## OUR ASTRONOMICAL COLUMN.

THE BIRTH OF THE MOON.—Prof. W. H. Pickering in *Popular Astronomy* (October, 1919) endeavours to reconcile Sir George Darwin's estimate of the moon's age (less than 60,000,000 years) with recent geological opinion, which demands a period of 1,200,000,000 years since the formation of the earth's crust. He suggests that the matter of the moon left the earth at that remote epoch, but remained for ages circulating round the earth as a cloud of fragments. In this form its tidal influence would be small, and the earth would for long retain its assumed primitive rotation period of some four hours. Gravity in the tropics would be much reduced by centrifugal force. Prof. Pickering seeks thus to explain the existence of the huge reptiles like the Atlantosaurus and the Diplodocus, also the fact that heavy reptiles like the Pterodactyls had the power of flight. He suggests that the moon was consolidated from the cloud of fragments in the middle of the Cretaceous period, and quotes geological authorities for a great invasion of land areas by the sea and tremendous volcanic activity at that epoch, which he ascribes to the great tides which the moon would have raised when so near the earth. That epoch would agree well enough with Sir George Darwin's estimate of the moon's age, supposing it to date from its consolidation, not from its leaving the earth.

DISTANCES OF THE STARS OF TYPE F.—Mr. C. F. Lundahl discusses the distances of these stars in *Meddel. Lunds Astr. Obs.* (series ii., No. 21). He works on the same lines as Prof. Charlier in his recent memoir of the B stars; that is, he assumes a constant absolute magnitude, and deduces the distance of each star from its apparent magnitude. The F stars have a wider range of absolute magnitude than those of type B, but the great majority of them are included in a range of about 2 mag.; hence tolerable results for the distances may be expected. In fact, he states that 60 per cent. of the stars the parallax of which has been measured agree with his values within the limits of probable error. He quotes Prof. Plummer's research on the same stars, which was based on the assumption that they were moving parallel to the galactic plane. As that method showed an agreement with measured values for only 40 per cent. of the stars, Mr. Lundahl concludes that his own assumption is nearer the truth. He notes from his results that $\zeta$ Tucanæ and $\eta$ Cassiopeiæ are evidently dwarf stars, while Polaris and still more Canopus are notable giants. The density of distribution of F stars is estimated by two independent methods which give respectively 8 and 4 cubic siriometers for one star of this type (a sir. = 1,000,000 astr. units).

ABSOLUTE MAGNITUDE AS A FUNCTION OF COLOUR.—Mr. F. H. Seares indicates a relation between colour and absolute magnitude in stars of the same spectral type (Proc. Nat. Acad. Sci., July, 1919). The colour is determined photographically by taking graduated exposures of the star on an isochromatic plate with and without a yellow filter. The ratio of exposure times that give images of equal intensity in the two cases is a measure of the colour. The method has been tested on about 150 stars the absolute magnitude of which has been otherwise determined. The following are the results deduced:—Giant stars of types G and K are decidedly redder than dwarfs: also in type B the brighter stars are redder, but the difference is less marked. On the other hand, in type A the fainter stars are redder, while in types F and M the curve is too flat to permit of the absolute magnitude being found from the colour. Thus the method can be applied only if the spectral type is known, but it promises to be a useful supplement to the spectroscopic method. Experiments are being made to examine whether the necessity of knowledge of the spectral type can be evaded by taking three series of exposures with screens of different colours; if this were possible, the method could be applied to much fainter stars.

## CROSS-CIRCULATION AS A PHYSIOLOGICAL METHOD.

IN the mutual co-ordination and integration of the physiological processes in a complex organism, in which actions exerted by the environment on a particular part affect the whole and the functional activity of one organ has its influence on numerous others, there are two chief methods adopted. One is by means of the central nervous system, in which messages received from the periphery along certain nerve-fibres are reflected back, as it were, to outgoing nerve-fibres, setting into play the appropriate muscular or other response, it may be in a distant part of the organism. This method has been compared to a telephone exchange. The other is by means of the blood. Owing to the continual circulation of the same mass of liquid through all parts of the body, it will readily be seen that a chemical substance, produced in any one part and passing into the blood-vessels supplying this part, must be carried, sooner or later, to all other parts, and give rise to effects in any tissue or organ sensitive to it. We have here an actual transport of material, the materials carried, when they result in changes in distant organs, being known as "chemical messengers" or "hormones."

In many cases there is difficulty in discovering to which of these modes of communication a particular reaction is due. Thus when muscular exercise is taken, the depth and rate of breathing increase. We know that carbon dioxide is produced in the combustion process that affords the energy for the muscular work. This passes into the blood, and may be in itself sufficient to set into greater activity the nerve-centre controlling the muscles of respiration. On the other hand, it might be that sensory nerves in the muscle are stimulated by the movements, and that the appropriate message is conveyed by nervous channels, or both chemical and nervous factors may be involved. Perhaps a clearer case is that of the pancreas, which pours its powerful digestive juice into the small intestine as the food arrives there from the stomach. We know now that the chief, if not the only, way by which this co-ordination is effected is that the acid of the gastric contents causes the formation of a chemical messenger in the walls of the intestine. This, passing into the blood, ultimately reaches the pancreas and excites it to activity, but it was for a long time believed to be a nervous reflex. Again, the origin of wound-shock has recently been shown to lie mainly in the production in the injured tissues of poisonous compounds, which are carried by the blood to the rest of the body and cause widespread damage to the capillary blood-vessels, resulting in a failure of blood-supply throughout the body. At the same time the co-operation of nervous factors has not been altogether excluded.

The analysis of many problems of this kind has been greatly assisted by the various methods known as "cross-circulation." It is obvious that if we can make a connection between the blood-vessels of one animal (A) and those of another (B), any chemical messenger produced in A must affect B also, whereas a process in A brought about entirely by the nervous system will have no effect on B. In this mode of experiment the blood of A may either be allowed to circulate through the whole of B, and *vice versa*, or