In the above table, column No. 3 gives time lag when hygrometer is treated with a current of moist air, and column No. 4 represents time lag when it is merely exposed to dry air of the room (hence longer time lag in the latter case). Then just after this, the second cycle of action is repeated in the same way, and its observations are recorded in columns Nos. 5 and 6. This data clearly indicates that the time lags in the second cycle are less than corresponding time lags in the first cycle.

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November 18, 1943.

* L. D. Mahajan, "An Optical Hygrometer", *Current Science*, Bangalore, 1941, **9**, **2**, 100, February. L. D. Mahajan, "The Optical Hygrometer and its Working," *Indian Journal of Physics*, Calcutta, Dec. 1941, **15**, **6**, 425–32.

CENTRAL HIMALAYAN GEOLOGY A REPLY

In a communication to the November 1943 issue of the *Current Science*, Mr. J. B. Auden raised certain questions on my recent paper on the correlation of Simla rock formations. He feels that my conclusions, based on the field study of the Sirmoor Himalayas, should not have been extended to other areas. I have only to state in this connection that the large-scale structural features in these tectonic mountains are not strictly local but have a much wider extent and may be found repeated in adjoining parts.

1. The first point raised by Mr. Auden is regarding the correlation of the Bansa Limestone with the Krols. In a table of several analyses he has tried to show that the differences are profound and as such the correlation is untenable. A perusal of the table would, however, show that the differences are not as profound as suggested but are quite within the limits of variations both lateral as well as vertical in any sedimentary formation. Moreover the differences between the Lower Krol and the Upper Krol limestones are much greater than those between the Lower Krol and the Bansa but this does not vitiate the inclusion of the former two into one Krol formation. The more important consideration in these correlations is the nature of the associated rocks which in the case of the Bansa limestone, are indistinguishable from the Simlas and the Infra Krols.

2. Regarding the nature of the Blaini boulder bed Auden states that the bed constantly occurs at a certain horizon in the Krol belt and can be traced for over 120 miles, hence has stratigraphic importance, but he omits to mention that it also occurs extensively outside this belt in association with rocks which are not members of the Krol sequence. Auden himself is not satisfied with the present conception regarding the mode of formation of this boulder bed but has failed to suggest any alternative mode. Regarding the position of the bed in my sections in the above paper I have indicated it by a line of thick dashes in Figs. 1-3 between the Infra Krols or Simlas and the Jaunsars.

Regarding the nature of the purple sandstone boulders observed in the Blaini bed their Dagshai character was recognised not by me but by officers of the G.S.I. I wonder what positive evidence Auden has to assert that they are not Dagshai but Simla or Nagthat.

3 (*a*) Regarding the occurrence of Nummulitics between the schistose rocks and Upper Tals the reference quoted by Auden is not quite clear or suggestive. But if that be true it may only indicate that the Jutogh Thrust was older than the Eocene and over a part of which, Nummulitics were deposited and later rethrusted.

(*b*) The fossiliferous limestone ascribed to Upper Tal may after all be Nummulitic and not Tal.

(*c*) Current bedding is a dubious structural feature in tectonically disturbed rocks and may not be due to the particular mode of sedimentation. This would not, further, prove the uninverted nature of the Upper Tal quartzites. Moreover, I have never asserted that they are inverted.

(*d*) The lithological gradation between 'Tal' shales and quartzites is more apparent than real and no process of sedimentation can bring about the deposition of hard quartzites over soft shales. Selective silicification or metamorphism of quartzites to the exclusion of shales is also inexplicable. Only thrust movements can bring about superposition of highly metamorphosed rocks over unmetamorphosed ones.

(*e*) I have seen the 'Tal' quartzites of the Koti-Dhaman area and they are highly metamorphosed. I fail to understand how Auden regards them as unmetamorphosed.

(*f*) I have not seen any remarkable lithological differences between the Tal and the Jutogh quartzites.

4. Lastly, Auden refers to the intrusive nature of Chor Granite. Along with previous workers Auden maintains that it is intrusive *in situ* into the Schists inducing contact effects on associated Palæozoic sediments. The Chor granite is everywhere surrounded by Jutogh quartzites and schists which are a highly metamorphosed set of rocks whether in the vicinity of the granite or away from it. The metamorphic effects are wholely of dynamothermal nature and show no characteristics of contact metamorphism. The inclusions of angular fragments of schists within the granite mass show not the least signs of resorption or even baking. Bands of dolomitic marble along the granite periphery are similarly unaffected. On the other hand the junction of granite with Jutoghs is marked by extreme foliation and brecciation the quartz porphyry being converted into papery schist and laminæ. Granite mass itself has assumed a gneissose structure which diminishes rather rapidly as we move away from the junction. This junction is also marked by an abundance of pegmatite and dolerite dikes. All these indicate clearly that the junction is a thrust plane along which there has been an appreciable movement of the granite mass over the Jutoghs.

