course, unknown. Probably it is small, but any such effect would bring the composition of the deeper parts of the Earth closer to that of olivine.

The compressibility of a sample of tachylite (basaltic glass) was also measured and found to be 1.45×10^{-6} per megabar. The velocity of longitudinal waves in this material is calculated to be 6.4_5 km./sec., while the velocity in a holocrystalline rock of the same composition would be 6.9 km./sec.

[1] L. H. Adams and E. D. Williamson, "The Compressibility of Minerals and Rocks at High Pressures," *J. Franklin Inst.*, **195**, 1923 (474–529).

[2] *Op. cit.*; see also L. H. Adams, E. D. Williamson and J. Johnston, *J. Am. Chem. Soc.*, **41**, 1919 (12–42).

[3] Bridgman, P. W., *Proc. Am. Acad. Arts Sci.*, **58**, 1923 (174).

[4] Washington, H. S., "Petrology of the Hawaiian Islands. III. Kilauea and General Petrology," *Am. J. Sci.*, **6**, 1923 (351).

[5] Bridgman, P. W., *Am. J. Sci.*, **10**, 1925 (359–367).

[6] Adams and Williamson, *J. Franklin Inst.*, **195**, 1923 (524).

[7] *Op. cit.*, pp. 517, *et seq.*

[8] For a discussion of the evidence in favor of a glassy, basaltic substratum, see R. A. Daly, *Proc. Am. Philosoph. Soc.*, **64**, 1925 (283–307).

RADIAL VELOCITIES OF 368 HELIUM STARS

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The determination of the radial velocities of the brighter helium stars (classes O and B) has been since 1901 an important item in the program of the Bruce Spectrograph attached to the 40-inch telescope. At that time it had not been established that sufficiently accurate values of the velocity could be obtained for stars of this class with broad lines. This was demonstrated, however, by the observations of the first score of these stars by Frost and Adams, and the work has continued until now we are able to present results for 368 stars of this type, mostly brighter than visual magnitude 5.5 and including essentially all of these stars of that degree of brightness north of 15° south declination. Numerous bright stars south of this limit have been included. The work has progressed slowly, because only about one-third of the night hours of the 40-inch telescope could be assigned to the spectrograph, and because our program has simultaneously included about 500 stars of class A, as well as a selection of visual binary stars, and a list of standard velocity stars observed with high dispersion.

One hundred and fifty-eight, or 42 per cent, of these 368 stars of classes

O and B have already been found to be spectroscopic binaries, 83 of them having been announced from the Yerkes Observatory.

While the period of revolution of the spectroscopic binaries of these classes thus far discovered is generally only a few days, some have been found which are reckoned in years, such as Nu Geminorum, with a period of $9^1/_2$ years; and it seems certain that Beta Cephei, which has the shortest period of the stars included in our list (4^h 34^m), also has a second revolution in a period of about 18 years.

It was originally planned to secure not less than three spectrograms of each star, but it was necessary largely to increase this number for the stars whose velocities were found to be variable. The total number of spectrograms measured and included in this paper is 2431. Of these, 2185 were taken with a dispersion of one prism, which was found most suitable for the spectra having diffuse lines. Sixteen were obtained with two prisms and 230 were taken with three prisms. The linear values of the dispersion of these three combinations at λ 4500, which was the central ray for the optical system, were, respectively, 30, 20 and 10 Angstroms per millimeter.

The observations at the telescope and measurement of the plates have been done by several other members of the staff of the Observatory in addition to those named above, chiefly by Walter S. Adams and Oliver J. Lee.

The principal chemical elements whose lines were measured for fixing the radial velocities were hydrogen, helium, silicon, magnesium, calcium, oxygen, nitrogen, carbon, titanium and iron. For comparison, the spark spectra of titanium and of iron have been impressed upon the plates at the beginning and at the end of the exposure to the star. Rowland's values of wave-lengths for the solar spectrum were used for the lines of the comparison spectra, while for the stellar lines the best available determinations in the laboratory were employed.

The derivation of the apex and velocity of the sun's motion is affected by the somewhat unbalanced distribution of the stars employed, inasmuch as only very few stars south of $-30°$ could be observed here. The sky was divided into 48 equal areas, according to the scheme of C. V. L. Charlier. After the omission of 18 stars for which the velocities seemed to be uncertain, it was found that 37 of the areas could be used for the least squares solution. Equal weights were assigned to each area so that the large number of stars in the region of Orion and Monoceros should not have too predominant an influence. This solution yielded the following results: the right ascension of the apex is 283.8°, the declination is $+11.7°$; the velocity of the solar motion is 17.2 km./sec. The average residual velocity is 10.0 km./sec. This includes the accidental errors of observation, indicated by the average probable error of ± 3.5 km./sec., and the radial component of the random velocities of the stars, which amounts to 9.4 km./sec. This is larger than the value of 7.0 km./sec., found by Frost and Adams for the first 20 bright stars, indicating that the average residual velocity increases as we use fainter stars. If we group our 350 stars according to magnitude we find that those of magnitude brighter than 2.0 have an average residual velocity of 6 km./sec., while those fainter than magnitude 5.3 have an average residual velocity of 12 km./sec. The rest of the stars have intermediate velocities.

It is still impossible to offer any adequate explanation of the *K*-term, amounting to 5.6 km./sec. It would be explained if we could adopt the idea that the group of helium stars is expanding outward with that velocity. If the wave-lengths of the lines in these stars were in the blue and violet part of the spectrum about 0.08 Å longer than in the laboratory, this excess of positive velocity or recession could be accounted for. The values of the wave-lengths of the helium lines used in our reductions have been those determined by Paul W. Merrill at the Bureau of Standards with the interferometer, referred to the cadmium standard. The faint components of some of the helium lines that are double, like λ 4472, were not blended in Merrill's wave-lengths in proportion to the apparent intensities in the laboratory. This tends to increase the *K*-effect by about 1 km. Dr. S. Albrecht, of the Dudley Observatory, has been re-determining the wave-lengths of lines in the stars of class B in the measures for the radial velocity by Frost and Adams with a dispersion of three prisms. The use of his values, instead of the laboratory wave-lengths for helium lines by Merrill, would tend to reduce the *K*-term by a fraction of 1 km., approaching the value obtained by W. W. Campbell from measurements of 225 B stars. It cannot be accounted for by differential effects between the shorter and the longer wave-lengths on our plates, as these have been allowed for. The Einstein displacement due to the gravitational field of these comparatively massive stars may reasonably account for a part of this, and the downward convection in the stellar atmospheres may be the cause of another part of the *K*-effect.

During this work a specification has been given for each star as to the suitability of its lines for exact measurement, the number of lines being classed as many or few, and their quality as good, fair or poor. The results for the 368 stars are as follows:

NUMBER OF STARS	NUMBER OF LINES	QUALITY OF LINES
45	Many	Good
59	Few	Good
17	Many	Fair
101	Few	Fair
7	Many	Poor
139	Few	Poor

The complete paper will be published in the *Astrophysical Journal.*