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Rhodesite, a new mineral from the Bultfontein mine, Kimberley.

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Summary. A small specimen at first thought to be natrolite has proved to be a new mineral, for which the name rhodesite is proposed; it is fibrous, with α 1.502, β 1.506, γ 1.515, elongation γ , extinction straight, sp. gr. 2.36. The composition is near $4(\text{Ca}, \text{Na}_2, \text{K}_2)\text{O} \cdot 10\text{SiO}_2 \cdot 7\text{H}_2\text{O}$, and the water is all zeolitic.

A MINERAL specimen was sent to me in 1938 by Miss M. Wilman, then Director of the McGregor Museum, Kimberley. It weighed about 200 gm., appeared to be fairly uniform in character, and was reported as coming from the Bultfontein Mine. In reply to her, I reported that it had many properties close to those of natrolite, a common zeolite, but that it differed in some essential details and also in general appearance. I sent a sample to Dr. F. A. Bannister of the British Museum asking if he would examine it by X-rays, and retained the bulk of the specimen with the intention of making a careful chemical analysis if it could not be identified.

Dr. Bannister reported that the powder photograph was not very clear and that he was unable to identify the mineral. He promised to examine it more carefully when he had time, but this was never done owing to the war and Dr. Bannister's illness. Subsequently I learnt that the material sent to him had been mislaid.

I made a rough chemical analysis, which showed that the mineral was a hydrated silicate of lime and alkalis with a silica percentage about 62 and a little alumina. This was quite different from natrolite which has a silica percentage of 47 and an alumina percentage about 27. At the end of 1954 Dr. H. F. W. Taylor of Aberdeen University undertook to

examine the mineral by X-rays and subsequently arranged for a differential thermal analysis. He will publish his detailed results separately, but has meanwhile sent me a summary of his results and confirms that the mineral is an undescribed species.

The specimen is a mass of matted silky white fibres, with a suggestion of subradiating texture, in the form of rosettes up to 2 mm. in size. Under the microscope individual fibres are not more than 0.5 mm. in length and some of them are slightly platy suggesting a possible cleavage parallel to the length. The specimen is macroscopically fairly uniform and looks as though it consists almost entirely of one mineral with the exception of a few minor grey-green patches probably consisting of serpentine typical of the Kimberlite of the mine. There is, however, a suggestion on the freshest face of the specimen that one-half of the specimen is slightly more silky than the other and thus possibly less altered. It was this material that was consequently selected for more detailed examination and some 10 g. were picked out for chemical, optical, and other tests. These tests showed that the selected material was in fact homogeneous whereas the other half of the specimen proved subsequently to consist to a large extent of a very similar but optically distinct species.

The hardness could not be determined accurately owing to the fineness of the fibres and the tendency of the fibres to tear apart instead of being scratched. On massive material, however, it appears to be about 4. The specific gravity also presented a problem. By the suspension method a figure of 2.31 was obtained for the little rosettes, but the individual fibres showed variation in sinking. A small diffusion column prepared in a test-tube showed that in general the tiniest fibres sank first and the larger aggregates last. This suggested that the aggregates enclosed a certain amount of air. The first appreciable crop of fibres to sink proved to have a specific gravity of 2.36, while some of the larger aggregates corresponded to less than 2.30. Results obtained by pycnometer were very variable and were probably affected by absorption of water. When air was boiled off, the figures obtained were round about 2.38. The figure of 2.36, however, seems to be most acceptable.

On ignition, fibres are fusible to a clear glass of refractive index about 1.532. This material is mostly colourless but in places stained a pale brown as though iron is originally distributed irregularly through the mineral. Water heated with the mineral gives a strong alkaline reaction with an indicator and on heating with concentrated hydrochloric acid the mineral quickly decomposes leaving a silica gel.

Single fibres under the microscope have straight extinction always with length slow whereas much of the material in the other half of the specimen is elongated along the β vibration direction. In the latter case there appear roughly equal numbers of fibres under the microscope showing length fast and slow respectively, and individually they can be distinguished from the mineral being described by the fact that when fibres are rotated about their length they change sign of elongation. These fibres are in general shorter and less distinct. Dr. Taylor has done a considerable amount of work on this latter mineral and believes it also to be an undescribed species. In fact the specimen first examined by him consisted largely, if not entirely, of this second mineral.

