

the reflex observation is made first, and the instrument is then turned in mid-transit to the direct position, in which the exposure is of very short duration before the observation in zenith distance is made. In the curve c, for which in each case the direct observation was made first, the exposure in the direct position would commonly be considerably greater; and the difference between this and the flexure-curve, attributable to such exposure, is accordingly much greater than the same differences for the A and B curves. Note that the difference becomes smaller under 40° zenith distance; it would be zero in the zenith in all cases.

Other instances of apparent refraction within the tube are found in the Greenwich observations:—

When the north and south collimators are aligned by looking through the holes in the telescope-cube, the collimation-error obtained differs systematically from that obtained by aligning the collimators with the telescope raised out of the way. This can only be explained thus: one side of the instrument is commonly warmer than the other at the hour (8 a.m.) when these observations are made, and the still air in the tube is affected in like manner. If we suppose the air in the spaces A and B, Fig. 3, to differ from each other 0.5 Fahr. in temperature, and to be separated by a surface which the path of the light between the north and south collimators cuts at an angle of incidence of 80°, the light will be deflected 0.60 of arc, and the collimation-error obtained would be in error by half this amount, viz., 0.30,

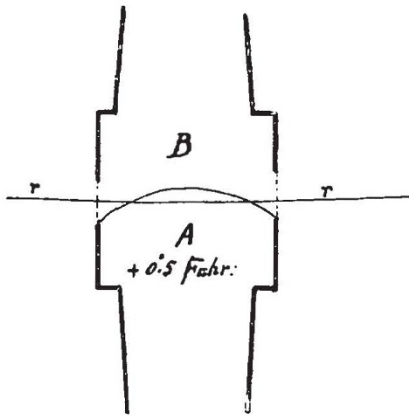


Fig. 3.—r. Shows path of light from north to south collimator refracted within cube of telescope when air is unequally heated.

which is about the difference between the values obtained by the two methods.

A similar discordance exists between the results for flexure of the tube formerly obtained by raising the telescope and those recently obtained by aligning the collimators through the cube; and this discordance has a similar explanation. The flexure obtained formerly, which I take to be the more correct, is about 0.80 of arc, as employed above to explain the R-D discordance.

I conclude that means should be provided—and used—for circulating the air in the tube when any observation—whether of star, of collimation, or of flexure, or otherwise—is made with a transit circle. I would also point out that the source of error here considered is of peculiar importance from the fact that it affects, to a relatively large amount, the zenith-distances of polar-stars, and hence the deduced results for latitude. The error is eliminated in the mean of a reflex and a direct observation taken at the same time.

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### SUGAR-CANE EXPERIMENTS.

IN the fourth number of the *West Indian Bulletin*, recently noticed in these columns, many pages were devoted to communications to Dr. Morris, the Imperial Commissioner of Agriculture, from Prof. d'Albuquerque, the Island professor of chemistry, and Mr. Bovell, the agricultural superintendent, in which an elaborate plan was laid down for undertaking an exhaustive investigation into the merits of several varieties of sugar-canes. The very full details therein given should be con-

sulted by any one desirous of mastering the significance of the facts contained in the pamphlet now issued by the Commissioner, giving a "summary of the results of the cultivation of seedling and other canes at the experiment stations in Barbados in 1900." Prof. d'Albuquerque and Mr. Bovell have read a paper on the subject before the Barbados Agricultural Society on the results of the cultivation and yield of selected seedling and other canes, and the pamphlet summarises the essential facts. It is important to remember that the experiments were throughout conducted on the ordinary system of natural cultivation, the planters themselves undertaking to set apart plots of their own plantations, so that the known and the unknown grew side by side, no exceptional treatment being recognised. In this way fairly typical results are obtained, and the results for subsequent years will, therefore, be watched with more than usual interest to see how the character of the season, as well as the quality of the soil, may affect the various canes. For the experiments seven stations were selected, representing the typical soils and climatic conditions of Barbados. Five of the stations were black soil, the other two red soil. At nearly every station there were duplicate plots of each variety, serving to show the variation to be expected with each variety from one part of the field to another. The lowest station was at an elevation of 100 feet above sea-level, the highest 910 feet, the rainfall in the growth period ranging from 56 inches to 89 inches. Fifteen selected varieties of canes were tested on the black soil estates, and ten of them on the red soil estates. For each variety the highest and the lowest yield in tons per acre in the black and the red soils respectively are given, and separate tables for black and red soils show for each cane the number of plots used for the investigation, the yield in tons per acre of canes and also of tops; the juice per cent. by mill; pounds per gallon of saccharose, of glucose and of solids not sugar; the quotient of purity of the normal juice; the juice in gallons per acre; saccharose in pounds per acre; and the sugar in tons per acre, calculated according to a formula supplied by Mr. Douglas, of the Diamond plantations, British Guiana. In the black soil B. 147 heads the list with 3.01 tons of sugar per acre, followed by B. 347 with 2.90 tons, and B. 208 with 2.83 tons, while at the bottom of the list stand D. 145 with 1.82 tons, the Burke with 1.73 tons, and the Bourbon with only 0.47 ton per acre. The White Transparent cane, which is cultivated in Barbados on a larger scale than any other cane, and may therefore be regarded as the standard for comparison, occupies a middle place with a yield of 2.41 tons per acre. In the red soil B. 208 takes first place with 3.34 tons per acre, followed closely by B. 156 with 3.32 tons and B. 147 with 3.31 tons, the lowest being B. 347 with 2.17 tons and B. 254 with 2.14 tons.

The mean results for both soils indicate B. 147 to be the best all-round cane, its yield being 27.52 tons of canes per acre, 3.1 tons of sugar and 6291 lbs. of saccharose, B. 208 occupying second place with respectively 22.55 tons, 3.02 tons, and 5443 lbs., compared with the standard White Transparent results of 20.49 tons, 2.41 tons, and 4528 lbs. A further table gives the results obtained on the three estates of "Dodds," "Pine" and "Waterford" with B. 147 and the White Transparent varieties, the means for the three estates giving B. 147 a yield per acre of 6999 lbs. of saccharose and 3.70 tons of sugar, while the White Transparent yielded 4527 lbs. of saccharose and 2.41 tons of sugar. It will thus be seen that the new seedling, B. 147, is better than the standard by more than a ton of sugar per acre. Looking to the individual and general results, the investigators consider there is a satisfactory degree of agreement under a considerable variety of conditions of culture and growth. B. 147 is regarded as the best all round seedling variety as a plant cane in Barbados, B. 208 giving promise of proving a good red soil plant and ratoon cane. Planters are advised to try, on a small scale, three or four of the varieties which have done best in these experiments, so as to be able to secure eventually the cane best suited to the nature of their particular fields and their own methods of cultivation—features which have, in their way, quite as much weight as the character of the cane itself. While B. 147 seems to be the most suitable cane for particular soils in Barbados, D. 95 appears to be the best for the different circumstances of Antigua. A private letter from Barbados, in which reference is made to the above experiments, states that the officials of the Agricultural Department seem determined on securing improved varieties that will suit each district, and will yield at least 50 per cent. more sugar than those hitherto cultivated.