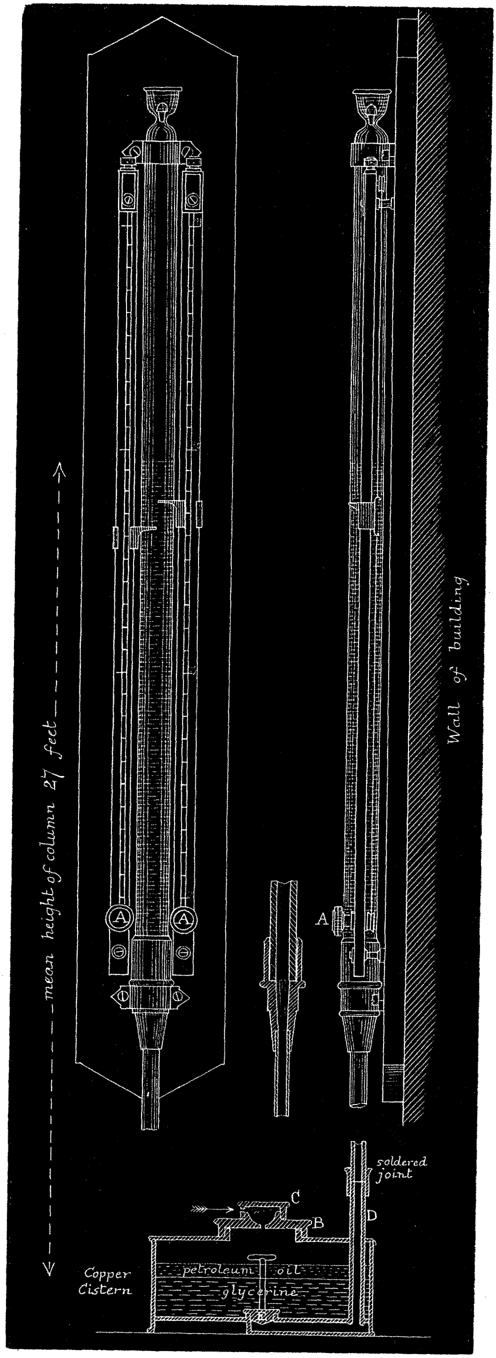
III. "On the Construction of a Glycerine Barometer." By James B. Jordan. Communicated by Professor Stokes, Sec. R.S. Received January 8, 1880.

Various attempts have been made from time to time to construct barometers with fluids of lower density than mercury, with the view of increasing the range of movement of the column by the direct action of the atmosphere, thereby rendering the variations of pressure more easily visible, without the intervention of mechanical appliances. I have been induced to give the subject attention in the belief that if precise instruments of this class could be made they would prove of scientific value in showing the character of the more minute vibrations of atmospheric pressure, and of practical use at storm stations, collieries, and other situations where it is of importance for the unpractised eye to notice frequently the movements of the column without the careful observation necessary in the reading of an ordinary mercurial barometer.

Water is apparently the most convenient liquid for a long range barometric column, and many water barometers have been constructed, notably that made for the Royal Society in 1830, by Professor Daniell. A water column is, however, of little use for indicating variations of pressure, owing to the effect of changes of temperature on the water vapour existing in the Torricellian vacuum, which often masks the effects which would otherwise be produced by changes of pressure. Having successfully constructed several water barometers, and finding this conflicting action caused by variations of temperature so detrimental to their value, I was induced to experiment with other liquids, and among those tried pure glycerine appeared to me to answer the purpose best. Glycerine from its high boiling point has a very low tension of vapour at the ordinary temperatures of the atmosphere; the length of the column is therefore only altered from changes of temperature by expansion and contraction of the liquid itself, and that in a very small degree, the mean coefficient of absolute expansion between 0° and 100° C. being ·0005455. The specific gravity of the purest glycerine as manufactured by Messrs. Price and Co. is 1·26, or less than one-tenth that of mercury; the mean height of the column is 27 feet at sea level, and a variation of a tenth of an inch in the height of the mercurial column is shown by a change of more than an inch in the glycerine; the boiling point is 440° F., and a very low temperature is required to solidify it. As glycerine absorbs moisture freely if exposed to the atmosphere, the action is prevented by covering the surface of the liquid in the cistern with a shallow layer of heavy petroleum oil, prepared especially for the purpose.

