OUR ASTRONOMICAL COLUMN.

THE CŒLOSTAT.—The name *cœlostat* has been given by M. G. Lippmann to a modified form of siderostat which he has devised (*Comptes rendus*, No. 19, 1895, and *Observatory*, August). The special feature of the instrument is that it gets rid of the rotation of the field of view which disqualifies the siderostat for some purposes, such, for instance, as long-exposure photography. It consists simply of a mirror with its plane parallel to the earth's axis, and turning on a polar axis once in forty-eight hours in the same direction as the apparent diurnal motion of the heavens. It is easily demonstrated that the image of any star whatever will be seen stationary in a mirror so mounted, and a telescope pointed at the mirror in any direction will have a constant field of view. The telescope being directed to the cœlostat in a given position, to observe other objects having the same declination as that in view, it will only be necessary to turn the mirror; but for objects with different declinations the telescope must also be moved. If it be desired to use a horizontal telescope, it must be directed to the point on the horizon where the object rises, and the mirror must be started in a position suited to the hour-angle; but there is a limit to the use of a horizontal telescope. It is pointed out that the simplicity of the instrument makes it possible to turn it into one of great precision; stability being readily attained, while the possibility of flexure can be reduced to a minimum.

ADAMS' MASSES OF JUPITER'S SATELLITES.—A question having been recently raised by Mr. Marth as to the work of Adams on Jupiter's satellites, Prof. R. A. Sampson has stated the results of an inspection of the MSS. with reference to this subject (*Observatory*, August). It appears that when engaged upon a revision of Damoiseau's tables in 1875, with a view to their continuation, Prof. Adams determined the following revised values for the masses of the satellites:—

$$m = 0{\cdot}0000283113$$
$$m' = 0{\cdot}0000232355$$
$$m'' = 0{\cdot}0000812453$$
$$m''' = 0{\cdot}0000214880$$

"There is no reason to suppose that Adams attached any weight to the above determinations of the masses, seeing that he never published the values directly; the MS. appears to be little more than a study such as he was in the habit of making upon any work that he was examining, in order to test by cross verifications the accuracy and consistency of the whole. . . . Considerable expectations have been built upon the fact that Adams was engaged more or less closely for some years upon the theory of Jupiter's satellites. It will be well to say at once that the chief fruit of his attention was published in the *Nautical Almanac* of 1880; this, like all the rest of his published work, was the result of exhaustive labour, quite out of relation to the unpretentious form in which the outcome was presented, and only discoverable by searching tests."

ATMOSPHERIC REFRACTION.—The ordinary application of Bessel's expression for refraction requires that five quantities be taken from specially prepared tables, but Prof. E. C. Comstock, Director of the Washburn Observatory, has worked out a simple formula for computing the refraction without the aid of tables. A transformation of Bessel's formula, and the introduction of numerical constants from the Pulkowa refraction tables, leads to the following simplified form:

$$R = [2{\cdot}99215]\frac{BF}{455{\cdot}9 + t}\tan Z$$

$$\log F = -(42{\cdot}3 + 0{\cdot}12t)\tan^2 Z.$$

The number in brackets is a logarithm; B is the barometric pressure in English inches reduced to freezing-point; t is the temperature in degrees Fahrenheit, and Z is the zenith distance for which the refraction is required. The formula for F gives the logarithm in units of the fifth decimal place.

The computation by the formula is not more laborious than the direct use of the tables, and a comparison of the two methods shows that the differences in the results are far less than the uncertainty in the tabular numbers themselves. Prof. Comstock's paper forms one of a series of interesting "Studies in Spherical and Practical Astronomy," in the *Bulletin* of the University of Wisconsin (vol. i. No. 3).

ON THE ORIGIN OF EUROPEAN AND NORTH AMERICAN ANTS.

