and steering at the same time, and we gave it a fixed inclination by attaching it at the two extremities. We could not follow our float and kite, but, as long as it was possible, we beheld it crossing the lake in the direction of Versoix or Coppet.

When I recently learned that Messrs. Lhoste & Mangot had succeeded in crossing the English Channel with a float, this kite experiment came to mind; and I have thought that in such passages as fail for want of a breeze, it would be infinitely simpler to have a float that would be able at will to swerve the balloon and give it the most favorable direction. Messrs. Lhoste & Mangot used a cylinder that they could fill with water or empty, but they did not utilize the property that is possessed by the flat float held by both ends, and that permits of moving at right angles with the wind or at any other angle.

I here call attention to the double cord method, which permits of presenting the obstacle to the direct wind, and of tacking, as with a ship.

G G and G' G (Fig. 4) are the extremities of this float, which are held by the two cords, *a a*, *b b*, at the extremity, G, and by *c c*, *d d*, at the extremity, G'. These four cords pass in pairs through two rings, *m* and *m'*, and are connected near the car, where they are held in place. *t t t* are apertures that permit of filling the float with water or of emptying it. With such a float it is permissible to attempt a crossing, even in a wind that has a direction that follows the axis of the channel, or any other direction.—D. Colladen.

THE RACING CAMEL.

THE animal represented in the engraving is a mehara obtained from the Touarag Foghas. It has belonged to me for three years, and, although a little aged, is still rendering me excellent service nearly every day.

The mehara, or racing camel, is to the pack camel what the pure blooded horse is to the cart horse. It is the product of a long selection. Urged to a full trot, the mehara is capable of attaining a speed of nearly 18 miles an hour, but I have no need to say that it could not long keep up that gait.

The mehara has three gaits: the ordinary gait, in which the Arabs say simply *iemchi*, "he goes," or "he walks;" the long step, in which he says *isir*; and the amble, in which he says *iraouel*, "he goes ambling." This latter gait, which the animal can keep up for days at a time, gives a speed of from 6 to 8½ miles an hour, and is in nowise fatiguing to the rider.

The Biskra Society of Races inaugurated camel races in January, 1885. It was a question of making the trip from Touggourt to Biskra (126 miles) in the quickest time possible. The first mehara arrived 26 hours after the start, and the other competitors were all at Biskra in the three hours following. From the three latter we must except a mehara that arrived at almost a dead heat with the first, but this animal lost his rider at Saada.

It is well to say that all the racers stopped five consecutive hours at Saada (18 miles from Biskra), on account of a rain that had rendered the road very slippery, this being a grave inconvenience for the feet of camels. Upon the whole, the trip was accomplished in 21 hours of effective travel, that is to say, at a sustained gait of 6 miles an hour. It is possible, with well urged animals, to make this distance in 20 hours at a maximum, provided that the rider is strong enough to endure a fatigue of this kind and to urge his animal on.

The race of 1886 was insignificant. Only two animals took part in it—one of bad stock and the other of good, but not trained. I was enabled to judge of this myself, for I rode him at Touggourt on the eve of the day of the race.

As for the race of 1887, I was in France at the time, and have not been informed as to its results.

In short, it will be seen from what precedes that the

THE MEHARA, OR RACING CAMEL.

mehara is a swift riding animal, and one that has bottom, and that it might render very great services if used in the army of Africa, and if a corps of mehara scouts were organized, for, in addition to its speed and bottom, the animal easily walks in sand in which horses could not move forward; and, moreover, it can do without drink for seven or eight days.—F. Foureau.

THE ARTESIAN WATER OF OUED RIR.

By G. ROLLAND.

IN two preceding communications to the Academy, we have briefly described the nature of the artesian water of Oued Rir', a large oasis situated to the south of Biskra, and to which attention has been called by the remarkable borings of Mr. Jus and, more recently, by the colonization enterprises which this country has been the scene of in recent years.

We now propose to furnish a few complementary details upon the artesian basin of this region, on account of the interest, both scientific and practical, that attaches to an accurate knowledge of it.

Let us recall the fact that Oued Rir' is a valley that descends from the south to the north, and that along this valley there is a great reservoir of water at a mean depth of 230 feet beneath the surface. This subterranean sheet feeds a numerous series of spouting wells, whose total discharge is 1,050 gallons of water per second. It is recognized for a length of 98 miles, but its

ARTESIAN WELL WITH A DISCHARGE OF 830 GALLONS PER MINUTE.

width is limited as compared with its length. We have compared it to a sort of subterranean artery.

The instinct of the aborigines therefore does not wholly deceive them when, in their imaginative language, they speak of the "subterranean river" of Oued Rir', which according to them, runs from the south to the north. The word "river" well translates the idea of our elongated zone, of our liquid artery; but this word makes us think of a rapid flow, of a stream having an appreciable velocity. Now such is contrary to what is really the case, and, from this point of view, the word artery is not much better.

