ON THE USE OF THE TERM "CHARNOCKITE DYKE"

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THE term 'charnockite dyke' has often been used somewhat loosely to designate basic dykes which contain hypersthene irrespective of their field relations or the metamorphic grade attained by such rocks. There are basic dykes of different ages and of many petrographic types in the charnockite province of India—varying from epidiorites to granulites. Some of the dolerite dykes are hypersthene-bearing, and some contain olivine. It is necessary, therefore, to be clear about the differences which exist among basic dykes which contain minerals normally found in charnockites, but which have had different modes of origin.

When Holland published his classic memoir in 1900 on the Charnockite Series of South India, he not only described massive outcrops, but also referred to the occurrence of these rocks as dykes. He observed that they are often found as 'bands' with sharp boundaries, and running parallel to the foliation of the biotite gneiss in which they lie. They do not exhibit glassy or felsitic selvages, though the borders are sometimes more compact than the interior. The texture is granulitic, but the rocks are finer in grain than the average massive form of the charnockite series. Holland considered that this difference in grain was just the same in degree and kind as would be seen between a large stock of gabbro and its corresponding dolerite dyke phase. He thought that the presence of such dykes corroborated other evidences which, according to him, pointed to the igneous origin and intrusive behaviour of the charnockite series.[1]

The exact date of publication of Wetherell's Memoir on 'The Dyke Rocks of Mysore' is not known but it was somewhere in the period between 1902 and 1905. In his four-fold classification of basic dykes, he considered 'Granulites' as the dyke equivalents of the basic charnockite series.[2]

'Dyke-like' inclusions of hypersthene granulites were noticed by Slater in the gneisses of Mysore State.[3] Jayaram[4] considered the dark finer-grained hypersthene-augite granulitic dykes as 'genetically related to the charnockite magma of a later period of consolidation'.

When geologically surveying the southern portion of Hassan District in Mysore State, Sampat Iyengar came across 'basic charnockites' occurring as 'thin parallel dykes' in the gneiss. They generally exhibited a granulitic texture, but when coarse-grained they had a peculiar greasy appearance. He believed that these dykes in the south-west corner of Hassan District were connected with the massive bodies of basic charnockites that occur in Coorg and its neighbourhood.[5] He noticed that these dykes are sometimes cut across by pink granite veins, and that in a few places they occur for some distance as irregular disconnected patches in the granite.

Later, Jayaram, in his report on the Closepet granites and associated rocks, considered that the end phase of the charnockite magma was represented by a number of hypersthene-bearing granulite dykes which were intruded into parallel fissures.[6] He also recorded that the hypersthene-bearing dykes, like the hornblende granulites, did not show any marked chilled edges, though sometimes finer, crushed and more hornblendic portions characterized the edges of these dykes.[7]

Smeeth[8] also considered that the charnockites which form the great mass of the Nilgiris 'come into Mysore on its eastern, southern and western borders where they are found distinctly penetrating the Peninsular gneiss both as tongues and as basic dykes'.

Rama Rao,[9] on the contrary, found that 'the region which has been mapped as showing tongues of the charnockites forking into their adjacent Peninsular gneiss resolves into an inter-banded series of charnockites and biotitic gneisses; and the former does not transgress anywhere the strike of foliation of the gneissic granites'.

Rama Rao later stated that the types which have been mapped in Mysore State as the dyke phases of the charnockite series, though megascopically similar, disclosed much variation in their textural details. He grouped them broadly into olivine norites and granulitic hornblende norites, but observed that while they showed a striking general resemblance to the basic charnockites, especially in their mineral composition, they differed in several minor details not only from the latter but even among themselves.[10]

It was Rama Rao, however, who for the first time visualized the possibility of some of the basic intrusives developing a granulitic texture and passing on 'by progressive stages to a hornblende hypersthene biotite granulite, hardly distinguishable from a typical basic charnockite'.[11]

On going through the literature, it appears that the earliest occasion in Mysore when the post-Archæan basic dykes were confused with the earlier ones was in 1911 when Sampat Iyengar, after describing typically granulitic dykes, goes on to say that the fine-grained dykes are often highly hornblendic, and that in many sections hypersthene granules are unrecognizable when, according to him, it becomes a matter of considerable difficulty to distinguish such rocks from the fine-grained hornblende schists.[12] Since then, it is apparent in the writings of many others that some of the later dykes have often been considered to have been related to the charnockites.

