The Banded Ferruginous Quartzites of the Bababudan Hills, Mysore State.

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One of the chief arguments for considering the banded ferruginous quartzites of the Bababudan Hills of Mysore, as being derived from the alteration of basic igneous rocks, has been founded on the occurrence of thin intercalated bands of schists, which have been variously described in the Records of the Mysore Geological Department as "hornblende beds," "riebeckite and cummingtonite schists," "amphibolites," "hornblende traps," and so on.

According to Dr. W. F. Smeeth, the hornblende beds which are of the nature of amphibolites appear to alter gradually into quartz-iron ore rocks, and this is more


Fig. 1.

A. Micrograph of bababudinite-magnetite schist.
B. Micrograph of hornfels with decussate structure. The section shows the banded nature of the rock.

noticeably the case where such amphibolites consist largely of the mineral cummingtonite" (1908, p. 21).

The late Prof. P. Sampat Iyengar considered the magnetite quartzites as derived from the alteration of riebeckite and cummingtonite schists. The thin quartz layers of the rock appeared to him to be "partly secondary enrichment in the schists at the expense of the cummingtonite, and partly the result of intrusion in the schists, of several thin quartz veins" (1908, p. 73). He explained the fine banding of the quartzites as the consequence of "lit-par-lit" injections of quartz veins in the amphibolites, the regularity of the banding being augmented by subsequent pressure which acted upon the whole mass of the schists (1908, p. 76).

H. K. Slater was of the opinion that the banded magnetite hematite quartzites were produced "through the metamorphism and oxidation of the bands of amphibole, which vary from one inch to three feet in thickness, that form the aphanitic greenstones" (1908, p. 56).


B. Jayaram thought that the iron ore formation had little to do with the "alteration, silicification and ferruginisation of the older hornblendic or later hornblendic traps that are underlying the above formation" (1923, p. 40). He did not, however, offer any suggestions as to the probable mode of origin of these rocks.

I have recently examined these intercalated schists both in the field and in the laboratory, and find myself unable to agree with the views advanced by Smeeth and Sampat Iyengar. These schists are often only a few inches in thickness, and are impersistent. Examples of bababudanite schists can be seen on the road sections between the 28th and 29th miles on the Chikmagalur-Lingadhalli road. They are crowded with glistening crystals of the amphibole. The microsections (vide Fig. 1A) show a felted or banded aggregate of acicular crystals of bababudanite which exhibit a very beautiful pleochroism from yellow to violet to blue. The matrix is formed of granoblastic quartz. So abundant are the crystals of magnetite scattered through the rock, that it is preferable to designate it as bababudanite-magnetite schist. The above description would make it clear that these schists bear no resemblance either texturally or mineralogically to the epidiorites which occur as dykes and lava flows in the area.

In order to elucidate more definitely the nature of this rock, a chemical analysis was made of a specimen of the bababudanite-magnetite schist occurring near Kemman-

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<tr>
<td>Fe</td>
<td>34.3</td>
<td>37.8</td>
<td>36.6</td>
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<td>34.5</td>
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| SiO₂ | 40-20 | 54-42 | 34-77 | 49-43  | 30-62 | 4-16 | 16-82  |       |
| Al₂O₃ | 2-25 | 1-14  | 1-15  | 0-62  | 0-20 | 0-40 | 4-20   |       |
| Fe₂O₃ | 1-90 | 2-62  | 2-40  | 2-13  | 4-32 | 4-26 | 2-46   |       |
| FeO  | 2-37 | 1-53  | 3-16  | 1-69  | 2-55 | 2-35 | 3-45   |       |
| MgO  | 2-60  |       |       |       |       |       |       |       |
| CaO  | 1-70 | 2-15  | 2-64  | 1-69  | 2-55 | 2-35 | 3-45   |       |
| Na₂O | 0-07  |       |       |       |       |       |       |       |
| H₂O  | 2-56 | 0-47  | 1-50  | 0-42  |       |       |       |       |
| TiO₂ | 1-60  |       |       |       |       |       |       |       |
| P₂O₅ | 0-55  | 1-73  | 0-34  | 1-01  |       |       |       |       |
| MnO  | 0-05  |       |       |       |       |       |       |       |
| CO₂  | 99-94 | 99-44 | 99-64 | 100-33 | 100-03 |       |       |       |


A. B and C. Magnetitic slates, Wisconsin (Irving & Van Hise, 1892, p. 197).


Q. Actinolite bearing recrystallised banded hematite silica rock, Badampanahir. (Percival, 1931, p. 224).

gundi. The results are given under column I in the above table. A-D are analyses of amphibole magnetite rocks occurring as intercalations in the Lake Superior banded ironstones of Michigan and Wisconsin, and which are considered to be of sedimentary origin. It will be seen that the Mysore rock compares very well with these analyses. P and Q are partial analyses of somewhat similar amphibole bearing rocks from the Singhbhum District, India. In these two analyses, only the percentage of metallic iron has been determined, and so, to facilitate comparison, the percentages of metallic iron in the other analyses have been calculated.