It is quite possible that initially in the autochthonous regions the granites were intrusive into the Jutoghs, but they appear definitely older than the Jaunsar-Simla formations. In the nappe zone, however, they are either thrusted over the Jutogh's or they form cores of the Jutogh folds.

In the end I have to state that my conclusions were based on the study of the Sirmoor Hills to which they are largely applicable. The extension of these views to areas outside Sirmoor is merely suggested as a possibility in view of the fact that these tectonic features are generally regional and not strictly local. Only a detailed study of any area in the light of these considerations would prove their applicability or otherwise to that area.

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ALGAL STRUCTURES FROM THE CUDDUPAH LIMESTONES (PRE-CAMBRIAN), S. INDIA

WITH reference to the note published on this subject in the July number of *Current Science*, I should like at the very outset to correct the impression conveyed in the second para of that note, that Professor Sahni has "agreed that the structures referred to above are of plant origin". Professor Sahni's view in the matter is that "While it is possible that some of the concretion-like growths are due to *plant activity*, there is no evidence whatever of plant structure. I include here what you refer to as algal dust".

Since publishing the note the material has been further investigated and many more sections of this limestone showing these structures

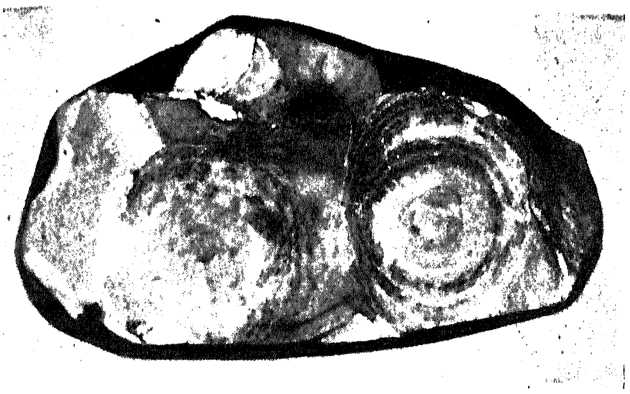

FIG. 1. Algal nodule (*cf. Cryptozoon.*) from Royalcheruvu. ×¾ (ca).

have been cut and examined. More recently I have also visited the area near Royalcheruvu, Ananthapur District, and have now been able to collect specimens of limestones showing structures remarkably similar to those described under the name 'Cryptozoon proliferum' by C. L. and M. A. Fenton,[1] from the Upper Cambrian of Pennsylvania. The rock frequently shows a number of columnar bodies of calcium carbonate tapering at one end, occurring either as free individuals or in groups when they are fused together at the bottom by horizontal or curved extensions, suggesting a colonial habit. They vary from about 1 to 2½ inches in diameter, and in a transverse view, on a polished surface of the rock, numerous irregularly concentric lines of growth can be seen; and the whole structure reveals characteristic porcellanoidal patches suggestive of algal origin. When examined under the microscope, these patches are seen to consist of aggregates of minutely crystalline calcite always having a different degree of crystallinity from the rest of the rock, and presenting a dark dusky appearance in reflected light strikingly similar to the 'algal dust' described and figured by Alan Wood[2] from the Carboniferous of England.

While it is true that definite recognisable plant-cell structures as such, have not been so far noticed, all other evidences, however, compel the author to believe that these structures are of organic origin and referable to algal activity. A full description of these structures is under preparation and will be published as early as possible.

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February 8, 1944.

1. C. L. and M. A. Fenton, *American Midland Naturalist*, 1937, **18**, 435. 2. Alan Wood, *Geol. Mag.*, 1941, **78**, 192.

MICROBIOLOGICAL ASSAY FOR PANTOTHENIC ACID

SINCE the discovery that the chick antidermatitis factor[1] is identical with pantothenic acid,[2,3] attempts have been made to estimate this vitamin in different biological materials. The two methods commonly used are (*a*) the chick growth method[4] and (*b*) the microbiological method employing *Lactobecillus caseie*[5–8] and *Proteus morganii*[9] as the test organisms. In a previous paper[10] pantothenic acid was shown to be essential for the growth of *Lactobacellus bulgaricus*. It was felt to be of interest to discover whether this organism could be used as a test organism for the assay of pantothenic acid.

The basal medium, inoculation and the assay procedure were essentially the same as those described by Pennington *et al.*[6] The growth response of *L. bulgaricus* to different concentrations of calcium pantothenate (0·02–0·70 μg. per 10 c.c. medium), as determined by the amount of lactic acid formed in 72 hours at 37° C., is shown in the figure.

The values shown in the figure could be satisfactorily reproduced within a wide range (0·01–0·15 μg. Ca pantothenate). The curve is linear, thereby indicating the suitability of this organism for the assay of pantothenic acid.

The pantothenic acid content of samples of dried yeast, yeast extracts and animal tissues was estimated using *L. bulgaricus*. The samples, after 48 hours autolysis, were autoclaved and the extracts *thus* obtained were used at two levels for the assay. The results are presented in the table.

The reliability of the response of *L. bulgaricus* as a measure of pantothenic acid is sup-