In order to give the method a fair trial, application was made to the Committee of the Government Fund for aiding scientific research,


mean height of column 27 feet
Wall of building
A
A
A
soldered joint
C
B
D
Copper Cistern
petroleum oil
glycerine

and on their recommendation a grant of £30 was made by the Treasury for the purpose. This sum has been expended in the construction of an experimental barometer of this nature, which has been erected at Kew Observatory by the permission of the Kew Committee, who have also sanctioned the taking of a series of observations to extend over a period of twelve months.

The tube forming the body of the instrument is an ordinary composition metal gas-pipe, $\frac{5}{8}$ths of an inch internal diameter, and furnished at the top with a gun-metal socket, into which is cemented a glass tube, 4 feet long, and having an inside diameter of one inch; the upper end is formed in the shape of an open cup and fitted at its neck with an india-rubber stopper. In this tube the fluctuations of the position of the top of the column are observed, and the height read off on brass scales placed on either side of the tube and fitted with indices and verniers, which are moved by means of milled heads placed at the bottom of the scales as shown in the drawing at AA. The scale on the right hand side is divided into inches and tenths of absolute measure, numbering from the level of the liquid in the cistern, while that on the left shows equivalent values reduced to a column of mercury and divided into tenths and hundredths, each hundredth being equal to about one-tenth of an actual inch. The whole of the top fittings, or observing portion of the barometer, is attached to a conveniently constructed back, made of oak and fixed to the wall of an upper room in the observatory building, the main tube being carried down in a direct line through the entrance hall into the barograph room, a distance of 27 feet. This distance was accurately determined by means of a tape measure, the error of which was found by close comparisons with the standard yard preserved at the Observatory. A suitable bracket is here fixed, on the north wall, on which is placed the barometer cistern.

The cistern is a cylindrical vessel of copper tinned inside, 5 inches deep and 10 inches diameter; it is fitted with a screwed cover, as shown at B in the drawing, the air having access only through a small hole in the cap C attached to the cover, which has a recess in it to hold cotton wool for filtering out dust. The main tube is connected with the cistern by attachment (with a soldered joint) to a projecting piece of tube D, which enters the cistern through the bottom and is fitted at its opening with a screwed plug E.

The operation of filling the barometer was performed in the following way:—The quantity of glycerine (coloured red by aniline) having been previously determined, it was heated to a temperature of 100° F., to render it more limpid, thereby enabling the contained air to disengage itself more freely; the whole quantity, about three-fourths of a gallon, was then transferred to the cistern, the plug E removed, and by means of an air-pump connected with the top of the glass tube, the

