mum height above the plane which passes through the upper edges of the orbits and the orifices of the ears. Mr. Galton adds, that while writing his account, instruments for head measurements were being solidly constructed for him, which will be in use in Cambridge, Eng., in 1885.

THE STATUS OF AERONAUTICS IN 1884.

DUROY DE BRUIGNAC, member of the French Société des ingénieurs civils, has recently presented to that association a very complete yet concise *exposé* of the present state of the art of aeronautics, especially as related to the general system of 'dirigeable' aerostats. The first indications of success are assumed to have been given by the experiments of Giffard (1852–55), Dupuy de Lôme (1871), and Tissandier and Renard and Krebs (recently). The first condition is considered to be stability, retaining the relative position of parts seen in the earlier balloons.

Giffard, in his earliest attempts, attained a speed of three, and later of four, metres per second. Dupuy de Lôme, and Renard and Krebs, have used better forms of balloon, and have secured more rigidity of structure; but none have obtained high speed.

Extreme lightness of motor is a vitally essential feature; and the best that has yet been done is illustrated by the steam-engines of Thorneycroft, weighing about 33 kilograms (73 pounds) per horse-power, and which, by sacrificing economy of fuel, it is thought possible may be reduced to 20 kilos (44 pounds), and the various storage and other batteries yielding electricity, which, according to Tissandier, may be reduced to a weight not exceeding 25 kilos (55 pounds) per horse-power. Messrs. Renard and Krebs claim a weight as low as 17 or 19 kilos. The experiment of Tissandier in 1883, in the application of electricity to this work, is thus expected to lead to useful results.

The propelling instrument is always the screw. Its position is a matter of importance. As usually arranged, it has a tendency to cause vertical deviations of the machine, which are objectionable. It is hoped that it may prove possible to place the screw-shaft in line with the axis of symmetry of the balloon, in order to avoid this difficulty. This may be done by setting it between a pair of spindle-shaped supporting balloons. It is uncertain whether it will be found best to place it ahead or astern of the balloon; but it is presumed best at the stern. The screw is objectionable on the score of its low efficiency, — about 0.30 (?); but nothing better has yet been devised.

Bruignac proposes a formula by means of which to calculate the resistance of the aerostat, and by its application determines the relative resistances of the machines of the several aeronauts whose work has been mentioned, as follows: Giffard, 1852, 0.076; Giffard, 1855, 0.035; Dupuy de Lôme, 0.18; Tissandier, 0.12; Renard and Krebs (1), 0.12; Renard and Krebs (2), 0.02. In the last two cases, the large and the small ends of the vessel are calculated separately.

The speeds actually obtained by them were 5.5 metres per second by the last named, and from 3 to 4 metres by their predecessors. Had the former driven their machines with the small end ahead, instead of the larger end, as actually practised, the critic calculates that they might have obtained a speed of nearly ten metres. A symmetrically formed cylindrical spindle is advised as the probably best form for the body of the air-ship, inserting a straight middle body when constructing very large vessels. The larger the machine, the lighter, comparatively, will be the driving machinery. The substitution of supporting hoods, sheets, or tissues, for cords, may assist in the endeavor to reduce resistances. The loss of gas by leakage can be reduced by choice of proper material for the balloon. The waste of gas in ascending and descending must be avoided, and may, perhaps, be obviated altogether. This becomes an easier matter in ascents of the kind here contemplated, in which no greater height will be sought than is sufficient to clear obstacles safely: probably a hundred metres will prove ample. For such work, the alternate compression and expansion of the adjusting volume of gas will probably suffice.

The conclusion is reached that the art of aerostation is much nearer a practically applicable state than scientific men generally suppose. The objects now sought are the attainment of better and more stable forms, the more effective arrangement of parts, the invention of lighter motors, invariable in weight, and convenient of operation, and the securing of higher efficiency of propelling instrument. Even now, with the experience of the past, it is possible to build a machine of this class capable of making at least ten metres per second through the surrounding medium.

These conclusions of Bruignac are especially interesting when compared with those of Pole as presented to the British institution of civil engineers, in which he finds that the supporting-power of the balloons adopted by the aeronauts above mentioned, and the driving-power and weights of the torpedo-boat engines of British makers, are such as should permit the construction of an air-ship four hundred feet long, to travel at the rate of thirty miles an hour.

R. H. THURSTON.

FINDING A BORE-HOLE.

Two novel and ingenious methods of locating the position of a bore-hole have recently been described in the London *Engineering*. In the first case, at Edinburgh, it was desired to connect the lower end of a bore-hole, two hundred feet deep, with a well some eighteen feet distant. A drift run in the supposed direction failed to strike the hole, although much rock was cut away, and it was evident that the drill had deviated considerably from the vertical. After an unsuccessful attempt to locate its direction