and 10″ respectively. The aperture of the finder is 62 mm. The whole instrument is an exquisite piece of mechanical workmanship, and for both design and execution the makers are entitled to the highest praise.

The construction of the object-glass, first offered to the Clarks, but declined by them because of the subsequent cutting in two, was accomplished by Merz of Munich. Its performance, using the Steinheil achromatic eyepieces, is an agreeable surprise. With either half the images are as sharp as with a good four-inch telescope. With the images superposed, there is a loss of the best definition; and this arises from the practical impossibility of adjusting the two halves of such an object-glass so that the images will be absolutely superposed. In actual observing, the greatest difficulty in the way of exact measurement is found in a want of similarity in the atmospheric conditions affecting two celestial objects which are supposably near enough to be influenced alike. Thus the two opposite limbs of the sun, except in the very best observing weather, do not maintain a steady contact together when heliometrically observed, but vibrate, alternately lapping over and receding from each other. In the observations of the last transit of Venus, this peculiarity presented the curious effect of a rapid breaking and forming of a ligament analogous to the 'black drop' described by the older observers when the limbs of Venus and the sun were in contact.

The model on which the whole instrument is constructed is a very great improvement on any previous heliometer, so far as lessening the observer's fatigue is concerned. Every motion is controlled, and every scale and circle is read, by the observer without leaving his seat.

With the cylindical bearings of the object-glass cells, the image distortion for measures up to 2° is rendered extremely small; by the rapid rotation in position angle, and equal rapidity in distance settings, the observer is no longer fatigued by manipulation; and it can be said that in this instrument the heliometer shows itself to be a measuring-machine of the highest precision. Leonard Waldo.

NOTE ON THE OBSERVATIONS OF THE TRANSIT OF VENUS, 1882, AT THE LICK OBSERVATORY.

By invitation of Capt. R. S. Floyd, president of the trustees of the James Lick trust, I went to Mount Hamilton to direct the observations of the transit of Venus at the Lick Observatory. The chief instrument of the equipment which the trustees had provided in time for observing the transit was the horizontal photoheliograph, which is essentially similar to those employed by the American commission on the occasion of the transit of 1874, as well as that of 1882, and which are described by Professor Newcomb in the first part of the American observations of the transit of Venus of 1874. The Lick photoheliograph, like all the others, has an objective five inches in diameter; and its focal length is almost exactly forty feet. The heliostat mirror, an unsilvered disk of glass, is seven inches in diameter, and was mounted on a pier adjacent to that which supported the objective. A third pier, coming up in the interior of the photographic house, supported the plate-holder; and all three piers were laid up of brick, their foundation being in the rock of the mountain summit.

I arrived at the observatory in the evening of Nov. 21. The photoheliograph had, in the main, been mounted and got in readiness before that time by Mr. Fraser, the superintendent of construction of the observatory. It remained to complete the unfinished portions of the instrument, to mount and fully adjust the same, to modify some details which had been unsuitably constructed, and to make sure of the convenient and effective working of every part. Especial attention was given to the accurate determination of the position of the focal plane of the objective; and the method adopted — being nothing short of a critical examination, by many persons independently, of several sets of trial-plates exposed at varying distances from the objective — finally indicated the true setting of the plate-holder with much more than the required precision. Great care was taken to insure the perfect definition and figure of all the pictures, and to prevent the mishap of fogged plates from scattering and extraneous light. Much time was consumed in this way in the preparatory work, but we had more than sufficient compensation in the superior character of the photographs of Venus in transit. All these were taken by the wet process, and the photographic operations were in charge of Mr. Lovell of Amherst.

