

REFERENCES

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CORRESPONDENCE

CORRELATION OF LAKI BEDS

SIR,—May I be permitted to reply briefly to Colonel Davies's letter published in your number for May/June, 1940, page 252 ?

It is unfortunate that the Laki section first to be described in detail should have been that of the Meting area in Sind, where the succession is obviously incomplete ; it comprises less than 500 feet of beds, mostly limestones, with pronounced unconformities above and below. *Alveolina (Flosculina) globosa* occurs in the lower limestone and is absent above, but it is doubtful whether this distinction has any zonal significance. A much more complete development of the Laki is present in Baluchistan and the formation reaches its maximum thickness in the Suleiman foothills. It is with these sections, rather than with the abbreviated section in Sind, that the correlation of the Punjab Laki should first be attempted.

The Laki sections of the Salt Range and the Kohat District are closely similar. In the Salt Range the Nammal Shales, with *Nummulites irregularis* and *Discocyclusina ranikotensis*, pass upwards into the Sakesar-Bhadrar limestones containing *Assilina* species formerly grouped with *A. granulosa*, *Nummulites atacicus*, and *Orbitolites complanatus*. These limestones become dolomitic above and pass, apparently without break, into the gypsum and salt deposits of the Lower Chharat. In Kohat, shales with the Nammal fauna pass upwards into the Shekhan Limestone, and this in turn into the Lower Chharat. On the stratigraphic evidence, therefore, the Shekhan Limestone is homotaxial with the Sakesar-Bhadrar limestones. Colonel Davies claims that the Shekhan Limestone is newer than the uppermost Laki of

the Salt Range ; but if so, where is the equivalent of the Shekhan Limestone in the Punjab and which part of the Kohat Laki represents the Sakesar-Bhadrar beds? The fossil evidence on which Colonel Davies relies seems insufficient in view of the stratigraphy ; part of the difference in fauna is due probably to the different conditions of deposition in the two regions (the relationship between facies and the distribution of the foraminifera is a subject as yet much neglected) ; for the rest, the distinction depends upon newly described species whose geographical distribution and range in time will certainly be extended by further work.

Although the Laki reaches a much greater thickness in the Suleiman foothills, the general succession is closely parallel with that in the Punjab and Kohat. The equivalents of the Lower Chharat can be recognized not only by the presence of gypsum beds and vertebrate fossils, but also by their position at the base of a well-defined Khirthar sequence. These beds pass down with apparent conformity into thick limestones containing *A. granulosa* and *N. ataticus* similar in lithology and stratigraphic position to the Sakesar-Bhadrar beds of the Salt Range. The next lower formation, the Ghazij Shales, attains a thickness of several thousands of feet and is somewhat variable in character. In the north the uppermost beds are estuarine (it is this part of the Laki which extends into South Waziristan) and the lower are for the most part unfossiliferous ; farther south, and in the Harnai-Dirgi region, the Ghazij Shales are locally very fossiliferous and contain *N. irregularis* and *Discocyclina archiaci* var. *baluchistanensis* (which is closely allied to and possibly identical with *D. ranikotensis*). Thus, not only do the Ghazij Shales occupy a corresponding stratigraphic position with the Nammal stage of the Punjab, but they also contain a similar fauna.

The Dughan Limestone underlies the Ghazij Shales continuously for over 600 miles from the Suleiman foothills to the Bolan Pass. In addition to several forms typical of the Laki (including those of the Nammal stage), it contains *Nummulites sindensis* (the *Operculina canalifera* group) which has hitherto been recorded only from the Ranikot. The Dughan Limestone is cut out from the succession near the southern border of Waziristan by overlap along the unconformity at the base of the Eocene. No representative of it has been recognized in the Punjab or Kohat, where its absence is explained by the unconformity between the Ranikot and Laki. It seems reasonable to conclude, therefore, that the Laki is more completely developed

in the Suleiman foothills than farther north, that the Ghazij Shales should be equivalent to the Nammal, and that the Dunghan Limestone is the oldest known Laki in North-West India.

The correlation outlined above is based mainly on the comparative stratigraphy but is also in accordance with the fossil evidence at present available ; much further work remains to be done in this latter connection, and our knowledge of the distribution of the foraminifera is as yet far from complete. The correlation suggested by Colonel Davies is independent of, and frequently in conflict with, the stratigraphy ; on his correlation not only are there no representatives of the Sakesar Limestone in Kohat or of the Shekhan Limestone in the Punjab, but there is similar difficulty in finding equivalents in these regions for the members of the well-marked Laki sequence of the Suleiman foothills.

Colonel Davies's reasons for abandoning the name " Dunghan Limestone " will appear insufficient to most of the geologists who have any knowledge of that formation. The sections in the immediate neighbourhood of Dunghan hill have been critically examined by Noetling and other members of the Geological Survey of India ; collections have been made from Dunghan hill itself. There is no ambiguity in the use of the name and no reason, therefore, to add still further to the already overburdened terminology of the Indian Eocene.

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