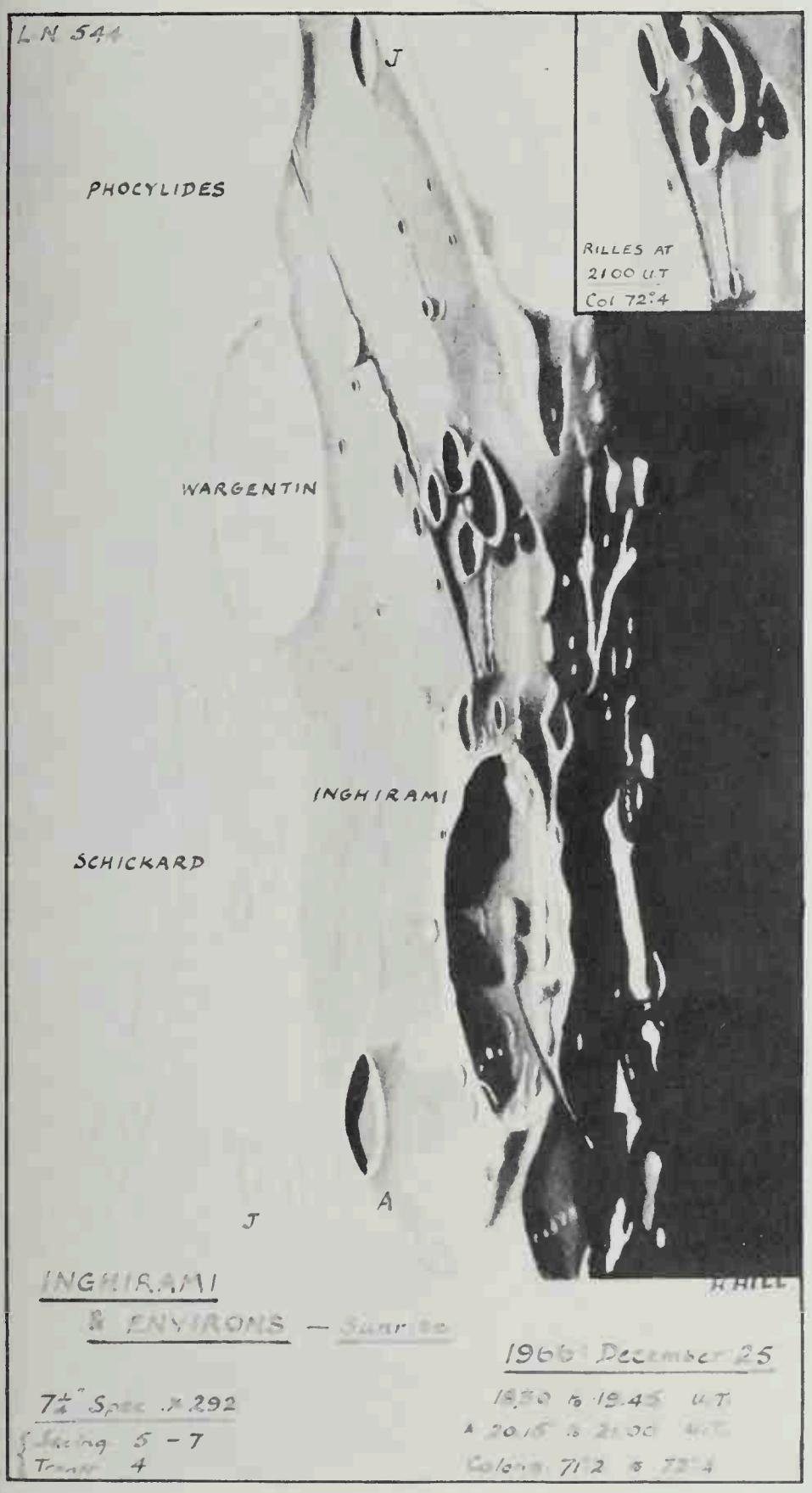
feasible with this method. For more serious work a driven telescope is desirable, and better still, one capable of being driven at the lunar rate rather than the usual sidereal rate. Many amateurs then project the image through a high-quality eyepiece directly on to the film. The sensitivity of a photographic emulsion is no match for the acuity of the human eye, and more detail can be seen on the Moon and planets by an observer than can be photographed through the same instrument. Photography has the advantage, however, that an exposure can be made in a fraction of the time it would take to make a drawing and the area covered is usually considerably greater. The effects of libration (page 101), mean that some features at the lunar limbs are easily visible at some times and quite out of sight at others. It may therefore take a considerable time to see or to be able to photograph some particular formation under just the right conditions of illumination.

A drawing by H. Hill of the same crater and made at the same time as the photograph opposite.



The appreciable motion of the Moon against the background stars – about its own diameter in one hour – causes it to pass between an observer on the Earth and a number of stars during the course of a month. The various lunar motions cause it to trace out a path in a wide band each side of the ecliptic, and there is a large number of such occultations which can occur. The disappearance of a star behind the dark limb of the Moon is a very striking phenomenon, and indeed, as the Moon is airless, is so sudden that it can come as quite a shock to an observer. However, the accurate timing of these events is very important indeed for determining the position of the Moon. Even simple visual methods giving an accuracy of perhaps ± 0.3 seconds of time enable the position of the Moon to be determined to an accuracy of about ± 0.15 arc sec. (about 300m), which is several times better than results obtainable with a transit circle. Depending upon the observer and the precise methods used, even higher accuracies can be achieved. It was an analysis of such observations that first indicated that the Earth's rate of rotation was not constant, and this led to the concept of ephemeris time (page 17).

Predictions for the various occultations are produced by several professional observatories and published in various yearbooks, or sent directly to observers who have established their seriousness and accuracy in this type of work. In a similar manner professional astronomers are prepared to analyse accurate timings, and so occultations provide an excellent opportunity for observers with small telescopes to contribute to astronomical studies. The only basic ancillary equipment is a good stop-watch, preferably of the 'split-action' type, which can be stopped against the first available time signal. For the latter most amateur astronomers use the telephone service's 'speaking clock'. From the recorded time and other details, such as the observer's geographic latitude and longitude, the appropriate calculations may be made. Many observers use rather more sophisticated methods of timing, for example picking up the continuously broadcast time signals available on certain radio frequencies, recording these on a tape recorder, and superimposing a signal at the time of the event. Photoelectric detection of occultations is yet another technique, and one which will yield highly accurate times.

The first of these more sophisticated methods is required to make the most of the events known as grazing occultations. In these the star appears just to brush the Moon's limb, and because of the irregularity of its surface may disappear and reappear several times. The observers' position on the Earth is all-important here, as just a few metres may make all the difference between seeing an occultation and missing it entirely. Because of the problems of exact prediction, grazes are best observed by a team, the members of which are able to place themselves at intervals along a line, ideally at right angles to the predicted graze limit. A team of observers has the further advantage that a series of timings is obtained, thus allowing a detailed limb profile to be determined. This may be compared with the known profile, or in cases where it was previously unknown, serve for future reference. Under any circumstances the result is highly accurate knowledge of the Moon's position at that moment of time.

Disappearances at the bright limb and