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:—

$$m = 0{\cdot}000283113$$
$$m' = 0{\cdot}000232355$$
$$m'' = 0{\cdot}000812453$$
$$m''' = 0{\cdot}000214880$$

"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, theoretical, actual or genetic; ultimately the resolution them, whatever they may be, takes its chief interest from the 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. Università 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.)

system of dry land (such a system was rather an extensive archipelago than a continuous continent); this last was again divided into two systems: an Arctic and Occidental one, comprising North America, together with the northern parts of Asia and Europe, and an Indian one, communicating with South Europe. The former was the home of the Cervidæ, the rhinoceroses and most other Perissodactyls, the latter that of the Cavicorns and elephants. Very few mammals of Indian origin migrated into America; much more from the Arctic system into India. The same seems to be the case for ants. *Myrmecina* is perhaps the only North American genus of Indian origin (*Tetramorium cæspitum* being doubtless introduced by man), whereas a number of American-Arctic genera, sub-genera and species-groups, as *Myrmecocystus*, *Messor*, *Myrmica*, *Camponotus pennsylvanicus*, &c., are more or less far diffused in India and Africa, *Myrmica* reaching Borneo, and *Messor* the Cape of Good Hope.

In Europe, the study of the Baltic and Sicilian amber proves that the Arctic fauna went down from the north, as a host of conquerors, invading the territory formerly occupied by other people. I believe that, in Miocene times the North American fauna was much like the actual cosmopolite and Arctic part of the recent fauna, and might have included a number of forms actually extinct. As in the Pliocene a bridge was put between North and South America, an invasion of neotropical forms took place, walking from south to north. But it is not improbable that other forms migrated in the opposite sense, and descended from North America into the neotropical region. I suppose that such was the case for the genus *Pogonomyrmex*, perhaps also for *Dorymyrmex*, *Forelius*, and several species of *Camponotus*. It is not improbable that other genera from North America migrated southward, and later became extinct in their primitive home. The recent work of Mr. Scudder on Tertiary Curculionidæ of North America seems to confirm this view, some of these fossil beetles belonging to genera now living only in South America. It is probable that a number of insects, actually regarded as typical members of the neotropical fauna, immigrated from North America, as it is proved by palæontology for several mammals, as, for instance, the llama and alpacca of the Pampas.

The North American origin of some South American ants was suggested by Prof. H. von Jhering,[1] in a paper published last year. The author endeavours to sustain, by the study of the ants, his theory of the multiple origin of actual neotropical fauna. I agree in many points with him,[2] but I must recognise that the Formicidæ afford but little evidence in favour of his views. Actually, the ants of South America are distributed chiefly in relation to the climate and vegetation, no strong obstacles being put to the wide dissemination of the species, some of which range from Central America or from Mexico to Paraguay and Rio Grande do Sul. Chili is, however, an isolated country, which we may call "a continental island," although it is not surrounded by water. If we should take the Chilian fauna as a standard for the primitive fauna of v. Jhering's Archiplata, that should have been a very poor one, like the fauna of New Zealand, with which it offers a striking resemblance. The most characteristic feature of the Chilian ant fauna is the occurrence of peculiar species of *Monomorium*, like those inhabiting Australia and New Zealand, and of the genus *Melophorus*, found only in Australia and New Zealand. These facts corroborate the hypothesis of a Cretaceous or Eocene connection between South America and Australia.

New Zealand appears as a bit of old Australia, quite free from later Papuan or Indian intrusions, like Madagascar, which, as an isolated part of old Africa, has received but a few immigrants, when, at the Pliocene epoch, a stream of Indian life entered into the Æthiopian continent. Probably Chili may be considered as a part of ancient Archiplata, secured from Guyanean and Brazilian immigrants by the heights of the Cordillera, but having preserved only an incomplete set of the original Archiplatean fauna.

I state these facts for the purpose of making the main conclusions of a special work known to a wide public. Exact knowledge of the exotic faunæ, and especially of the fossils, may enable us in future to carry further these incomplete and in part hypothetical results. Similar studies made on single groups of animals and plants by specialists, which do not only accumulate by blind statistical work names of families, genera, and species, but deal with them, knowing the value of each, are highly desirable. Summarising and integrating the single results will build up an exact knowledge of palæogeography, and of the origins and interrelations of the faunæ and floræ of the world.

C. EMERY.

[1] H. von Jhering. "Die Ameisen von Rio Grande do Sul." (*Berliner entomolog. Zeit.* 39 Bd. 1894. Pp. 321—446. 1894.)

[2] Other points of v. Jhering's theories, which I cannot accept, refer chiefly to the origin and antiquity of island faunæ. In these points I think that Wallace's views are right.

A NEW FILM HOLDER.

NO outdoor photographer can take a rough survey of the past few years without feeling some astonishment at the rapid progress made in nearly every branch of his art. The amateur is no doubt indirectly responsible for much of this advance; for it is through him that other brains have been set to work to satisfy all his many and various wants, in the way of instruments and accessories, to lighten his task at every step.

The camera, which a few years back was a heavy, clumsy and awkward instrument, is now of a light and handy construction, capable of being used in many cases without the tripod. Stops are now more generally of the Iris type, thus eliminating all possibilities of loss or of leaving them behind; while plate-holders are now supplied capable of holding a dozen or more plates, and necessitating the use of only one dark shutter.

The introduction of the film has brought us, however, into a new era; but the full benefit of this improvement can only be best appreciated by those who make use of their cameras while travelling.

Hitherto it has been impossible to make satisfactory use of the enormous advantages of celluloid flat films over glass plates; but now we have before us a holder which seems to give satisfaction, and which should prove a boon to photographers in general.

A holder to be really efficient should be readily adaptable to any ordinary camera; it must contain a large quantity of films,

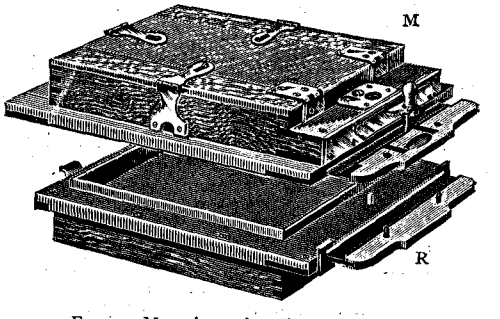

FIG. 1.—Magazine and receiver, separated.

and when complete and loaded should not be any larger or heavier than the three double backs (lighter if possible); and, finally, should be provided with some means of swiftly and automatically changing the positions of the exposed films.

Such a holder, if simple and of moderate price, would be much sought after by the photographic world. A very near approach to such an ideal film-holder will be found in that known as the "Frena," of which a short description follows.

Fig. 1 gives a complete view of the holder (the two parts are here shown separately), ready to be fitted to any camera. It consists of two parts: the magazine (M) and the receiver (R), each of these parts being about half as thick again as an ordinary dark slide. The exposure is made in precisely the same way as with an ordinary dark slide, namely, by inserting the magazine in the slide rails of the camera, and by withdrawing, and subsequently replacing, the shutter of the magazine.

The film changing is brought about simply by folding the magazine and receiver together until they interlock, drawing out the two shutters, pressing a change button to one side, and pushing the shutters back again.

The exposed films, stored in the receiver, may then be removed for development one by one, or as a complete pack, just as the operator desires.

An automatic counter upon the back of the magazine shows at a glance how many pictures have been taken.

The peculiarity of these films is that their edges are notched, and in their packing an alternate sequence is maintained as regards the position of these notches.