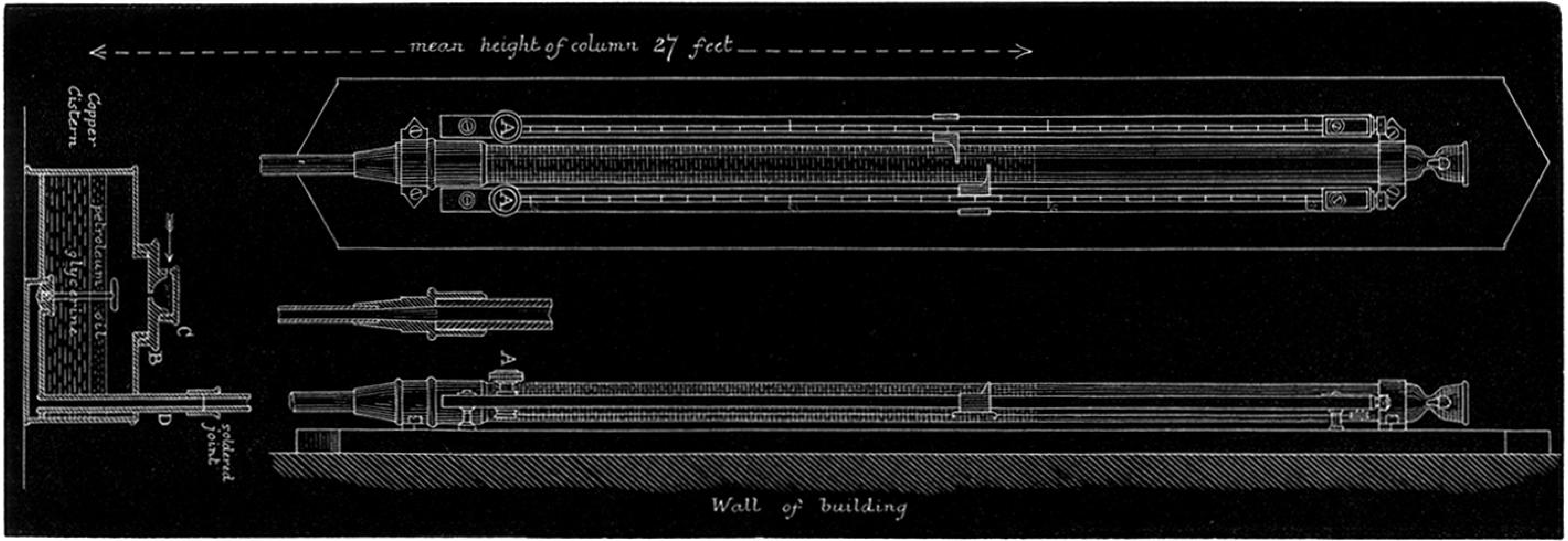
air was exhausted and the liquid forced up the tube by the pressure of the atmosphere, to a height of 323·571 inches, being equivalent to 30 inches of mercury, the Kew standard at the time reading 30·3 inches. The plug in the cistern was now screwed in its place, to support the column, while the air was admitted at the top and the air-pump connexions removed; a sufficient quantity of glycerine to fill the tube was then poured in and the india-rubber stopper inserted. The screw plug being removed for a few seconds to allow the column to fall an inch or two and then replaced, the instrument was allowed to remain until the liquid in it was completely exhausted of its air, which rose slowly to the surface into the Torricellian vacuum above: then the india-rubber stopper was again withdrawn and the tube finally filled up with glycerine, which had been previously exhausted of air under the air-pump receiver: the stopper was now replaced and the cistern plug finally removed, when the column gradually fell until balanced by the pressure of the atmosphere, leaving a small quantity of glycerine in the cup above the stopper, a plate glass cover being placed on the top to keep out dust. The barometer was now complete and it has since continued in operation. Whether it is to be of any scientific or practical value will be proved by the observations which are now being regularly taken under the superintendence of Mr. Whipple, the Superintendent of the Kew Observatory, to whom I am under many obligations for his kind and courteous assistance during the progress of the work. When the observations are completed I shall ask the honour of submitting them to the Royal Society.

IV. "On a Possible Mode of Detecting a Motion of the Solar System through the Luminiferous Ether." By the late Professor J. CLERK MAXWELL, F.R.S. In a Letter to Mr. D. P. TODD, of the Nautical Almanac Office, Washington, U.S. Communicated by Professor STOKES, Sec. R.S. Received January 7, 1880.

Mr. Todd has been so good as to communicate to me a copy of the subjoined letter, and has kindly permitted me to make any use of it.

As the notice referred to by Maxwell in the "Encyclopædia Britannica" is very brief, being confined to a single sentence, and as the subject is one of great interest, I have thought it best to communicate the letter to the Royal Society.

From the researches of Mr. Huggins on the radial component of the relative velocity of our sun and certain stars, the coefficient of the inequality which we might expect as not unlikely would be only something comparable with half a second of time. This, no doubt, would be a very delicate matter to determine. Still, for anything we know



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