The writer would like to propose the discontinuance of the term 'charnockite dyke' as it suggests a magmatic origin. If it is to be used at all, it should be confined to describe rocks of charnockitic regions which have the following characters:—

1. *Mode of occurrence.*—Parallel bands or dyke-like masses, generally not showing cross-cutting relations with gneissic rocks.[1,9] Where such rocks transect the prevailing foliation, the dyke-like runs are cut up, and enclosed by granites and gneisses.[5,13]

2. *Structure.*—Sharp contact with country rock but with no glassy or felsitic selvage.[1,7]

3. *Texture.*—Though granulitic, there is generally a rough banding (Figs. 1, 3, 4). This feature was noticed quite early by Wetherell.[14]

Photomicrographs of granulitic dykes

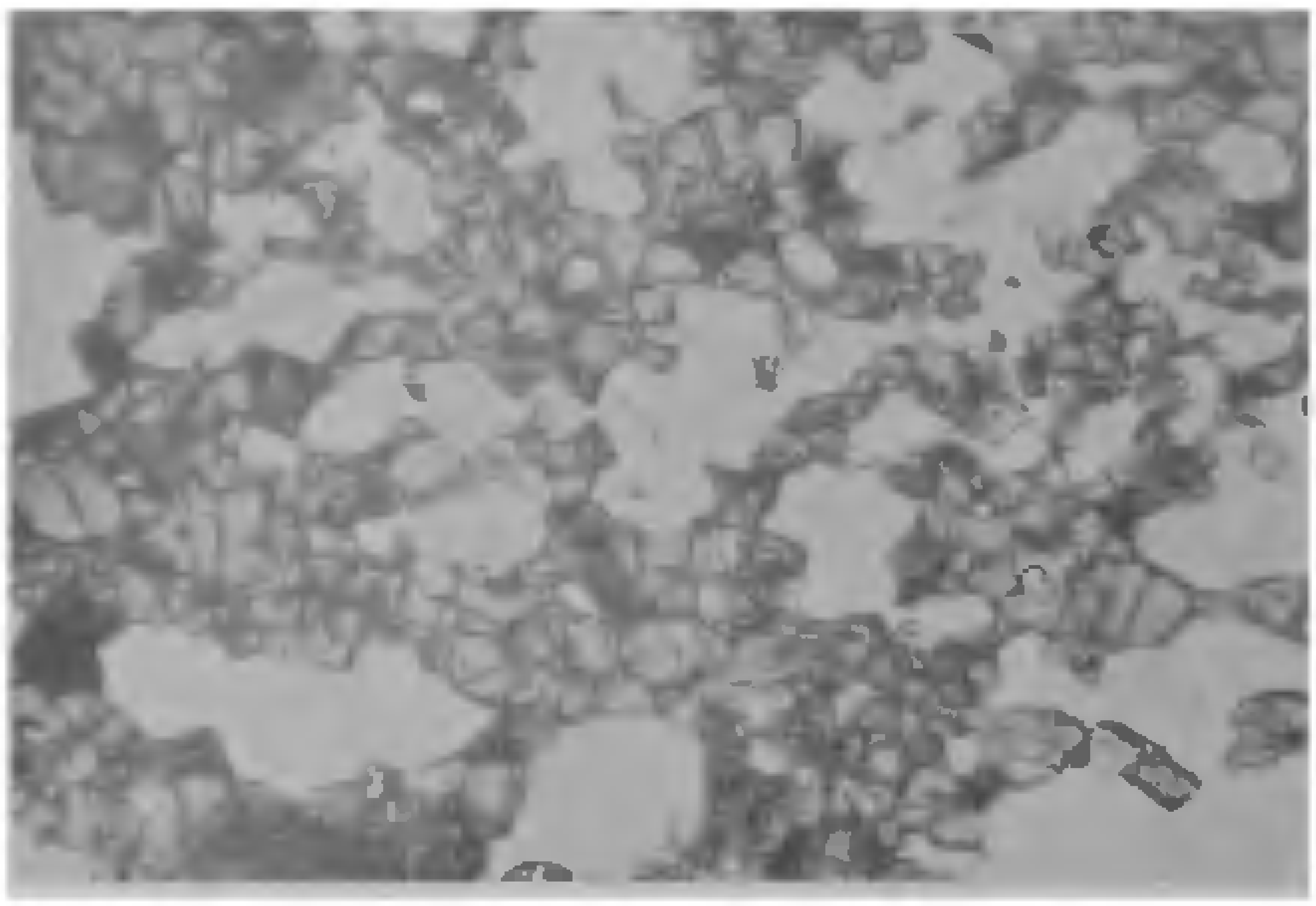

FIG. 1. The classic Fraserpet dyke described by Holland, which outcrops on the bed of the river Cauvery on the Coorg-Mysore border. Note the granulitic texture, rough banding, and water-clear nature of the feldspars. ×9.

