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New Analysis of the Interferometer Observations of Dayton C. Miller

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For nearly thirty years the results of the Michelson-Morley experiment obtained by Dayton C. Miller on Mount Wilson have stood as evidence with all other kinds of observations, in favor of Einstein's special theory of relativity. In the present time, however, the original observations are available in the original volume. It has seemed surprising that the observations be subjected to a new analysis. It is now shown that the small periodic fringe displacements found by Miller are due to an optical disturbance in the mounting of the interferometer. It is a very difficult experiment. The mounting necessarily affects an optical system which requires new conditions. There was much loss of coherence at Mount Wilson due to the atmosphere. In the present analysis, including Miller himself in his work done at Case in Cleveland, the comparison in the present study, Miller's previous Mount Wilson data include no effect of the wind produced by the surface waves and, within the limitations imposed by local disturbances, are entirely consistent with a null result at all speeds during a year.

INTRODUCTION

THE null result obtained in the Michelson-Morley experiment at Cleveland in 1887 was the culmination of the long nineteenth-century search for an ether and proved to be a major impetus for the theoretical developments made by Lorentz, Poincaré, Einstein, Planck, and especially Einstein. The crucial significance of the Michelson-Morley result stimulated many experiments of this experiment during the next fifty years, especially in the investigation of the theory of relativity. Although all trials of this experiment except the one carried out at Mount Wilson by Dayton C. Miller failed to yield results within the accuracy of the observation, Miller's observed fringe displacements also were very small, being on the average only about 1/50 of those predicted by the ether theory for the 30 km/sec velocity of the earth in its orbit. However, as these small effects have received no adequate explanation, and their interest in them has continued, it has seemed desirable to make a rather detailed analysis of the observations recorded.¹

Michelson and Morley had originally planned to repeat their experiment at intervals of about three months throughout a year and then to allow for any possibility

that the earth's orbital velocity at one epoch might fortuitously coincide with the motion of the entire solar system through space and give a small residual velocity in their apparatus. However, after completing the July, 1887 observations, they did not return to this problem, and the completion of the authors' first experiment for all epochs was finally carried out by Miller during the years from 1910 through 1918 in Cleveland and at Mount Wilson. Miller's Mount Wilson experiment² was conducted at intervals from April, 1910, through February, 1918, being interrupted with and followed by numerous trials at Cleveland.

In February, 1911, the interferometer was set up at Mount Wilson, and Miller made numerous observations during the period April 6-26, 1911. These data indicated a possible small periodic effect, with an average residual harmonic amplitude of about 400 fringes, but Miller suspected that temperature effects or expansion of the steel base of the interferometer as it rotated in the earth's magnetic field might be the cause. Accordingly he had designed a concrete base for the interferometer, which was cast at Mount Wilson in October of 1911. Unfortunately the greatest incentive to continue the experiments came from Professor Albert Einstein who visited Miller at Case on May 25, 1913, and urged that

¹ R. S. Barnard and R. W. McGonnell, *Rev. Mod. Phys.*, **27**, 101 (1955).
² The author completely agrees with the early experiments done only in the present form, the present analysis of the data is published in *Rev. Mod. Phys.*, **27**, 101 (1955).

³ F. C. Lewis, *Sci. News*, **26**, 374 (1913); *Sci. News*, **26**, 375 (1913); *Sci. News*, **26**, 376 (1913); *Sci. News*, **26**, 377 (1913); *Sci. News*, **26**, 378 (1913); *Sci. News*, **26**, 379 (1913); *Sci. News*, **26**, 380 (1913); *Sci. News*, **26**, 381 (1913); *Sci. News*, **26**, 382 (1913); *Sci. News*, **26**, 383 (1913); *Sci. News*, **26**, 384 (1913); *Sci. News*, **26**, 385 (1913); *Sci. News*, **26**, 386 (1913); *Sci. News*, **26**, 387 (1913); *Sci. News*, **26**, 388 (1913); *Sci. News*, **26**, 389 (1913); *Sci. News*, **26**, 390 (1913); *Sci. News*, **26**, 391 (1913); *Sci. News*, **26**, 392 (1913); *Sci. News*, **26**, 393 (1913); *Sci. News*, **26**, 394 (1913); *Sci. News*, **26**, 395 (1913); *Sci. News*, **26**, 396 (1913); *Sci. News*, **26**, 397 (1913); *Sci. News*, **26**, 398 (1913); *Sci. News*, **26**, 399 (1913); *Sci. News*, **26**, 400 (1913); *Sci. News*, **26**, 401 (1913); *Sci. News*, **26**, 402 (1913); *Sci. 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