plosive eruption such as excavated these gigantic craters, its first effect will be to fill up the crater before overflowing the edges.

Lateral outpourings can only occur when the cone has been sufficiently rebuilt, above the level of the surrounding country, to give enough hydrostatic force to rend this cone.

The radiating rays around these craters cannot be lava streams, as these only flow out of the crater by its lowest lip. They are not due to landslips of the loose ejecta collected on the slopes of the cone, such as I described and figured in my book on the great Vesuvian eruption of 1906, and which had until then been attributed to water erosion, for the following reason. These ravines, like the depressions around a half-opened umbrella, are straight radially and not sinuously radial as in those surrounding the great craters of the moon.

Were these radial rays lava streams, which originally issued from a cone now truncated by a later explosive eruption, then they would have been obliterated by the enormous mantle of fragmentary materials that would have been ejected.

These rays have more the appearance of erosion valleys, but this we cannot admit if physicists maintain that there is no lunar atmosphere to speak of.

Their greatest resemblance, however, is with the irregular, radial cracks formed around the splash of a missile striking a comparatively hard surface, such as is observable when bullets are fired into soap, hard clay, lead, or half-set plaster, or even steel.

The more I compare the moon's surface with volcanic vents in different parts of this world the less I see a resemblance between the two, and the more does the planetoid and meteorite projectile theory become acceptable. The obviously asymmetrical craters with high, overhanging, narrow lip on one side, and low, broad lip on the opposite side, point to the impact of the meteorite being oblique to the moon's surface. The long, deep furrows, such as the valley of the Alps, &c., are, to my mind, formed by bolides ploughing in a path of high ellipticity the surface of the moon, but at so low an angle as not to penetrate its surface.

I think it a great pity that a good lunar-observing astronomer with one of the most powerful telescopes at his disposal, does not collaborate with a thoroughly practical vulcanologist to examine many of the lunar features without very rigidly fixed preconceived ideas. How often have I wished to be able to study carefully the moon's surface, and no doubt astronomers have often craved for a more extensive vulcanological knowledge.

H. J. JOHNSTON-LAVIS.

Villa Lavis, Beaulieu-sur-Mer, January 26.

The End-product of Thorium.—A Suggestion.

THE chemical composition of thorites and thorianites does not seem to suggest any probable end-product for the contained thorium. It has occurred to us that the only explanation at present available is that the end-product is an isotope of thorium itself. This condition might be brought about by the emission of sufficient β rays.

If this be the case, thorium, as we know it, must be a mixture of two isotopic elements, one of which is radio-active. There is some support in favour of this suggestion to be found in the erratic position of thorium on the Geiger-Nuttall curve (*Phil. Mag.*, October, 1912). According to this curve, the value of λ for thorium, as observed, is too low. Now, if there is a stable component present, this result will naturally arise.

From the position of thorium on the diagram it is possible to estimate the value of λ for the active constituent on the above hypothesis. It comes out approximately as $1 \cdot 0 \times 10^{-16}$ sec^{-1}. The percentage of this active constituent would appear to be about 0·7. It is also possible to estimate the time for this composition to have been attained, starting from the pure active constituent. The time appears to be about $1 \cdot 6 \times 10^9$ years.

The view that thorium possesses a radio-active constituent as determined above may, of course, be made the basis of an independent hypothesis.

J. JOLY.
J. R. COTTER.

Trinity College, Dublin, February 3.

A Curious Ice Formation.

I AM taking the liberty of enclosing a photograph of an occurrence which, so far as I am aware, is quite unique for this part of the country, and will no doubt have some interest for your readers.

The water was frozen during the night of December 31, 1913 (on which night at least 14° of frost were registered) into circular floes of ice of varying diameter, which, being encrusted with snow, had the appearance of water-lilies.

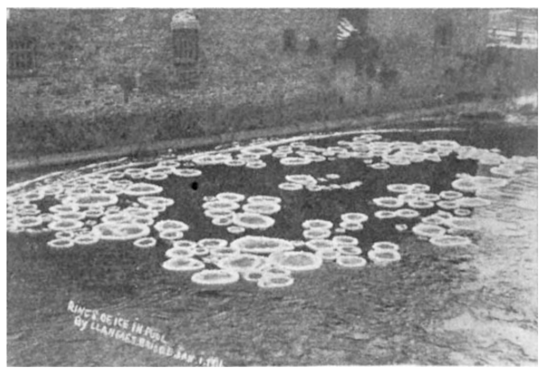

Photo.] [*J. Clark, Brecon.*

The river at this point flows almost due southward, and has just passed under a bridge over a weir, at both ends of which is a whirlpool.

The accompanying photograph shows the east whirlpool as it appeared on New Year's Day.

The river, I may mention, is the Usk, and the photograph was taken at Brecon.

D. J. PHILLIPS.

University College of South Wales and Monmouthshire, Cardiff.

Soil Protozoa.

IN a letter to NATURE (No. 2266, vol. xci., 1913) one of us (C. H. M.) gave an account of a method of obtaining permanent preparations of Protozoa in the state in which they were living in the soil.

The fixative used in this method was picric acid in saturated aqueous solution, but we have since found this reagent to be less serviceable in the case of clay soils than the following mixture:—Saturated aqueous solution of mercuric chloride, 1 pt.; methylated spirit, 1 pt. The soil should be crumbled into this fluid, and mixing is best accomplished by gently shaking the containing vessel, care being taken to avoid making the clay component of the soil pass into suspension.

A delicate film containing Protozoa will appear on the surface of the liquid, and this can be removed by floating cover-slips over it, and stained by the usual methods.

K. R. LEWIN.
C. H. MARTIN.

Lawes Experimental Laboratory, Rothamsted, January 27.