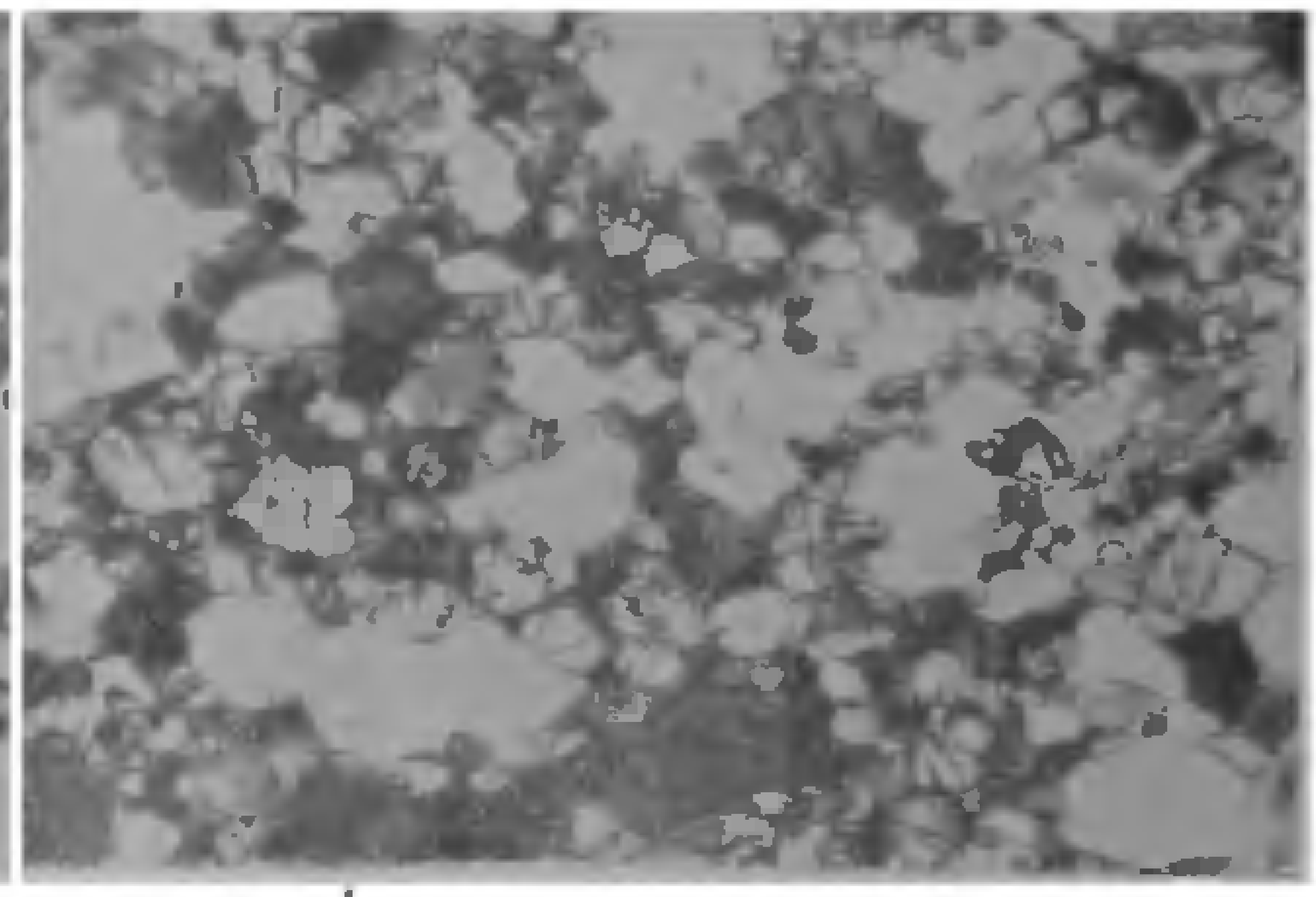

FIG. 2. The same section as in Fig. 1, between crossed nicols. The plagioclases are seen to be generally untwinned. ×9.

