Models

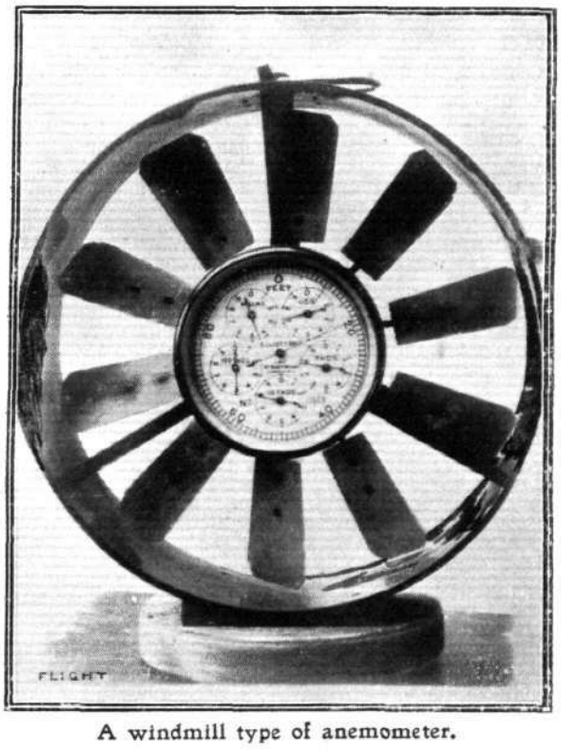
Conducted by V. E. JOHNSON, M.A.

Wind Measurement or Anemometry.

BEFORE any proper comparison can be made between different distance records, it is essential that the wind velocity be known, and that as far as possible a proper allowance be made for it. A perfect instrument for measuring either the direction or velocity of the wind should be without weight and friction; such being impossible, we must evolve the instrument most likely to conform approximately to these requisites. Lightness, strength, an absence of friction (as far as possible) and of liability to be affected by meteorological changes other than those for which the instrument is designed having been, we will presume, achieved; the next question is to determine the relation that exists between the indications of the anemometer and the wind. This is a task of no mean difficulty. A method commonly employed for calibrating a velocity anemometer is to mount it on the arm of a whirling machine and move it through still air at a known rate, and compare the indications of the instrument with this rate. But for the air to be "still" means, in practice, that the experiment must be carried out indoors and in a closed room where the continual rotation of the turning arm soon sets up a rotational movement of the air surrounding it, the effect of which it is very difficult to properly allow for. If the experiment be made out of doors really calm days are seldom obtained anywhere, and if the day be not calm the effect of the natural wind seriously impairs the result. The wind tunnel cannot be used unless we know the velocity of the wind through it, and how are we to know that before we have an instrument to measure it?

However, as the result of a number of experiments extending over many years, we probably have now fairly accurate instruments, obtained by a careful comparison of the various results arrived at, due weight being given to the varied conditions under which the experiments were carried out. When using a whirling table a source of error which must be allowed for is the effect of the centrifugal force on the bearings of the anemometer if the rotation of speed be high.

In the well-known Robinson cup type of anemometer it is obvious that there will be considerable back pressure—originally the cups



A windmill type of anemometer.

were supposed to revolve at one-third the wind velocity, irrespective of the size of the cups or their distance from the centre, but more recent experiments have shown that neither the ratio one-third nor any other will apply to all sizes of the instrument. As a rule a larger instrument registers higher than a smaller. Instruments fitted with large cups compared with the length of the arms register higher at low velocities and lower at high velocities than those having relatively smaller cups and longer arms, because the larger cups of the more compact anemometer shelter one another at certain points during their rotation. Dines found that the factor for the old Kew pattern should be 2·10; and when the distance of the centre of the cups from the centre of the axle is 24 ins., and the diameter of the cups 9 ins., 2·2 is probably the most correct (average) factor. In any record taken by means of such an instrument the following facts should be stated: (1) length of arm (axis to centre of cup): (2) diameter; (3) how the registration is effected, mechanically, electrically, &c.; (4) name of maker; (5) height above the surface of the ground.

Another form of rotational anemometer (illustrated) is the windmill or fan type, and which is or should be *kept normal to the wind by means of a vane*. In general practice with this and similar forms of anemometers—only one vane is used—which rotates about a vertical axis, the general supposition being that the wind blows *horizontally*, which, as a matter of fact, is by no means the case, and the anemometer is not kept truly normal to the wind; to do this a form of universal joint would be necessary.

In the illustration (an instrument built by Messrs. Elliot Bros., and owned by Mr. T. W. K. Clarke), the diameter of the fan wheel has been so calculated (suppose) as to allow a foot of wind to pass every revolution—this ratio being verified on a whirling table. What an anemometer of this type does is to make a direct measurement of the quantity of wind passing through the instrument in a given time, and it is necessary to use a stop-watch at the same time in order that the reading of the anemometer be converted into velocity, say, 200 ft. in 30 secs., or so many miles per hour. When we wish to ascertain the wind velocity with such an instrument, the casing is placed back to wind, so that the dial faces the observer, and the wind-vanes are allowed to rotate for a second or so, so as to get up speed. The lever seen at the top is then pulled to the left, and the large pointer on the dial commences to rotate, registering 100 ft. every revolution, the five smaller dials registering hundreds, thousands, tens of thousands, hundreds of thousands, and millions respectively. The instrument can be reset to zero by turning it to face the wind and allowing it to run back. This is, however, unnecessary if the position of the hands on the smaller dials be noted before each experiment. Instruments of this character are now constructed which can be reset and which are also self-timing.

When used in competitions these anemometers should be mounted on a vertical pivot fitted with a wind-vane and should be placed at a minimum distance of seven feet from the ground—nine feet is still better. It is most important that they should be so mounted and provided with a wind-vane, because if the wind impinge on them at an angle, not only do they fail to register correctly, *but can quite easily be made to turn in the opposite direction*, as a few experiments soon show.

Having taken the number of feet of air passed through as registered by the anemometer, there still remains to apply the correction chart, which each should possess, and to add or deduct the necessary amount of air in feet.

For instance, in the anemometer we are referring to, suppose the velocity was 200 ft. per minute, then we must add 16 ft., *i.e.*, 8 ft. per 100 ft. Again, suppose the velocity was 525 ft., then it is correct, and above 525 there is a very small increasing deduction to be made.

Other well-known form of anemometers are of the pressure type—these we must leave over for future consideration.

Notes.

Wind Velocity and K. and M.A.A. Records.—To accurately allow for wind velocity in the case of a model travelling, say, north to south, but circling in so doing, is obviously impossible, and the decision which the Kite and Model Aeroplane Association have come to in the matter is that the model must be launched and flown *with the wind*. The wind velocity in every case as registered by the anemometer (and corrected) *to be deducted*.

If the model fails to fly with the wind flying, say, across it, the deduction is still made, and not only so, but even if the model were to veer round and fly into the wind. It is an essential qualification therefore for a good record that the model should fly *straight*.