Restorations of the fore and hind legs of Allosaurus are given. They are remarkable for the great disparity in size. A new classification of the order Theropoda is also proposed, including the European as well as the American forms.

THE ASTRONOMICAL LABORS OF MR. COMMON.

In his address before the Royal astronomical society in February last, on the presentation of the gold medal to Mr. Common for his photographs of celestial bodies, the president of the society, Mr. Stone, remarked that the council, in making the award, had been less influenced by originality in the methods adopted than by the great practical success which has attended his efforts in this field of astronomical research. It will be of interest to note a few points, relating to the labors of Mr. Common, which have contributed more or less directly to the importance of his results.

He began celestial photography about ten years ago, with a small refractor of five and a half inches aperture. In 1877 he supplied himself with an eighteen-inch mirror by Calver, the mounting for which was designed by himself, and executed under his direct personal superintendence. In a paper presented to the Royal astronomical society in 1879, he laid down certain assumedly proper conditions to be fulfilled in the mounting of large reflectors, according to which he was proceeding with the construction of an exceedingly powerful telescope, and among which were the following:—

1°. No tube properly so-called. 2°. No mass of metal either below or at the side of the line joining the large and small mirrors. 3°. An equatorial mounting capable of direction to any part of the visible heavens, and of continued observation past the meridian without reversal. 4°. An efficient means of supporting the mirror without flexure. 5°. Driving-clock, circles to find or identify an object, and motions taken to eye-end. 6°. A collimator for the ready adjustment of the mirrors. 7°. Such a construction of mounting as to give the greatest amount of steadiness with the least amount of friction. 8°. An efficient means of resilvering the mirrors and of protecting them from dew. 9°. A safe, steady, and easily adjusted platform for the observer, allowing about two hours continuous observation without the necessity of any motion except that from the observer's place, and of easy access.

In designing a mounting to satisfy these conditions, Mr. Common made such departures from the old form of mounting and platform, that an account of it was deemed worthy of a place in the Memoirs of the Royal astronomical society, where may be found (vol. xlvi. p. 173) a description of his instrument, together with fully detailed drawings suited not only for his, but also for a much larger telescope. In the actual construction of the thirty-six inch reflector, the cost was kept down as much as possible without sacrificing any essential points, all elaborate mechanical arrangements coming under the head of mere luxuries being avoided. Both the telescope and its house were so contrived as to be completely under the management of one person.

The difficulties which Mr. Common surmounted in the construction of his telescope were of the most discouraging nature, — in fact, unique. Just as the great speculum — a lump of glass of about thirty-eight inches diameter, and seven inches thickness — was ready to receive its final figure in the hands of the optician, it burst into a thousand pieces with a terrific explosion. Within a few hours time, Mr. Common had telegraphed to the glass-makers in Paris for two more disks of like dimensions, the extra one to be brought into service in case of another explosion. The second disk, however, was successfully ground, polished, and mounted ready for work, about the middle of 1879, and it is with this instrument that Mr. Common has carried on his unequalled researches. In some respects it is proper to call it the most powerful telescope in existence, although the great refractor of thirty inches aperture, now being mounted near St. Petersburg, may be expected to surpass it.

A description of Mr. Common's novel plan for silvering large mirrors may be found in vol. xlii. of the *Monthly notices* of the Royal astronomical society, at p. 79.

Of the mounting of Mr. Common's reflector, Mr. Stone remarks, that it shows in every direction great engineering-skill, guided by the experience, gained in the use of the smaller instruments, of the actual requirements for successful astronomical work. The method of relieving the friction of the polar or main axis of the instrument deserves especial attention, and is fully dealt with in his memoir. Mr. Common alluded, in this publication, to the fact that this principle is equally applicable to other astronomical instruments of large dimensions; and at the meeting of the Royal astronomical society, March, 1884, he presented plans for a large transit circle in which mercury-troughs are used to sustain the weight of the tube when in certain positions. By these means he believes that flexure may be practically eliminated.

Early in 1880 Mr. Common attempted to photograph the great nebula of Orion; the result being a failure, as the stars appeared on the plate as lines, and the nebula had impressed itself only as a faint stain. But such failures only suggested the necessity of improved clock-driving, and the use of more sensitive plates. In June, 1881, Mr. Common obtained a successful photograph of comet (*b*) of that year; and, in March of the year following, a photograph of the nebula of Orion, which excited the admiration of all the astronomers who had an opportunity of inspecting it. He continued, however, to push the refinements of his photographic and instrumental equipment to a farther limit, and obtained on the 30th of January, 1883, a photograph of the nebula, with an exposure of thirty-seven minutes, a carbon enlargement from the negative of which was presented to the Royal astronomical society in the March following. This photograph showed a marked advance on

all his previous ones, and gave evidence of a time approaching when the shapes of nebulae, and the relative brightness of the different parts, will be recorded photographically in a better manner than by the most careful hand-drawings. The behavior of the very faint stars in the nebula also led to results of the greatest interest. These stars appear on his negatives taken with exposures of from thirty-seven to sixty minutes; and, as the time of exposure can be easily extended to hours, Mr. Common thinks it quite possible to get stars invisible to the eye in the same telescope used for photography. Mr. Common has already experimented with the longer exposures, and more details are brought out with every increase of the time; and it appears that the extreme limit of useful exposure has not even been reached at an hour and thirty minutes.

