age calculated from the ratio of lead-207 to lead-206, which may therefore be accepted as a minimum value. Apart from the standard deviation, one can only conclude that the age of the Bikita monazite is less than 2,680 and more than 2,600 m.y., suggesting that the most probable age is about 2,640 m.y., as given by the ratio lead-208 to thorium.

The monazite from the Jack Tin Claims (Table 2) is a concentrate from a post-Bulawayan pegmatite worked for tin and tantalum north of Salisbury. The 'age pattern' in this case clearly points to loss of lead⁹, in which case the most reliable age is that given by the ratio lead-207 to lead-206, namely, $2,650 \pm 10$ m.y.

The monazite from the Irumi Hills of Northern Rhodesia (Table 2), near the southern extremity of the Katanga pedicle, is a concentrate from alluvium derived from the rocks of the "Lower Basement" Group. Although nearly all the crystals are clear and apparently unweathered, the 'age pattern' indicates that the mineral has, in fact, been considerably altered. Loss of lead is the dominant effect, accompanied in this case by subsidiary loss of uranium. The only age indicator of value is the ratio lead-207 to lead-206, which remains unaffected by recent weathering and would be only slightly reduced by alterations that occurred long ago⁹. The age given by this ratio, $2,620 \pm 10$ m.y., may therefore be a trifle less than the true value. The accordance of this result with those recorded above adds convincing support to Guernsey's provisional suggestion—based on lithological and tectonic similarity—that the Lower Basement rocks of Northern Rhodesia may be partially equivalent to the Bulawayan System¹⁰.

The Bulawayan rocks represent sediments and lavas that were deposited or erupted at the earth's surface considerably earlier than the period of pegmatite formation here dated at about $2,640 \pm 40$ m.y., especially so if the pegmatites concerned are post-Shamvaian, as is highly probable. Since these pegmatites are not only the oldest dated examples known in Africa but are also the oldest yet recorded for any continent, it is interesting to direct attention to their bearing on the time during which life is known to have existed on the earth. In 1935, Dr. A. M. Macgregor detected algal structures in graphitic limestone (33 miles north-north-east of Bulawayo) associated with cherts and lavas low down in the Bulawayan System, which at that time was known as the Greenstone System. In 1941, the structures were described and figured¹¹. This important discovery by Macgregor, and the age determinations now recorded, provide indubitable evidence that life has existed for at least 2,600 m.y. and probably for considerably longer than 2,700 m.y.

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OBITUARIES

Dr. F. M. Penning

FRANS MICHEL PENNING was born on September 12, 1894, at Gorkum in The Netherlands. He studied physics at the University of Leyden under Kamerlingh Onnes, and his thesis on isopycnic curves of gases at low temperatures is in keeping with the Leyden traditions of those days. In 1924 he joined the research laboratories of the Philips Company at Eindhoven, and there he remained until his death on December 6, 1953, devoting his activities almost exclusively to the study of the electric discharge in gases, a field in which he soon became a prominent figure.

A characteristic feature of his work was his continual effort to obtain reproducible results under well-defined conditions. With great skill and patience he carried out a number of carefully designed experiments to determine fundamental constants relating to discharges in gases. This work also led to brilliant new discoveries.

Penning was the first to recognize that the breakdown potential of inert gases can be profoundly modified by small quantities of other gases which may become ionized by collision with metastable atoms of the original gas. This concept enabled him not only to explain the discrepancies between existing data but also to discover a number of new and striking phenomena.

A second aspect of his work dealt with discharges in magnetic fields. One of his results was that, in a magnetic field with a certain electrode configuration, a discharge can subsist at very low pressures. This led to the development of the Penning type of ion source and of the Penning ionization gauge, both of which are valuable tools in modern experimental technique.

In the years after the Second World War, Penning made further important progress in obtaining reproducible values of the cathode fall on a molybdenum electrode by showing how the influence of oxides and other impurities can be eliminated by an elaborate sputtering technique. This work led also to the development of a new stabilizing tube.

Mention should also be made of his article with de Groot on the excitation of quantum transitions by collisions, in "Geiger und Scheel's Handbuch der Physik" (1930), and of the well-known review article with Druyvesteyn (*Rev. Mod. Physics*, 1940).

Although handicapped by delicate health, Penning was not only a very hard worker but also a man with broad interests. Those who had the privilege of knowing him personally will remember him as a loyal friend and unselfish colleague, who to a rare degree had attained harmony between his personal faith and his daily life.

H. B. G. CASIMIR

Dr. N. G. Horner

DR. NORMAN GERALD HORNER, who died on March 7, was editor of the *British Medical Journal* from 1928 until 1946, and for eleven years before that he was assistant editor under Sir Dawson Williams. Dawson Williams was an exacting chief, who was held in awe by his staff and colleagues; but Horner, a man of very different constitution and manner, became his devoted disciple, even to the extent of a (probably unconscious) change of literary