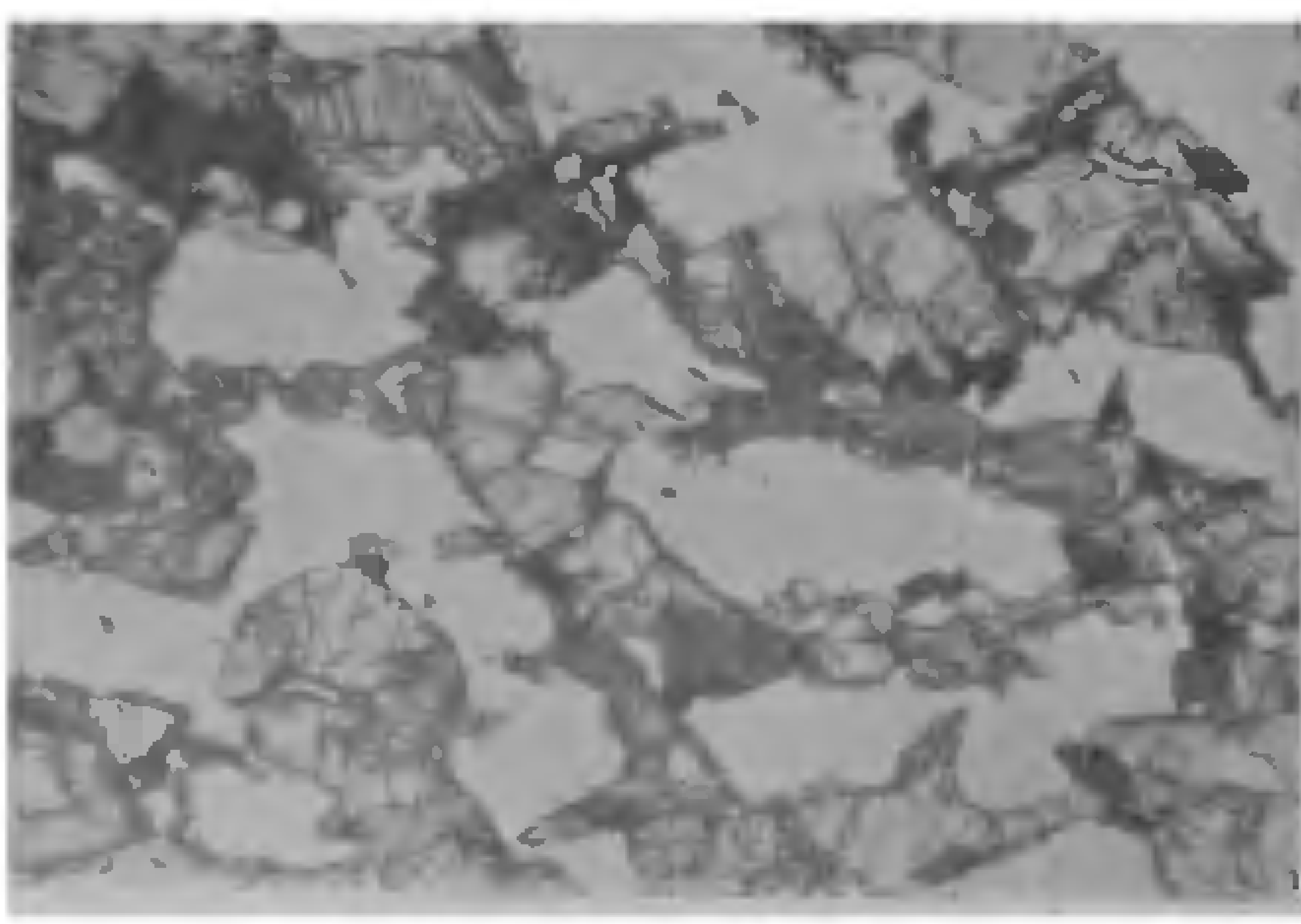

FIG 3. Dyke near Talkad, Mysore State. The pyroxenes and brown hornblendes are drawn out into somewhat parallel bands. The feldspars are clear and unclouded. ×9.