QUESTIONS belonging to zoogeography may be practical or theoretical, actual or genetic; ultimately the resolution of them, whatever they may be, takes its chief interest from their relations to genetical problems, that is, to the explanation of the origin of actual faunæ, and to the knowledge of the original home of phyletic groups, and of the ways followed in their gradual diffusion over the whole or part of the world. To this purpose, not only living animals, but also fossils, have to be determined, and their affinities exactly worked out; changes in the distribution of land and sea and in the shape of continental areas must be investigated, and analogies and differences in the diffusion of various groups of living beings taken in consideration, as far as they are known. The work involved is long and difficult, and its results will form the science of the future.

In a paper published in 1891, on the fossil ants of Sicilian amber,[1] I made out that at the beginning of the Miocene epoch, North and South Europe had very different faunæ of ants, the Sicilian amber containing genera which belong to the actual Indian and Australian fauna, but wanting the typical holarctic genera *Formica*, *Lasius*, *Myrmica*, which are found in the Baltic amber, some species of them being extremely common and abundant. A similar, but not such a striking, difference exists between recent Mediterranean and North European ants, the former including a greater percentage of Indian and cosmopolite forms, and an absolutely and relatively lesser number of typically holarctic ones, the most species of *Formica*, *Myrmica*, and *Lasius* not having reached Africa (*F. fusca*, L., and *M. scabrinodis*, Nyl., are introduced in gardens in Algeria), and these genera being scarcely represented in Mediterranean islands. After discussing these facts, I came to the conclusion that South Europe should have had in the Tertiary epoch an ant fauna compound of old Mesozoic cosmopolite genera (chiefly Ponerinæ), mixed with Indian-Australian forms. In North Europe these lived together with northern genera, which, after the emergence of the bottom of the middle European sea, invaded the South, being perhaps expelled from the North by gradual cooling of climate. Later, the glacial epoch destroyed in Europe nearly all the rest of tropical insects, their return being made impossible by the natural barriers of sea, deserts, and mountains, accumulated southward and eastward of our continent.

These studies I have carried a step further in a revision, now printed, of the Formicidæ of North America.[2] A great number of North American ants are specifically identical to European ones. My attention was directed to find differences between American and European specimens, and indeed but a few species were so similar to their European relatives as to be not distinguishable as sub-species or varieties. The one genus, *Epœcus* and two sub-genera are exclusively Nearctic; all the other genera of North American ants not represented in Eurasia (*Discothyrea* has two species only, one in North America, another in New Zealand) are Neotropical. The northern regions of Europe has the one peculiar genus *Anergates*, allied to *Epœcus;* middle and south Europe have two further genera not found in other parts of the world, and some others known from the Indian region. All these facts lead to the result, that the Palæarctic ant-fauna is made of cosmopolite + Arctic + Indian elements; that the Nearctic fauna is similarly composed of cosmopolite + Arctic + Neotropical ones.

The question that now arises is: how has such a mixture been effectuated—what changes have determined it? A complete and detailed answer I believe to be at present impossible; but the knowledge of the fossil mammals may help us greatly, supplying for the want of evidence taken from fossil ants, other than the Miocene fauna of European amber, the fossil prints of Formicidæ being too imperfectly known, and a careful revision of the existing collections from a trained specialist wanted. I believe that mammals and ants are both of the same age; their migrations took place by means of the same land connections, with the difference, that winged females of ants could, easier than terrestrial mammals, pass over sea-arms, being carried by winds.

I admit that in the Oligocene epoch, after Australia, Africa and South America had been cut off from a great northern

[1] C. Emery. "Le Formiche dell' Ambra Siciliana nel Museo Mineralogico della R. Universitä di Bologna." (*Memor. Accad. Bologna* [5], vol. v. 1. 1891).

[2] C. Emery. "Beiträge zur Kenntniss der Nordamerikanischen Ameisenfauna. (*Zoolog. Jahrbücher*. Abth. f. Syst. 7 Bd. pp. 633-682, Taf. 22; 8 Bd. pp. 257-360, Taf. 8. 1893-95.)