The refractive indices determined by immersion were found to be α 1.502, β 1.506, γ 1.515, so that the mineral is presumably orthorhombic. The cleavage previously mentioned appears to be normal to the β -vibration, but although oriented sections were prepared no recognizable interference figure could be obtained in any orientation. The determination of β was not very accurate owing to the composite nature of the fibres, but at least it seems probable from the value of β obtained that the mineral is optically positive.

Chemical analyses made on the material used for the physical properties gave the following results. On crushing, the mineral cannot be sieved, but aggregates into small spherical masses like short-fibre asbestos.

| | 1. | 2. | Average. | Molecular ratios. |
|--------------------------------|---------------|--------------|---------------|-------------------|
| SiO ₂ | 61.79 | 61.86 | 61.83 | 1030 |
| Al ₂ O ₃ | 0.30 | 0.28 | 0.29 | 3 |
| FeO | 0.25 | 0.25 | 0.25 | 3 |
| CaO | 14.95 | 14.85 | 14.90 | 266 |
| MgO | 0.09 | 0.07 | 0.08 | 2 |
| Na ₂ O | 5.04 | 4.82 | 4.93 | 80 |
| K ₂ O | 5.40 | 5.16 | 5.28 | 56 |
| H ₂ O | 12.45 | 12.55 | 12.50 | 694 |
| | <u>100.27</u> | <u>99.84</u> | <u>100.06</u> | |

Analysis 1 was made by fusion methods before it was realized that the mineral could be decomposed with acid. Analysis 2 was made after decomposition with hot concentrated hydrochloric acid. Chemical tests on other samples suggest that the lime can be as high as 18% and the alkalis correspondingly low. The analyses were made on air-dried material so that the water represents total water. It is impossible to give a simple figure for hygroscopic water as the amount driven off at 110° C. varies so much with time.

Mr. J. B. Hawthorne of Rhodes University carried out some preliminary dehydration experiments on the mineral. After prolonged heating at 110° C. the loss of water was determined as 4.14 %, and on subsequent cooling all the water was recovered under room conditions in about 12 hours. On heating at 275° C. practically all the water was driven off within 20 minutes and after cooling most of the water was recovered after 8 hours, but about 1 % of the water remained unrecovered. As stated previously, on ignition the mineral melts and then no water is recovered on cooling. The dehydration curve for different temperatures is almost a uniform curve and there is no well-defined change of slope.

The composition corresponds roughly to $4(\text{Ca}, \text{Na}_2, \text{K}_2)\text{O} \cdot 10\text{SiO}_2 \cdot 7\text{H}_2\text{O}$ with a molecular ratio $\text{CaO}:\text{alkalis}$ about 2:1.

All these properties are similar to those of certain zeolites, especially the natrolite-thomsonite group, but the mineral differs chemically from the zeolites in containing virtually no alumina and in having a low oxygen/silicon ratio of 2.4. Pure natrolite, for example, contains 27 % alumina and has an oxygen/silicon ratio of 3.3. Amongst the allied minerals, however, the nearest approach seems to be okenite which contains no alumina and has an oxygen/silicon value of 2.5. Its composition is given as $\text{H}_2\text{CaSi}_2\text{O}_6 \cdot \text{H}_2\text{O}$. Its physical properties are rather similar, but its refractive indices are given as 1.530–1.541 which is well outside the range of the present mineral, while the virtual absence of alkalis in okenite also shows that it is quite distinct.

For this new mineral I suggest the name *Rhodesite* (pronounced rōdzite). It would seem to be suitable in view of the close connexion between C. J. Rhodes and Kimberley and also after Rhodes University where the mineral has been examined.

Finally it may be of interest to note that Bultfontein, one of the Kimberley diamond mines, is already the source of another new mineral bultfonteinite $2\text{Ca}(\text{OH}, \text{F})_2 \cdot \text{SiO}_2$ described by Parry, Williams, and Wright in 1932. It had previously been referred to as dutoitspanite by Williams in his book 'The Genesis of the Diamond', but this earlier name was apparently discarded. Bultfonteinite was accompanied by another new but undescribed mineral, a hydrous calcium sulphate.