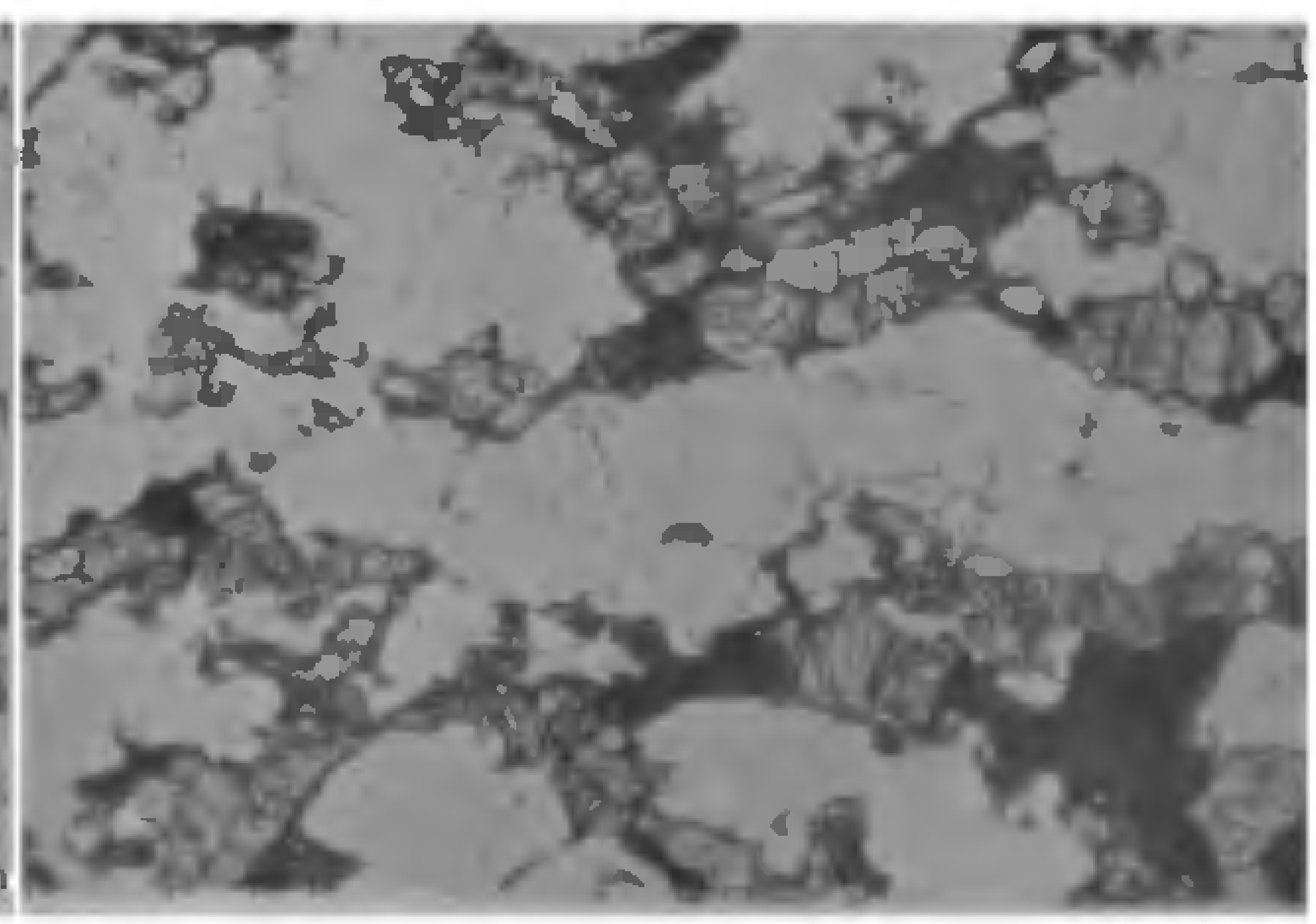

FIG. 4. Dyke from the Shevaroy Hills, Salem District, Madras State. The minerals are disposed in roughly parallel streaks. There is no clouding of the feldspars. ×9.

4. *Feldspar.*—The plagioclases are free from clouding, and generally water-clear. There is no great tendency for twinning[1,15] (Fig. 2).

The writer has recently put forward the suggestion that there are charnockites of two different ages, an earlier type formed by the regional metamorphism of pre-existing rocks, and a later type derived from metasomatism and rheomorphism.[16,17] The former is gneissic or granulitic, and the latter granitic and coarse-grained.

In the light of the above explanation, it follows that these so-called charnockite dykes belong to the earlier phase when basic dykes of Dharwar age were regionally metamorphosed and reconstituted into granulitic or gneissic charnockites containing hypersthene and clear plagioclase.

The post-Archæan dykes of various petrographic types, some of which are hypersthene-bearing, have chilled against the charnockites of the earlier period, generally retained their igneous textures such as ophitic, and have had clouding induced in plagioclase, pyroxene, and olivine, due to the regional thermal metamorphism caused by the later formed metasomatic charnockites.

The two groups of dykes can, therefore, be clearly distinguished by their field relations, texture, and clouding of minerals.

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3. Slater, H. K., *Rec. Mys. Geol. Dept.*, 1908, **8**, 65.
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LUNIK II—THE RUSSIAN MOON ROCKET

WHAT will go down as a remarkable achievement in the history of cosmic space rocketry was the successful launching by Russia of the Moon Rocket, Lunik II, which landed on the moon almost to the minute according to schedule, thus accomplishing the first space flight from the earth to another celestial body. The rocket was launched on the afternoon of Saturday, September 12, 1959. The final stage of the rocket hit the moon at 00 hours 2 minutes 24 seconds (Moscow Time) on Monday morning, September 14, 1959.

