Migration and the Telescope.

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SOMEWHERE it is mentioned—I thought it was in *The Emu*, but careful search has failed to unearth the reference—that astronomers engaged in solar and lunar observations have often remarked on the numbers of birds seen crossing the apparent discs of the sun and moon. When I read this I was not particularly struck with the possibilities of ornithology at the telescope, and should probably have forgotten all about it but for a curious experience of recent date.

The moon was full at 3.15 p.m. (Eastern Australian standard time) on 21 October, 1926. It was to rise at Cowangie on the same evening at 6.52. In the early evening there was to be an occultation by the moon of 39B Arietis, a star of magnitude 6.5, situated, as its name suggests, in the zodiacal constellation of The Ram. The observation was not without its difficulties and the chances were against its success, especially at a station so far west as Cowangie, where the moon rises about 40 minutes later than at Sydney. However, an occultation at a time so near to full moon could be observed to advantage even in an observatory not equipped with a position-circle micrometer. Accordingly, I was at my post at the appointed hour. Astronomically I was disappointed, for the star was gone before the moon could be plainly seen. But the cloud which veiled the moon relieved any strain on the eyes and I was ready for anything else which could be seen.

Presently a bird fluttered across. It was just dusk; and the telescope was set very low. I decided to keep watch for a few minutes. Before I left the instrument quite thirty birds crossed the field of view. Some were gone in a moment. Others must have been far away and much higher, for although they beat their wings rapidly enough they were in view for many seconds. Then again at great distances a great radial velocity may be represented by very small tangential shift. In most cases, however, this last point could be determined from apparent angle of flight. If the bird appeared to be increasing its elevation gradually, it would probably mean in most cases that it was approaching the observer, and this, combined with slight tangential shift and rapid or normal movement of the wings, might settle the point.

I do not pretend that all the possibilities or all the difficulties were realised in a few minutes spent at the telescope, or that I have given all the thought that it deserves to one method which may *occasionally* add some little thing to what we know of birds and their movements. I have said " occasionally " because very little could be expected from the professional astronomer or even the keen amateur, as such. The

greatest chance of seeing birds is, naturally, when the telescope is low. And that is not the position in which astronomical observations are made. Indeed, if it were possible to arrange it so, every observation could be made at the zenith where the disturbances from atmospheric causes are at a minimum; and in practice there are few observations which are made at an altitude less than 40 degrees above the horizon. The reason for this is obvious. Even if the atmosphere were limited in height to 10 miles one would have to pierce 322.3 miles of atmosphere in observations at the horizon, while even at an altitude of 20 degrees one would be looking through 29.1 miles of atmosphere subject to varying movements, temperatures, and densities. (Journal B.A.A., XXII, p. 24.)

Nor is this the only reason why astronomers, as such, could give very little assistance. In these days fewer visual observations of the sun and moon are made than formerly. Photogrpahy has revolutionised astronomy and in a time measured in seconds or even the fraction of a second the dry plate can record more than the skilful draftsman would even see on sun or moon in the course of prolonged and careful scrutiny. Visual observations of the sun may be said to be confined in the main to transits of Venus and Mercury, and those of the moon to occultations of stars and planets. The transits may be dismissed, for none of Venus will occur again till 2004 A.D., and those of Mercury come only about 4 times in 33 years. The next of the latter will be in May of 1927. But with the occultations by the moon the case is different. Hardly a month goes by but there are several such announced in the New South Wales Astronomical Bulletin.

After "immersion" there are before "emersion" several minutes during which it is advisable to remain at or near the instrument, and when the little diversion to be gained from keeping a look-out for birds might appeal to the amateur astronomer whose interest in the beautiful and wonderful in nature is not confined to the starry heavens. Such vigilance might be productive at or near full moon, with the moon and instrument low, and at a time when migrations, particularly of birds travelling in flocks, might reasonably be expected. The chief training for such work away from the instrument would be the study of characteristic flights of individuals and flocks, particularly when viewed *against* the light; for in the telescope all figures are silhouetted against the bright background of the sun or moon. There is no need to warn the astronomer of the protection of the eyes needed if even the moon is to be looked at in this way for protracted periods.

In conclusion, a few of the mathematical considerations involved may be treated very briefly. The mean angular semi-diameter of the sun is 16 minutes 1 second; that of the moon is 15 minutes 34 seconds. As they are similar it will be sufficient to consider the moon. If a bird were a mile off and flew *across* the line of sight and at right angles to that line, it would travel 47.817792 feet in traversing the full moon. There is no need to be quite so exact, especially as the moon does not always appear of the same size. If the bird were two miles off it would travel nearly 100 feet in crossing the full moon. If it crossed at anything but a right angle, which of course is more likely

than not, the time occupied in crossing would be greater and the distance actually traversed would be greater.

In his *Natural History of the Ducks*, Dr. J. C. Phillips states that the Ducks, for instance, do not exceed sixty miles per hour. A Duck travelling at this top speed a mile away and directly at right angles to the line of sight would occupy 0.543384 of a second of time in crossing the mean apparent disc of the full moon. Even at four miles off the bird would be seen only for a little over two seconds. But, as earlier noted, sixty miles an hour is their maximum speed and the chances are against their flight being at right angles to the line of sight. It is not surprising that Ducks " get a move on " and exceed the speed limit with an aeroplane in full pursuit over the rice-fields of California ; but under normal conditions, and at a distance of a mile or two, it should not be difficult for an observer as skilled in ornithology as in telescopy to recognise the flight of a flock of Ducks and to report on the height and speed at which they travel.

A writer in *The Emu* in 1921 (XXI, p. 69), speaking as an aeronaut as well as a bird-observer, mentioned 16,000 feet as the *average* height of migration. I may be worth mentioning that birds travelling at that height, and distant nearly $4\frac{3}{4}$ miles from the telescope, would be within the range of an astronomer observing the moon at an altitude of 40 degrees.

I do not claim great possibilities for this line of investigation, but I hope to devote to the experiment any opportunities which may offer themselves. And no doubt there are other readers of *The Emu* who can bring to the task greater mental and more suitable instrumental equipment than I possess.

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POINTS OF NOMENCLATURE.

(To the Editor.)

SIR,—In the New Edition of our Checklist there is a paragraph re *Creadion*. This comes under the heading of Type Designation. For all future workers, I publish now, how type designation is done when following the "International Rules of Zoological Nomenclature," as published in 1905 and corrected in *Science* for 18 October, 1907 (New Series, vol. XXVI, No. 668), pp. 520-523. (P. 521, Art. 30) : A. " When in the original publication of a genus, one of the species is definitely designated as type, this species shall be accepted as type regardless of any other consideration.

(Type by original designation). C. " A genus proposed with a single original species takes that species as its type. (Monotypical genera.) D. " If a genus, without originally designated or indicated type, contains amongst its original species one possessing the generic