$v_1 = 3{\cdot}68$ km./sec., the thicknesses of the crustal layer as calculated from the P and S observations are $34{\cdot}2 \pm 0{\cdot}8$ and $38{\cdot}2 \pm 1{\cdot}0$ km. respectively. The inference to be drawn from the smaller thickness found for the P phases is that the ratio of the average velocities of P and S waves in the crust is greater than the ratio V_1/v_1. This is consistent with the fact that early P arrivals were observed between 220 and 300 km., whereas early S arrivals could not be identified with certainty.

Finally, there is a third argument. Given the thicknesses and velocities in the layers, it is possible to calculate the distances at which the P and S phases totally reflected at the Mohorovicic Discontinuity should appear. For the single-layer crust, these distances are 72 and 87 km. for P and S respectively. For the two-layer crust the corresponding figures are 92·9 and 99·5 km. respectively. The observations agree satisfactorily with the predictions for the two-layer crust.

Any one of the above arguments taken by itself might not be regarded as convincing; but when they are considered together it would seem reasonable to conclude from the South African observations that there is a change in the composition of the crustal layers at depth, and that the change is such that the ratio of the P and S velocities increases at depth. It is not possible to decide between a continuous variation of composition and a discontinuous change, that is, the existence of an intermediate layer.

It is of interest to examine the implications of this change in the ratio of the velocities. Birch and Bancroft[3] noted that "Quartz is peculiar in possessing high rigidity with respect to its bulk modulus". It follows that for rocks containing a fair proportion of quartz it would be expected that the ratio of the P and S velocities would be low. This tendency is strikingly illustrated by the data given in the accompanying table.

VELOCITIES OF CERTAIN ROCKS AT 4,000 km./cm.² AND 30° C.

Rock	Percentage of quartz	V_P (km./sec.)	V_S (km./sec.)	$\frac{V_P}{V_S}$
Sandstone (quartzitic)	80	6·08	4·00	1·52
Granite, Quincy	26	6·08	3·61	1·68
Granite, Rockport	28	6·24	3·59	1·74
Syenite, Ontario	0	6·05	3·36	1·80
Norite, Sudbury	8	6·49	3·65	1·78
Diabase, Vinal Raven	0	6·97	3·88	1·80
Diabase, Maryland	0	6·96	3·83	1·82
Gabbro, Mellen	0	6·96	3·71	1·88
Gabbro, French Creek	0	7·15	3·98	1·80

(The table was compiled from Table 5–8, p. 80, of the "Handbook of Physical Constants", Special Paper 36 of the Geological Society of America, and papers by Birch and his associates.)

Thus the seismic observations in South Africa are consistent with the view that the crustal layers increase in basicity with depth.

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[1] *Nature*, **166**, 1053 (1950).
[2] Willmore, Hales and Gane, *Bull. Seis. Soc. Amer.* (in the press).
[3] Birch and Bancroft, *J. Geol.*, **48**, 752 (1940).

MUCH of the evidence produced by Prof. A. L. Hales is directed against the postulate of uniformity for the materials above the Mohorovicic Discontinuity. The conclusions are indisputable up to that point, and the only question is the extent to which different types of rock are collected into horizontal strata extending over continental distances.

The observations can be explained on the assumption that two materials exist in the crust, propagating P waves with velocities of about 6·09 and 6·8 km./sec. respectively. The reflexions from the Mohorovicic Discontinuity show that substantial volumes of the high-velocity material must exist within 100 km. of the origin, whereas the fast refracted wave is observed between 220 and 300 km. At the shorter distances, the high-velocity material must be deeply buried; but there is no direct seismological evidence concerning the depth of the material which produces the refracted wave. The discrepancy between the estimates for the thickness of a single upper layer confirms the heterogeneity of the crust without yielding any further evidence on the distribution of the materials.

Seismologists often postulate horizontal stratification because they feel that such a distribution is inherently plausible, when their data may be equally consistent with other structures. The Transvaal seismograms show only that appropriate materials exist at an appropriate depth in one location, and at undetermined depths elsewhere. In some areas such evidence might be sufficient; but in the Transvaal the more distant recording stations were resting on the diabasic lavas of the Ventersdorp series, the properties of which are very similar to those required for the high-velocity material. Hence, the advocates of a high-velocity layer at depth have to admit three layers in the western Transvaal, but they dismiss the uppermost one as being too thin to transmit waves of measurable amplitude. In fact, the thickness of the lavas is known to exceed 5,000 ft. in some areas[1]; but I have not seen any figures relating to the thickness under the seismic stations. The difficulty of getting seismic energy into the surface layer does not appear to be overwhelming. The matter could be decided if observations along other profiles were available or possibly by a more exhaustive examination of existing data. In the meantime, it seems premature to assert that horizontal stratification provides the only possible explanation of the results.

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[1] Du Toit, "The Geology of South Africa" (1939).

Reaction of Metmyoglobin with Hydrogen Peroxide

THE formation of a well-defined red complex between hydrogen peroxide and methæmoglobin or metmyoglobin is well established[1–3]. Keilin and Hartree found that the formation requires one molecule of peroxide per hæmatin iron atom. With reducing agents this complex is reduced back to methæmoglobin or metmyoglobin, and in the overall reaction the peroxide is *reduced* to water.

In this respect the complex is very different from that formed between ionic ferric iron and hydrogen peroxide, which Evans, George and Uri[4] showed to have the ion-pair structure

$$[Fe.^{3+}.O_2H^-], \text{ that is, } Fe.O_2H^{2+}.$$

In a kinetic investigation of this system, Barb, Baxendale, George and Hargrave[5] found evidence that this complex plays no independent kinetic part,