

## ETHER DRIFT EXPERIMENTS IN 1929 AND OTHER EVIDENCES OF SOLAR MOTION\*

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The ether-drift interferometer, previously used on Mount Wilson in California from 1921 to 1928, has been remounted on the campus at Case School of Applied Science, Cleveland. Some minor improvements have been adopted, such as shock-absorbing pads on the supporting piers, to eliminate traffic vibrations, and added precautions have been taken to eliminate temperature disturbances. The methods of making and reducing observations are so devised as to remove the possibility of instrumental or terrestrial disturbances, and the observed effects seem to be cosmic in origin. As before, the interferometer has a sensitiveness represented by a light path of 214 feet, or about 130,000,000 wave-lengths of light. The numerical results are reliable to the hundredth part of a wave-length of light, corresponding to one-half of a kilometer per second of relative motion of the earth and the ether. A series of experiments recently completed gives results wholly in accord with those previously obtained at Mount Wilson; the observed effect is such as would be produced by a relative motion of the earth and ether of about ten kilometers per second. The direction of the indicated motion is fixed with relation to sidereal time; that is, it is towards a fixed point in space, as of a motion of the solar system towards the point having a right ascension of seventeen hours, and a declination of 68 degrees north. Ether drift produces an effect as observed in the interferometer which is proportional to the square of the ratio of the velocity of the cosmic motion of the earth and the velocity of light; this is a "second order" effect, and is periodic in each half revolution of the interferometer. The complete theory of this experiment shows that there is necessarily also present a "first order" effect periodic in each full turn of the interferometer; this has never

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\*Abstract of a paper presented to the National Academy of Science, Washington, D.C., December 6, 1929.

before been taken into account. But it is now shown that this effect is always present and that it is in accord with the theory, and it is considered a further evidence of the validity of the present experimental results. It seems impossible at the present time to account for a cosmic effect of this small magnitude, and it will be necessary to continue these experiments and to coordinate them with others before an acceptable theory can be propounded. It is interesting to note that the present interferometer is mounted about three hundred feet from the location of the original Michelson-Morley interferometer of 1887, and that the magnitude of the observed effect is almost exactly the same as that obtained by them. The recent results, therefore, notwithstanding a prevalent opinion to the contrary, fully agree with and conform the original Michelson-Morley observations, though the present interpretation is different. Attention is called for the first time to the results of several recent important experiments in diverse fields which seem to corroborate the indicated cosmic motion of the solar system. Meridian circle observations of star places made by direct and reflected rays show peculiarities which are explained by assuming a motion of the solar system towards the sidereal time meridian of about seventeen hours. This effect has been found by the independent observations of Courvoisier (Berlin) and of Esclangon (director of the Paris Observatory). Esclangon finds evidence of similar motion in observations of lunar occultations of stars, and still more convincingly in elaborate studies of earth tides (deformation of the earth's crust) and of ocean tides. In the latter work, he considered 166,500 observations, extending over a period of nineteen years. The well-known study of radial and proper motion of stars in our own galaxy by Campbell (Lick Observatory) and by Wilson (Dudley Observatory) give a motion of the solar system towards the constellation Hercules, of eighteen hours right ascension. Stromberg (Mount Wilson Observatory), from an investigation of clusters and nebulae, finds evidence of a motion of the solar system with its apex at twenty-one hours right ascension and declination of 56 degrees north. By a study of the reflection of light, Esclangon finds strong evidence for what he calls an "optical dissymmetry of space" with its axis of

symmetry in the meridian of twenty hours sidereal time. This effect would be explained by an ether drift, and the results are in striking agreement with the ether-drift observations here reported. Many recent observations on cosmic rays show a very definite maximum of radiation coming from the direction indicated by the meridian of seventeen hours sidereal time. The very extensive observations of Kolhorster and Von Salis, and Weld and of Steinke, all show this effect. Observations made on the non-magnetic ship *Carnegie* show a maximum at seventeen hours sidereal time for the observations made between 30 degrees north and 30 degrees south latitude. There are several anomalies in astronomical observations of less definite character, which, however, might be explained by the existence of an ether drift. Such anomalies occur in connection with the observed constant of aberration, standard star places and clock corrections determined at different times of day. There are at least twelve different experimental evidences of a cosmic motion of the solar system, all indicating the same general direction, and ten of them show a motion towards a right ascension lying between sixteen and one-half hours and eighteen hours. Seven of these investigations give the declination as well as the right ascension, and thus determine the apex of the motion of the solar system. The various apexes all lie within a circle on the celestial sphere having a radius of 20 degrees. This is a remarkable agreement considering the nature of the various observations involved.