The rocket moved along a trajectory near to that calculated in advance and the time and place of its hitting the moon had been accurately forecast. The time of impact was to be at 1 minute 1 second past midnight, September 14, and the place of impact was to be in the triangular region of the moon's surface bounded by the Sea of Serenity, the Sea of Vapours and the Sea of Tranquillity.

The last stage was a guided rocket weighing 1,511 kg. (3,324 lb.), without fuel, and included scientific and measuring equipment, energy sources and container, of total weight 390 kg. (860 lb.). It contained a remote control device which would correct its "very small" deviation from the planned trajectory as it sped towards the moon. The accuracy of 1 minute 23 seconds on a journey of a quarter of a million miles proves a "tremendous achievement of radio navigation".

The rocket took approximately 34 hours to travel from the earth to the moon which was 374,000 km. (233,600 miles) away at the time of impact.

A sodium cloud emitted by the rocket on the first night of its flight was observed and photographed.

The rocket was sending back continuous radio signals and these were heard clearly but faintly until 20 minutes before it hit the moon. The signals began to fade badly and shortly afterwards were inaudible altogether, which was the indication that the rocket had landed on the moon. The giant radio telescope at Jodrell Bank kept track of the rocket till its impact "less than 90 seconds behind schedule".

The impact would not have been visible even through the world's most powerful telescope. A space ship hitting the moon would have to be at least 200 yards in diameter for the landing to be visible from the earth.

The Budapest Observatory, however, reported that at the time of the rocket's landing on the moon a black circle was noticed through the observatory's 7-inch refractor, on the surface of the moon in the region of the expected impact. The black ring remained visible for 58 minutes and is believed to be the moon's surface dust raised by the impact.

Special steps were taken to ensure that no earthly micro-organisms were carried to the moon by the rocket.