It is therefore proposed that the infra-red M stars have evolved from O stars surrounded by the remnants of the interstellar clouds out of which they formed. If this is so, two predictions can be made: the spatial and velocity distributions of the infra-red M stars should be similar to that of the O stars, and they should be highly luminous supergiants.

If these objects occur in expanding associations, their distances from the centres of the associations should be rather larger than those of the O stars on account of their slightly greater ages; on the other hand, if they are contracting stars they will be younger than the O stars and should be nearer the centres; this may be used as a criterion for deciding between the alternative theories of contracting stars and evolved stars.

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PLANETARY SCIENCE

Implications of the Revised Mars Radius

Kliore, Cain and Levy¹, in an analysis of the trajectory of the *Mariner IV* vehicle across Mars in July 1965, have presented revised values for the radius of Mars. For the radii measured from the centre of mass, they give $3,384 \pm 3$ km at the entrance occultation (50.5° S. lat.) and $3,379 \pm 4$ km at the exit (60° N. lat.). These figures formally yield 3,392 km for the mean radius R , but give a rather greater value for the ellipticity of figure ϵ than the usual value (near 1/192) inferred from dynamical observations. If the usual value of ϵ is used the yielded value of R is nearer 3,388 km. If one accepts the authors' estimates of the observational uncertainties, it would therefore appear safe to assume that the observations yield $3,390 \pm 6$ km.

This result is a substantial increase from earlier estimates over the past 10–15 years, and has interesting implications on the internal structure of Mars. In 1949, I formally arrived², on certain assumptions, at an estimate of 3,391 km for R . Later, the observational evidence appeared to favour a value of order 3,330 km (see, for example, ref. 3), and this was used as a principal argument by many authors for rejecting one or more of the assumptions made in 1949. The return to 3,390 km, in removing this objection, means that the assumptions can now be rejected only on other grounds.

The assumptions are, essentially, that (a) Mars has the same overall composition as the Earth model B (ref. 4); (b) the changes at the Earth's mantle-core boundary are associated with change of phase rather than with change of chemical composition, in line with the postulate of Ramsey⁵ and myself⁶.

As regards (a), the crucial property of model B in this context is the comparatively high density reached fairly high up in the mantle, as compared with most Earth models. Some difficulties have arisen in sustaining this high density, but the question is by no means closed. Recent work by Lyttleton⁷ takes, in effect, a slight variant of (a) (see ref. 8).

I am under no misapprehension as to the difficulties associated with (b), which involves a phase change at a pressure of 1.3 million atmospheres, accompanied by a density jump in a ratio of the order of 1.7. But again the matter is not closed, and several writers, including Lyttleton⁹, continue to follow the phase-change postulate. Al'tshuler and Kormer¹⁰ point out that an argument from shock waves (see ref. 11) that has been used to refute the postulate is not conclusive.

An essential point in the revised Mars radius is that it does shift the probabilities somewhat on the matters mentioned, and carries with it the need for a measure of re-assessment of previous theories and models.

The revision, if sustained, is also valuable in enabling theories on the internal constitution of Mars to be somewhat narrowed. For example, it removes the necessity for considering Mars models of the type constructed by me in 1957⁸, and it rules out the type of structure examined by Kovach and Anderson¹². These authors had shown the feasibility of an overall common composition for Mars and the Earth without the need for resorting to the phase-change postulate, but subject to the proviso that R does not much exceed 3,310 km. The new Mars radius would also entail some revision of calculations by Urey¹³.

It may be added that the *Mariner IV* observations also yield a slightly reduced value for the mass M of Mars. The revisions of R and M thus both act in the direction of reducing the estimated mean density of Mars and are of interest in relation to curves for planetary models connecting masses and mean densities (see, for example, ref. 14).

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Atmospheric Pressure Wave from an Explosion

PRESSURE waves were obtained from one of two explosions set off at White Sands Missile Range ($33^\circ 27' N.$, $106^\circ 34' W.$; elevation 4,900 ft. above mean sea-level), New Mexico. The first explosion occurred at 1100 p.m. M.S.T., October 28, 1965, and the second at 1100 a.m. M.S.T., November 2, 1965. These explosions were identical shots of 10 tons of TNT. Pressure waves from the first explosion