It will be seen from the above analyses that the Mysore rock contains 3-11% of MgO as against a trace of CaO. The dominance of magnesia over lime is suggestive of a sedimentary origin. Van Hise and Leith considered that the Lake Superior iron bearing formations must have been chemically precipitated because the average proportion of magnesia to lime is over 5 to 1 (1911, p. 506).

A similar calcium-magnesium ratio has been observed in the Noamundi area by Dr. Percival (1931, p. 200), who is of opinion that these banded iron ores have originated as chemical sediments. The dominance of ferric over ferrous iron noticed in the bababudanite-magnetite schist, when considered in conjunction with the magnesia-lime ratio, strengthens the view that these rocks must have had a sedimentary origin.

A striking difference which the analysis

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of the Mysore schist exhibits, is in the presence of \(2.60\%\) of \(\text{Na}_2\text{O}\). The igneous rocks adjoining and underlying the banded ferruginous quartizes of the Bababudan Hills, are many of them rich in soda, as may be seen from the prevalence of albitic and acid oligoclase. I ascribe the soda content of the bababudanite-magnetite schist to the sediments being derived from these spilitic rocks.

Jayaram looked upon bababudanite as a "secondary metamorphic mineral derived from the alteration of impure grits and tufts of the Champion gneiss series" (1923, p. 40). This is followed on the next page, by the statement, "the occurrence of this amphibole seems to be precisely comparable to that of tourmaline in the altered acidic rocks of the Champion gneiss series," which makes it rather difficult to understand his view regarding the origin of this amphibole.

In a previous note in this journal" (Pichamuthu, C. S., and Srinivasa Rao, M. R., 1933, pp. 276–77), it was shown that the amphiboles occurring in the banded magnetite quartizes of the Bababudan Hills were formed by contact metamorphic action due to the intrusive epidiorite dykes, and had nothing to do with the origin of the ironstones themselves. I consider the bababudanite-magnetite schists also to have had a similar origin.

In view of the suggestion made by Slater, that the banded ferruginous quartizes have been produced through the metamorphism of layers of a rock described by him as "aphanitic greenstone," I carefully examined the occurrences of this rock, not only from his type area near the 23rd milestone on the Chikmagalur-Lingadhalli road, but from several other exposures in the road sections between Mulaingiri (\(\Delta\) 6310) and Kondekkhan (13° 33' : 75° 46'). These are usually very thin intercalations, often exhibiting extraordinarily fine bandings. The rock is dark in colour and mixed with abundant ferruginous dust. When altered, it is converted into a yellow ochreous material. There is practically no grit. The exposures of this rock near the Kondekkhan coffee estate house are highly jointed, the joint faces being very smooth. The specific gravity of specimens collected here is 2.65; in other parts of the Bababudan Hills, I have observed a range in specific gravity between 2.51 and 2.75. Sections cut from this rock do not exhibit any igneous character. The rock could best be described as a mudstone or argillite.

The rock is normally soft but has been hornfelsed near igneous contacts, with the result that it has become extremely compact and tough, the fracture suggesting a glassy rock. This is caused by the development of mica or amphibole with the typical decussate structure characteristic of a hornfels (vide Fig. 1B).

From what has been said above, it will be seen that the amphibole-magnetite schists of the Bababudan Hills have developed in certain bands as the result of contact metamorphism, and that they do not represent remnants of the parent rock from which the banded ferruginous quartizes have originated. The "aphanitic greenstones" of Slater are merely interbanded argillitic layers which have become hornfelsed near igneous intrusives.

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Madras Fisheries Department.

RECORD of another year's good work is contained in the Administration Report of the Madras Fisheries Department for the year 1933–34.

"The outstanding event of the year which has brought back some measure of prosperity to the fishing industry of the West Coast was the return of the oil sardine in unexpected abundance after an absence almost complete for an unusually long series of years." It is unfortunate, however, that maximum advantage could not be taken of the abundance of fish owing to the prevailing economic depression. Attention may here be directed to an observation made by the Director (p. 22): "When the sardines became rich in oil, and boat loads were available at a nominal price, the station had run out of funds. When the funds were actually sanctioned, the sardines had ceased to occur and the amount had to lapse." It shows that the Government methods in dealing with economic problems require revision and it seems desirable that there should be a special provision in the departmental budget which could be drawn upon only in cases of emergency.

The oil sardine is unquestionably the