliances and other apparatus, and the teaching of practical physiology was soon firmly established under Argyll Robertson. Professor M'Kendrick himself installed similar teaching in the University of Glasgow in 1876, the date of his appointment to the chair of physiology. The requirements of modern physiological teaching are shown by a statement in the address that while Professor M'Kendrick has worked and taught for thirty years in five rooms, twenty-five are apportioned to physiological work in the new buildings. Reviewing the progress of physiology, Professor M'Kendrick detailed the advances made in histology and expressed the doubt whether much more progress can be expected. Graphic methods have been elaborated during the same period, and the action of electrical stimuli on muscle and nerve elaborately worked out. The study of the functions of living isolated organs, modern vivisectional methods, our knowledge of the nerve paths in the central nervous system, and the subject of internal secretions, are all among the triumphs of physiological science during the past thirty years, and were each passed in review. In conclusion, Professor M'Kendrick indicated physiological chemistry as the direction in which progress will be made during the next few decades.—*Nature.*

ASTRONOMICAL NOTES.

THE SYSTEM OF CASTOR.

Castor was one of the first close double stars known and one of those which led Sir William Herschel to the belief that such stars form real binary systems.

Belopolsky discovered, in 1896, that the fainter, preceding component of Castor, a_1 Geminorum, was a spectroscopic binary, having a period of about 2.9 days. In the June number of the *Astrophysical Journal* Dr. Heber D. Curtis gives an elaborate investigation of this system, which has been made at the Lick Observatory. The refined results now obtained amply confirm the general conclusions of Belopolsky. The final period found at the Lick Observatory is 2.928285 days.

Curtis has also discovered that the brighter, following component, a_2, is a spectroscopic binary having a period of 9.218816 days. Ignoring the faint and distant companion which also exists, Castor thus becomes one of the most wonderful stellar systems known. While the elements of the spectroscopic systems thus revealed are well known, less can be said of the visual components of Castor themselves. These have been observed since the time of the elder Herschel, but their motion is slow, and Burnham considers that the problem of finding the elements is indeterminate at present, and likely to remain so for a century. Different determinations of the period have varied from little more than 200 years to more than 1,000 years.

An interesting phase of this quadruple system lies in the fact that while the orbits of the components of a_1 are nearly circular, those of a_2 are very elliptical. The change in the mutual attractions of the components of so eccentric a system as that of a_2 must be great, and in other cases this has been found to be associated with variability in the light. On this account Mr. Curtis made some photometric determinations of the light of a_2, but no proof of variability was found. This need not cause surprise, however, since the physical condition of a star must determine whether such increased attractions would show themselves in a change of luminosity.

REFLECTING TELESCOPES OF SHORT FOCUS.

H. C. VOGEL, director of the Astrophysical Observatory at Potsdam, calls attention, in a communication to the *Kgl. Akademie der Wissenschaften,* Berlin, to the possibilities of short-focus reflecting telescopes. A translation of this article appears in the June number of the *Astrophysical Journal.* The competition, which has always existed between reflecting and refracting telescopes, is still keen, but at the present moment the reflector seems to occupy the center of the stage. Each form of instrument has certain limitations which are inherent, and each has distinct advantages over the other for certain purposes. A good reflector brings all the colors perfectly to the same focus, while the best refractor is not really achromatic. Also, the loss of light by reflection is in general much less than that by absorption. The result is that for nearly all objects the action of a reflector is much more rapid than that of a refractor of equal size. The circles of chromatic aberration may also cause a distortion of the form of the image of certain objects, such as the Orion nebula, when photographed with a refractor. On the other hand, the field of good definition is very small, in the case of the reflector. The images are perfect only at the center, and sufficiently good for use only over a region half a degree in diameter, or even less. Certain forms of the refractor, however, give good definition over a field ten, or even twenty, degrees in diameter. It is evident, therefore, that where a large field is required, as in making a photographic map of the sky, the refractor must be used. Over a small field, however, the reflector can photograph objects of such extreme faintness that they lie quite beyond the reach of the largest refractor.

