

quotation in the text-book of which one of my critics is a co-author.

(2) *Weathering and oxidation.* Obviously highly weathered samples do not lend themselves to age determinations—they may not qualify even as uraninites. Sample selection largely obviates such difficulties, especially when the minuteness of the material required for X-ray determinations is considered. Heat treatment, particularly as used for γ -types, further helps to limit, and also recognize, this factor. The effect of oxidation should not be over-emphasized, as in some samples the effect on the parameter proved less than the error in determination.

The material used for the tabulated results is above reproach.

(3) *Radiation damage.* This is a negligible factor here, except perhaps in comparatively young pitchblendes. To try to explain γ -uraninites by increase in lattice parameter brought about by radiation immediately poses the question of the other two types: Why are these not similarly affected? The suggestion cannot explain the chemical differences observed.

(4) *Presence of rare-earths and alkaline-earths.* Sample selection by the avoidance of nivenites and cleveites controlled the effect of the omnipresence of the rare-earths. These elements generally depress the parameter but, in the samples used, such reduction is negligible. The role, if any, of the alkaline-earths is inconsequential here.

I thank Drs. Hoekstra and Katz for their criticism, but it has offered no explanation of the regularity observed in my table of results; they infer that results may show haphazard values. If cube-edges of uraninites are considered in the light of my thesis, a fine order is found to exist where chaos now reigns.

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Age of the Mineralization of the Witwatersrand

Louw¹ has recently reported new isotopic assays of radiogenic lead from the uraninites of the Witwatersrand, and has utilized these data in arguments supporting a placer origin for the Rand mineralization. The same information has been published in fuller extent elsewhere², and a third paper by the same author, already circulated in preprint form, is in the press³.

These arguments based upon mass-spectrographic analyses form the sole response of South African scientists to the criticisms of the placer theory which I have published in recent years⁴. A refutation of Louw's conclusions awaits printing elsewhere⁵; and since repetitive publication is to be deprecated, it will suffice to note here that much of the latest South African work is vitiated by the lack of mineragraphic control of the uraninite samples studied, which were greatly contaminated by galena of unknown isotopic composition. Restricting attention to measurements on the less impure samples carrying upwards of about 50 per cent uranium, there are now nine ²⁰⁷Pb : ²⁰⁶Pb ages available for Witwatersrand uraninite, determined by four different laboratories. These ages uniformly fall within the average of $2,055 \pm 150$ million years, a result in good agreement with the dating of $2,080 \pm 40$ million years arrived at by Holmes⁶ for the Limpopo granitization nearby. Age determinations therefore lend support to the already

weighty arguments favouring an epigenetic origin for the Rand ores by pointing, for the first time, to a cycle of granitization with which the mineralization may be connected.

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Feb. 21.

¹ Louw, J. D., *Nature*, 175, 349 (1955).

² Louw, J. D., *S. African Min. Eng. J.*, 65, 621 (1954).

³ Louw, J. D., *Trans. Geol. Soc. S. Africa*, 57 (1955).

⁴ Davidson, C. F., and Bowie, S. H. U., *Bull. Geol. Surv.*, 3, 1 (1951).
Davidson, C. F., *Mining Mag.*, 88, 73 (1953).

⁵ Davidson, C. F., *Mining Mag.*, [92, 152 (1955)].

⁶ Holmes, A., *Col. Geol. Min. Res.*, 5, 3 (1955).

A New Joule Manuscript

IN 1851, William Hopkins, of Cambridge, obtained a grant of £250 from the Government "for investigations on the effect of pressure on the temperature of fusion of certain substances". It was stipulated that expenditure of the money should be under the control of a committee which included Joule.

During the next few years Hopkins, Joule and William Fairbairn worked in close co-operation on these problems, and Hopkins reported some of their findings (which were not recorded) to the Hull meeting of the British Association in September 1853. This report would certainly include results given in a letter, written by Joule, and recently found in a volume of Watts's translation of "Gmelin's Handbook of Chemistry" (which once belonged to Joule and is now in the Manchester College of Technology Library). Joule gives details of a series of experiments he did on the physical properties of beeswax "which may perhaps serve to throw some light on the alteration of the point of liquefaction by pressure".

It is addressed to William Hopkins from Acton Square, Salford, and is dated August 20, 1853. It would appear to be a draft, because in a letter dated August 24 to Fairbairn¹ giving him only a brief outline of the results, Joule says: "I transmitted to Mr. Hopkins yesterday . . ." that is, three days later than the date on the letter recently found.

There are twelve small pages, and the first eight give details of nine experiments carried out to determine the specific heat of wax at differing temperatures and the heat absorbed in changing the state of one grain of wax from perfect solidity to perfect fluidity. Joule remarks: "having no exact point at which perfect solidity is followed by perfect fluidity, our 'stationary point' (Hopkins's term) was entirely delusive". The remaining four pages are devoted to the expansion by heat of beeswax, in which Joule uses a formula of William Thomson. He finishes by saying: "the experiments which I have related are worth repeating and with greater accuracy. This, however, would require apparatus for the purpose and more time than I shall have at my disposal for some weeks to come. I hope, however, that the above results, such as they are, will not be without their use in formulating your views".

The letter may be seen in the College of Technology Library, Manchester.

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Manchester. Feb. 11.

¹ Pole, William, "Life of Sir William Fairbairn", 296 (1877).