The subterranean water of Oued Rir' is evidently not stagnant, nor inclosed in a tight reservoir and having no motion, as this would be contrary to the ordinary laws of nature. It has a real and continuous flow between the springs that feed it and the points at which it emerges; but it is a question of a general flow of imperceptible velocity, save in the immediate vicinity of certain points of entrance and exit. This flow, moreover, takes place from the north to the south, and not *vice versa*; for the supply of the subterranean water of Oued Rir' and upper Sahara is derived from the north, as we have already explained, and this water comes for the most part from the Atlas mountains.

On the surface of Oued Rir', when heavy rains fall, water is seen to flow along the *thalweg* of the valley, and run toward the north. But care must be taken not to confound this line of superficial water with the subterranean deposit of Oued Rir'. These two aquiferous levels are entirely distinct, and a continuous mass of

valley, but is of the most capricious character. The artesian artery meanders under the impermeable covering of the superposed earth, and exhibits variations in width of from 2½ to 8½ miles, and sometimes divides in two, as in the region of Ourlana, where it forms an irregular X.

Finally, it would be inexact to imagine a river occupying a hollow channel limited by banks. The subterranean water infiltrates through a continuous mass of permeable sand. Laterally, the liquid zone is not isolated; it is situated in the midst of a network of aquiferous veins and secondary sheets in innumerable quantity. Now, just as the arteries carry the blood from the heart to all parts of the human body, just so the artesian zone of Oued Rir', continuously fed subterraneously, incessantly forces its surplus of water into the permeable portions of the surrounding earth, wherein it spreads and disperses, and whence it rises to the surface and finally evaporates.

This granted, it is easy to answer the question that has often been asked of us, viz.: In multiplying the borings in Oued Rir', are you not afraid of injuring the present wells and of exhausting the artesian basin? Although the spouting wells of Oued Rir' are the most apparent points of emergence of the water of the artesian basin, they are far from being the sole ones. In fact, the greater part of the water that flows subterraneously finds an outlet through the waste that occurs all around the artery, through lateral filtrations as well as leakages through defects in the covering. Let a bore hole be made, that is to say, let an outlet free from resistance be offered to the compressed water, and it is clear that it will change its course and flow, by a certain radius, toward such point. The entire volume of water that the wells of Oued Rir' are now discharging is so much the less lost through evaporation at the *chotts* or at the side. But, since what is still lost much exceeds what goes to the wells, and as the radius of action of each well is quite limited (½ to 1¼ mile, according to the region), it may be said that, in the present state, a new sounding made at a sufficient distance from the existing wells is effected not at their expense, but at the expense of the waste water—that is to say, it realizes a gain.

There will assuredly be a limit, for the artesian basin of Oued Rir' is not able, any more than any other, to furnish an indefinitely increasing discharge. When will such limit be reached? Experience alone will teach; but we believe that we are yet far from it, especially if future soundings be made by preference in regions where the artery has not yet been tapped, and if the French colonists persevere in this way (which is our own) of creating new oases outside of the old ones and even far from them.

However this may be, it is certain that it will be well, before all, not to jeopardize what has been acquired, and that the present absence of all control in what concerns the borings in Oued Rir' is not without danger. After this, then, it would be expedient to take the necessary measures to protect existing interests, while at the same time to let private initiative have its full swing; and, to conciliate all, the simplest way would be to form a sort of syndicate of the landholders of the country in which the government, the inhabitants of the oasis, and the French colonization societies would have representatives, and which would play the part of a committee of surveillance over the borings in Oued Rir'.—*Le Genie Civil*.

SUB-IRRIGATION.

By H. C. HOVEY.

CONSIDERING the importance of artificial watering of gardens and farms, especially in hot and dry regions, every new idea will be welcomed on the subject. Several different methods of irrigation are advocated by agriculturists. A very ancient method is that of flooding level fields and retaining the water for a time over them, until it has deposited the mud held in suspension and saturated the soil with moisture. Another plan has been to apply currents of water by means of conductors and drains, either catching the surplus so as to be used over and over again, or letting it flow down on some lower meadow to be utilized there. Still another method has been that of upward irrigation, by which the water that would otherwise be carried off by drainage is forced up through the soil. This has been adopted quite extensively in Germany; the plan being to lay earthenware pipes intersected by vertical shafts in which are slits through which the water rises to be distributed through the soil. The English method is by ditches from which the water flows by conduits built at right angles, being gently backed up by stop-

ping the mouths of the main drains, and the excess being removed by sluices.

Most treatises that I have noticed on the subject deal with the question on a large scale, as applicable to extensive regions, or at least to considerable tracts of land. The demand for some practical method for small gardens has been successfully met by the experiments recently made by Mr. Clark Marsh, formerly of Bridgeport, Conn., but now of Silver Beach, Florida. The results, as detailed by the *Florida Agriculturist*, are extraordinary. It is claimed that ten times as much may be raised on a given space by this means as could be had without it.

The plan recommended for sub-irrigation, on Marsh's method, is to lay off the garden in beds five feet wide and of any length desirable. The soil is then removed to the depth of two feet or more, according to circumstances. The sides are sloped inward toward the bottom of this trench. The bottom of the bed must be made perfectly level, so that the whole contents may be equally moistened. A cheap way of leveling is by a wooden square with a plumb bob hung as a pendulum. The bottom should then be thoroughly tramped down, and covered by Portland cement three quarters of an inch thick, the whole basin being thus