During the important days of the transit-period, the meteorological conditions on Mount Hamilton were especially favorable. At midnight, Nov. 30, the sky cleared, after three and a half days of continuously cloudy weather. From that time until the afternoon of Dec. 7 we saw no cloud, day nor night, which could in the least interfere with any observation we had to make. Thin cirrus was float-

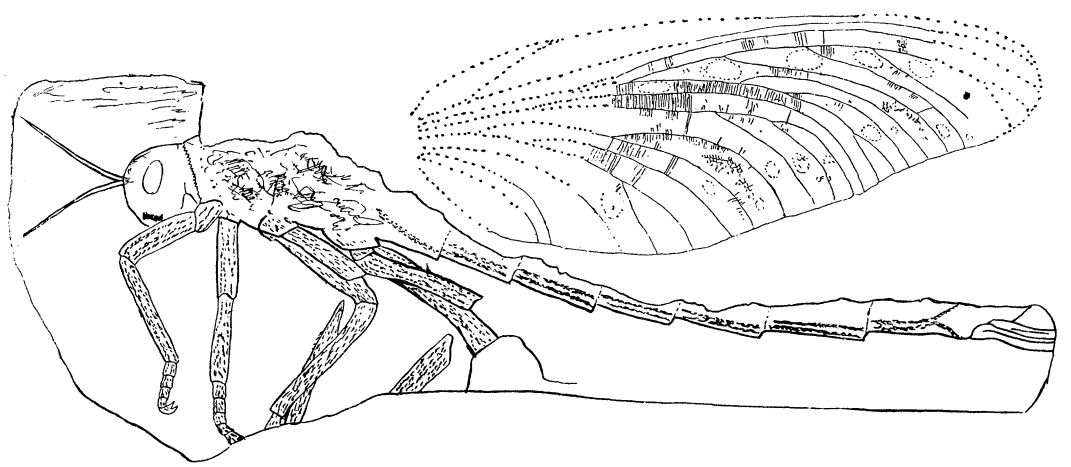
ing above the mountain summit on the morning of the 2d, but it had vanished completely within two hours; and on three or four occasions clouds were observed very near the horizon, but they never rose. Fitful gusts of wind prevailed night and day the 3d and 4th, and the morning of the 5th; but, about noon this latter day, a period of the utmost tranquillity set in, and lasted for fifty or sixty hours, the temperature ranging only between sixty and seventy degrees.

Dec. 6 the sun rose about seven o'clock, with Venus a good way on its disk. The first sensitive plate was exposed at eleven minutes after seven, the slit being three inches wide, and the exposure a second and a half long; but a very faint image was all that came out on the plate in developing. Six minutes later, with an exposure of one second, a picture sufficiently intense for measurement was obtained; but the vertical diameter of the sun was about a quarter of an inch, or one-eighteenth part, shorter than the horizontal one. Something like a half-hour later, very satisfactory pictures began to be obtained, with the slit an inch wide, and an exposure less than half a second long. By twenty minutes past nine the slit had been reduced in width to 0.25 in., and was kept at this setting throughout the remainder of the transit, the exposures varying only slightly from 0.25 sec. in length. At twenty-two minutes before twelve the last exposure preceding interior contact at egress was made, and subsequently ten additional photographs were taken between the two contacts. The total number of plates exposed was a hundred and forty-seven, and about five-sixths of them will be available for exact micrometric measurement. Their number and quality are about as follow: A signifying a plate of the first order of definition, and any two successive grades being separated by only a slight variation in quality: —

Grade.	No. of Photographs.	Grade.	No. of Photographs.
A	71	B—	3
A—	23	C	4
B+	13		—
B	9	Total,	123

The record of the times of exposure of these photographs was kept by two chronometers independently, one record being automatic. The original photographic record, and such parts of the photoheliograph as have yet to be investigated, together with the greater part of the photographs themselves, are now stored for safe-keeping in the vault of the observatory on the mountain.

No other observations of importance were attempted, except those of the two contacts at egress: these being observed by Capt. Floyd, with the twelve-inch equatorial, aperture reduced to six inches; and by myself, with the four-inch transit instrument. DAVID P. TODD.



TITANOPHASMA FAYOLI BRONGNIAT. — ONE-FOURTH NATURAL SIZE.

A GIGANTIC WALKING-STICK FROM THE COAL.

WE owe to the favor of M. Charles Brongniart of Paris, sketches of an enormous insect from the carboniferous beds of Commentry, France, which we have reproduced upon this page; in short preliminary notices, given last December to the Paris academy and the geo-