Mr. Common has also obtained beautiful photographs of other nebulae and of the planets Jupiter and Saturn, and has also applied himself successfully to obtaining photographic star-maps to stars of the eleventh magnitude.

In connection with all this variety of valuable astronomical work, it should be noted that Mr. Common belongs properly to the ranks of amateur astronomers; and this fact was dwelt upon at some length by Mr. Stone, at the conclusion of his address, as follows: —

"The lesson taught is not a new one. The records of our society are rich in the labors of our amateur astronomers. The amateur who can provide himself with sufficient instrumental means for original research need fear no professional rivalry. Untrammelled by the necessity of continuing observations whose value largely depends on their continuity, having the power of taking up any subject he pleases, without fear or responsibility of charges of wasted time and wasted means, he possesses advantages which are priceless in the tentative and experimental stages of any work.

"It is in work of this class that the most striking advantages in our science must be expected ; and such work will most certainly repay, by the gratification of personal success, the efforts of those who devote themselves to original work in our science; and the field of research presented is absolutely boundless."

INSECTS AND FERMENTATION.

THANKS to a long line of investigators and experimenters, beginning with Sprengel, and including among its recent leaders Darwin and Hermann Müller, we know that very intricate relations exist between flowering plants and insects which result to the advantage of both; many insects obtaining their food exclusively, or in large part, from the nectar and pollen of flowers, which are strengthened by intercrossing as a result of their visits. Within the last few years the activity of insects has also been shown to have a close connection with the distribution of other and lower organisms. The fetid slime of phalloids has long been known to be attractive to many flies and scavenger-beetles; and, as Mr. Gerard suggests in the case of the common stinkhorn (Phallus impudicus), the dissemination of these fungi is largely traceable to such insects. Rathay has likewise shown that a partnership of a somewhat similar nature probably exists between some of the rust fungi (Roestelia, Aecidium), and insects which feed upon the sweet secretion that accompanies their spermatia. In these cases the arrangement appears to be mutually beneficial. In the last it may also favor the spread of diseases of the higher plants, and so lead to important indirect results. Zymotic diseases of man and the domesticated animals are also known to be carried by the same active agents, which, however, appear to be rather accidental than specially provided for; while, in the asserted intervention of mosquitoes in the parasitism of Filaria, they are decidedly losers by their part in the transaction.

Boutroux has recently shown[1] that insects also play a very important, if indirect, *rôle* in the life-history of yeasts. It has been generally asserted that the agents of spontaneous fruit-fermentations, like those employed in the manufacture of wine and cider, are found on the surface of the ripe fruit, whence they readily reach the expressed juice. Boutroux was led to investigate their occurrence not only on ripe fruits, but on those which were immature, as well as in the saccharine secretions of flowers and on the bodies of the insects which visit both classes of objects. He prepared tubes of sterilized cherry-juice, or other fermentable liquid, from which germs were excluded by means of cotton. After these had shown their freedom from yeast by remaining unchanged for a fortnight, at a temperature favorable for fermentation, a fruit, flower, or insect was introduced into each, precautions being taken to prevent the introduction of germs from other sources. Repeated transfers were made from these first propagation cultures, where several species were usually found, until these were isolated, when their form and physiological characters were studied.

Contrary to the prevalent opinion, it was found that ripe fruits, as long as they are intact, bear comparatively few yeast-germs, these being much more frequent on green fruit, as well as in the nectar of flowers and on the bodies of the insects which are common about flowers. From what appears to have been a careful series of experiments, Boutroux advances the opinion that these spontaneous yeasts are regular inhabitants of nectar, being carried from flower to flower by insects in their visits for this beverage. After the fading of the flower, especially where some of its organs persist on the ripening fruit, they remain, the number of germs suffering constant diminution from rain and other causes. When the fruit has ripened, a few of these germs may still be present; while others are brought from later flowers, or from injured and fermenting fruit, by insects which feed upon the juices of the latter. The hibernation of these species is thought to occur on the remains of fallen fruit, as well as in the ground, whence a new supply is obtained the next spring. It is interesting to note that the species which have been obtained in these cultures are not identical with the wine and cider ferments, although some of them resemble these closely; and it is suggested, that, while

[1] *Ann. des sci. naturelles, Bot.*, 6 sér., v., xvii., p. 144.