No 1087

On the Absolute Value of Gravity.

The length of the equatorial seconds pendulum according to my observations in Hoboken and Kew, combined with the station errors found in my unpublished investigation on the figure of the earth, these two station errors depending mainly on the observations of Herschel is 990.mm95. The value obtained by me in Paris using station error mainly depending on Sabine's work is somewhat different. I cannot admit the view of Helmert expressed in his Höhere Geodäsie that the discrepancy is owing to the unusual rigidity of the support used by me in Paris, although this opinion is based upon a suggestion in my own Memoir: but further studies in the matter of the flexure of pendulum supports, together with the comparison of my result at Paris, with those of previous and of subsequent observers, inclined me rather to the belief of an error in the relative course of gravity as determined by

Sabine. In any case however, it is indisputable that the value of the length of the equatorial seconds pendulum, as deduced from my work in Paris, altho probably really nearer the truth than other careful determinations is never-the-less not comparable with them. The large correction due to the flexure of the pendulum staff itself during the swingings never having been allowed for

The swingings at the Smithsonian in the year 1885 with pendulums 1 and 2, differ but little from those deduced from the previous work at Kew and Hoboken. One of the knives of Pendulum No 4 having been found to be loose it is not surprising that the value obtained with this pendulum differs considerably. It seems, however, that it is difficult to account for the difference of about 1/7 of a millimetre in the value given by the yard pendulum No 3

When the reductions were first made this seemed to fall in very well with

the others, but this appearance of agreement seems demonstrably due to the combined effect of several errors, and the discrepancy remains over, for which I am unable to account. The following tables give the results, calculations and comparisons of length

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The values of the constants used in reducing the observations will be more fully discussed in another place. At present, I may mention that the effect of temperature upon the viscosity effects, as well as the whole amount of this effect, may be somewhat in error; but the quantities are so small that the error cannot be serious. The value of the expansion here used is deduced from comparisons with a meter bar made at 18°.5 C and at 31° C. These give 18μ.24 as the expansion per degree Centigrade, at 24°.6 C. But the observations at Fort Conger, made after the interchange of knives ~~will~~ were at an average temperature of −30°.4 C., Now, determinations of the expansion of brass, by Fizeau (Comptes Rendus Vol. LXVIII p. 1125) make the coefficient of expansion of brass increase at the rate of 1.96 millionths per 100° Centigrade. In default of any other information, I shall suppose that the same rate of change of the expansion applies to the brass of the pendulum used by Gen. Greely. For a difference of 55°, this would be 1.08 microns. Since Fizeau's brass had, at 24.6 C., an expansion of 18.28 millionths, almost exactly the same as ours, it seems reasonable to suppose that the second terms of the formulae would likewise be equal. I therefore

assume, in the correction of the different observations made at Fort Conger to ~~an~~ their mean, an expansion of 17.μ16 per degree Centigrade. But in bringing these observations to the Standard temperature of 15° C., the expansion for −7.°7 must be used; and since this temperature is 32.°3 below the temperature at which the expansion was observed, I calculate the coefficient to be used in bringing the observations to the standard temperature, as follows:

Coeff. at 24.°6 = 18.24 microns per degree Cent.

Corr. to − 7.°7 = 1.96 x .323 = .63

Coeff. at −7.°7 = 17.61

In Sergeant Israel's record of his observations for flexure, he states that these measures were made with "the 2.5 pound weight." But I ~~f~~ am so confident that the weight supplied to Mr. Israel by me for this purpose was a kilogram, that I have assumed it to be such in the reductions.

Elaborate observations were made by Mr. Israel upon the descent of the arc, and these have been reduced by Mr. H. Farquhar of the Coast and Geodetic Survey, according to the method given in my memoir on the "~~ab~~measurement of Gravity at Initial Stations;" with some improvements

in details. In the following tables, these observations with their reductions are first given, and are followed by the observations of the periods with their reductions.