LETTERS TO THE EDITOR

CENTRAL HIMALAYAN GEOLOGY

IN a recent paper[1] Professor K. P. Rode has discussed the stratigraphical and tectonic successions of the Himalayan rocks of Sirmur State, and has extended his conclusions to other areas not studied by him. These conclusions are in complete disagreement with published and unpublished work of W. D. West and myself. Only a few of Rode's assumptions can be discussed within the limits of a short letter to *Current Science*.

(1) Rode states that the correlation of the Bansa limestone with the Krol limestones is "irresistible", and that the true Krol Nappe is represented by the outcrop of the Bansa limestone. In view of the absence of fossils in these rocks, correlation of necessity depends on a balance of evidence from lithology, chemical composition, thickness of stages, metamorphism and structural position. The analyses of certain Himalayan limestones and dolomites are given in the table below:—

	Mandhali	Bansa	Blaini	Lower Krol	Upper Krol	Upper Krol Marble, near Mussoorie
Number of analyses	3	7	2	7	8	12
SiO_2	12·80	27·84	6·20	27·64	0·18	0·14
$Al_2O_3+Fe_2O_3$	3·53	3·47	4·48	12·90	1·24	0·15
CaO	45·79	37·20	28·02	23·57	33·05	55·14
MgO	1·01	0·71	18·48	5·84	18·45	0·38
$CaCO_3$ calculated from CaO	81·8	66·6	50·0	42·1	59·0	98·47
CaO/SiO_2 ratio	3·58	1·34	4·52	0·85	183 5	394
CaO/MgO ratio	45·3	52·5	1·52	4·04	1·79	145
Lithology	slaty limestone and calc slate	sandy limestone and calc quartzite	pink hard siliceous dolomite	shaly limestone and calc shale	dark and pale dolomite	white marble
Thickness in feet of bands or stages	50–300	50–300	10–30	300–700	2,500–3,000	15–100
				With Krol Red Shales and dolomites the thickness of the Krol series may be taken as 3,500—4,000 feet.		

The profound differences between the Bansa and the various Krol carbonate rocks is clear from this table, and is sufficient to refute Rode's correlation on the only evidence at present available. Whatever the age relation-

ship of the Krol and Bansa rocks may ultimately prove to be, in lithological facies and structural positions they are entirely different.[2] Moreover, Rode's idea that the Bansa limestone lies in the core of a fold (his Fig. 1) is almost certainly untenable, because this limestone continues below the Chandpur series and crops out on the south side of the Tons syncline, where it dips northwards.

(2) Rode assumes that the Blaini boulder bed is a mid-tertiary tectonic breccia or conglomerate devoid of stratigraphical significance. He omits, however, the Blaini from his sections, in the places where it should have been shown, as if it did not exist, and fails to indicate the thrust planes which he postulates from its supposed nature. The Blaini boulder beds (over wide areas there are two boulder beds, separated by banded slates) and Infra Krol slates have been traced for 120 miles, constantly overlain along the Krol belt by Krol rocks. They can be followed, for example, for seventy miles round the Mussoorie basin (one of five basins of the Blaini-Krol-Tal succession east of longitude 77° 30′) in a very definite stratigraphical position. Rode is further mistaken in supposing that the occasional boulders of Dagshai-like sandstone found in the Blaini must be of Tertiary age. Such sandstones are found in the Simla slates and the Nagthat series, both almost unquestionably pre-Mesozoic formations.

(3) Rode regards the Lower Tal shales as inverted Infra Krol, and divorces them by thrust contact from the Upper Tal quartzites which he considers to be Jutogh. Our two successions may be placed side by side:—

	RODE	AUDEN
Top	Jutogh Nappe	Schists and phyllites of the Garhwal nappe, with intruded Lansdowne granite
		thrust
		Nummulitic
		Tal fossiliferous limestone
		Upper Tal quartzites (*uninverted*)
	thrust	*lithological gradation*
Bottom	Infra Krol (*inverted*)	Lower Tal shales

In uniting so many different units in his Jutogh nappe, Rode has ignored the following facts:—

(*a*) The Nummulitics between the schistose rocks and the Upper Tal:[4] (*b*) the Upper Tal fossiliferous limestone, the fossils of which are not, unfortunately, of diagnostic value: (*c*) the uninverted nature of the Upper Tal quartzites, as abundantly proved by the disposition of the current bedding:[5] (*d*) the lithological gradation between the Tal shales and quartzites, which makes them with virtual certainty one series:[6] (*e*) the meso-grade metamorphism of the Jutogh series as contrasted with the unmetamorphosed (locally epi-metamorphosed) nature of the Tal quartzites: (*f*) lithological differences between the Tal and Jutogh quartzites.

(4) Rode believes that the Chor, Dudatoli, Lansdowne and Almora granites have exerted no thermal metamorphism on the schists in which they occur, but are thrust klippen tectonically divorced from the schists. W. D. West has found that the Chor granite sinks northwards under Jutogh schists, and has in fact been intruded along the centre of a syncline of the Jutogh series. The Dudatoli and Almora granites occur in the form of lenticular sills embedded within the schists. Moreover, the Chor, Dudatoli and Lansdowne granites have all been found to have caused a superposition of thermal metamorphism upon the more general regional metamorphism.[7] The interpretation which West and I put upon the field evidence is that these granites were intruded into the contiguous pelitic sediments before the thrust movements which later brought both granite and host into their present tectonic positions. Rode's "Central Granite Thrust" does not exist, because, after crossing the great tectonic window which the writer has traced from Banchangaon (30° 54′:78° 14′) south-eastwards to Almora, and by Heim and Gansser from Dudatoli to near the Nepalese frontier (their Calc Zone of Tejam),[8] one returns to a composite series of ortho-gneisses, para-gneisses and schists, of the south face of the main Himalayan range, which is homologous with the rocks of the Dudatoli-Almora zone. The same feature is found north of the Larji 31° 43′:77° 13′) tectonic window towards the Rohtang pass. The massive granite around Gangotri is also clearly intrusive, lying capped by roof-pendants of metamorphosed Simla Slates, into which it has locally sent up a network of pegmatite offshoots in part responsible for the presence of garnet, staurolite and kyanite.

The verification of these points is in the field, for the most part in areas beyond those visited by Rode, but notwithstanding described by him.

Geological Survey of India,
Calcutta, J. B. AUDEN.
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1. *Proc. Ind. Acad. Sci.*, 1943, **17**, 157. 2. *Rec., Geol. Surv. Ind.*, 1942, **77**, Prof. Pap. 2, 7. 3. *Op. cit.*, 1937, **71**, 415. 4. *Ibid.*, Plate 37, Section 2. 5. *Ibid.*, 1933, **67**, 394; 1937, **71**, 417. 6. *Ibid.*, 1933, **67**, 394. 7. *Mem. Geol. Surv. Ind.*, 1928, **53**, 60–72; *Rec. Geol. Surv. Ind.*, 1887, **20**, 136, and maps 40, 143. 8. *Denkschr. d. Schweiz. Naturforsch. Ges.*, 1939, **73**, Abh. 1.

CHEMICAL EXAMINATION OF *OCIMUM CANUM* SIMS.

Ocimum canum Sims. belongs to the natural order Labiatæ and grows abundantly throughout Gujarat. Its leaves are used in skin diseases,[1] and seeds, locally known as "Tukmaria", are said to be tonic and very useful in gonorrhœa. With a view to isolate active principles from them, the investigation of the seeds, leaves, etc., of this plant has been undertaken.

The powdered seeds were successively extracted with ether, carbon tetrachloride,