Schwarzschild has shown that an extension of the field of the reflecting telescope may be obtained by the use of a second mirror. It is possible that the diameter of the field may be extended to several degrees in this way. Practically, this has not yet been done, but its successful accomplishment would mark an epoch in the history of the telescope. The power of the reflector evidently increases with the decrease of its focal length. Schaeberle has recently made some experiments to show how far this can be carried. He constructed a thirteen-inch reflector of twenty-inch focus, with which he was able to photograph stars of the seventeenth magnitude with an exposure

of only two minutes. The scale of the photographs, however, is so small that great magnification is necessary, and many details must be obscured, although the definition at the center of the small plates used appears to be good. There must be some practical limit to the decrease in the ratio of focus to aperture, and Schaeberle has apparently been working near, if not beyond it. Vogel gives some wonderfully good results obtained with a Schmidt mirror, using an aperture of 24 cm. which makes the ratio of aperture to focus 1:3.86. With the full aperture of 41 cm. and an exposure of ten minutes, many more stars were photographed than are visible in the great Lick refractor of more than 91 cm. aperture.

SOME CONSIDERATIONS REGARDING THE NUMBER OF THE STARS.

THE above title is the subject of a paper in the May number of the *Monthly Notices* of the Royal Astronomical Society. It is written by Miss Winnifred Gibson, B.Sc., and communicated by Professor Karl Pearson, F.R.S.

The problem is one of the deepest interest, but its solution is rendered difficult, if not impossible at the present time, by lack of fundamental data. The distribution of the stars would be readily determinable, if the parallaxes of a sufficient number had been determined. After confessing the lack of such materials, Miss Gibson, nevertheless, proceeds to an elaborate discussion of such data as exist. She arrives at the conclusion, for the brighter stars, that 'There is no sensible relation between magnitude and parallax.' The chief trouble with this conclusion is that it is derived from entirely inadequate data. The stars, whose parallaxes are taken into consideration, are of the ninth magnitude, and brighter. Of such stars there are in the sky about 150,000. For obtaining any law of relation between the magnitudes and distances of all these stars, the parallaxes of 72 stars, about one in 2,000, are available. Neither is there evidence that this small number is distributed by chance among the stars, nor that the parallax in many cases is sufficiently exact for purposes of discussion. Results based upon such meager data must have little or no value, however skillful and elaborate the treatment may be. Not much more can be said of that part of the discussion relating to proper motions and colors.

The latter part of the paper is concerned with the relation of magnitudes and frequencies, and gives results which are in substantial agreement with those of Professor E. C. Pickering, recently published, although Miss Gibson prefers a somewhat different formula. The author confines her attention to the brighter stars. The problem becomes at once more interesting and more difficult as it is extended to the fainter stars. Miss Gibson complicates the problem by assuming that magnitude is largely a physiological phenomenon, and hence that 'It is hardly conceivable that a scale of pure magnitudes could have any meaning in physical nature.' This is quite erroneous, since the determination of magnitudes, whether by visual or photographic methods, is simply the determination of the intensity of certain radiations, which surely have an objective reality based on physical conditions.

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RECENT VERTEBRATE PALEONTOLOGY.

FROM the Brazilian Coal Commission, through Dr. I. C. White, state geologist of West Virginia, the American Museum of Natural History has just received the gift of a number of natural casts of a small Permian reptile closely related to the *Mesosaurus* of South Africa. These Brazilian remains have been carefully studied by J. H. McGregor for a memoir which will be published by the commission, and which for the first time gives us a complete knowledge of the anatomy of this extremely ancient reptile. It is related to the genus *Stereosternum* Cope, also from Brazil, which Baur made the type of the order Proganosauria, under the impression that these were very ancient and generalized reptiles. It is true they are very ancient but are not generalized, they are rather already considerably specialized for aquatic life, as shown in Dr. McGregor's restoration of the skeleton and