DUCKER'S PORTABLE BARRACK AND FIELD HOSPITAL.

(Continued from first page.)

bullets of the enemy. There is, therefore, every inducement to reduce this unnecessary fatality by providing proper shelter and treatment for both the wounded and the strong. With the charitable purpose of lessening these dangers, an exhibition was held at Antwerp on the 1st of September, 1885, under the auspices of the Society of the Red Cross, and the inventors of the world were invited to contribute the products of their ingenuity. The object of the exhibition was to develop the best possible design for a barrack or field hospital, which might be utilized either in war or in time of peace. The requirements of the proposed structure were as follows:

"The barrack should be capable of being easily converted into a hospital, and *vice versa;* it should be so constructed that it could be set up and taken down with ease, transported without difficulty, and, as far as possible, interchangeable in all its respective parts, and should be able to resist the varying temperatures and withstand the violence of the wind; it should be waterproof, and so simple in its construction that no skilled workmen would be necessary in its manipulation."

A circular containing these requirements having come into the possession of Mr. Wm. M. Ducker, of Brooklyn, he addressed himself to the solution of the problem, and in a short time produced a structure in accordance with the specifications of the society. He forwarded a full sized model to Antwerp, where it was placed on exhibition, in competition with seventy-six other designs from all parts of the world. Mr. Ducker's model attracted much attention, and was very favorably commented upon by the medical and military gentlemen acting as judges. It is a representative American invention, for it combines in an eminent degree lightness and portability with strength and convenience. In recognition of his valuable services in the interests of humanity, Mr. Ducker received a silver medal, contributed by the Empress of Germany, and has also been honored by a message from the Emperor congratulating him upon the excellence of his design. He is now in correspondence with several European governments, with reference to the adoption of his "baraque" in their respective countries.

The merits of Mr. Ducker's design lie in the care with which all the details have been worked out, for, apparently, no condition has remained unsatisfied.

We show in our illustration an exterior view of the baraque, as set up for use, its appearance when loaded on a truck ready for transportation, the medal awarded by the Empress, the interior of the baraque when used as a hospital, the manner of erecting the structure, and the details of its construction. The main building is 34 ft. long and 17 ft. wide. The height is 10 ft. 3 in. at the ridge pole, and 6 ft. 6 in. at sides. It is built in sections, for convenience in transportation, and can be put up without the use of nails or screws. Two men can erect the baraque without the least difficulty, and in little more than an hour's time, as all the parts lock into each other and are perfectly interchangeable. Each side consists of six double sections. These are made of strong, light frameworks of wood, hinged together, and covered on the outside with leather board or other light, waterproof material.

To each double section there are attached, as shown, a bed, table, and chair, while in the panel over the table there are a glass window sash, opening inwardly, and a slatted shutter opening outwardly. During transportation the hinged section is shut together, inclosing these several articles and protecting them from damage. The end of the baraque is also made in sections. The ridge pole is divisible into two or three parts, and is provided with suitable slots, into which the rafters are keyed. When the structure is set up, a standard army duck roof extends over all. The floor is made in similar sections, which key into the sides and into a central longitudinal shaft. The floor being 8 inches above the ground, all dampness is avoided. The central shaft is provided with three registers, and may be used either for hot or cold air, or for disinfectants. Ordinary inequalities in the ground are provided for by adjustable feet attached to the side sections and to the floor. In addition to the main structure, there is a small annex at each end, to be used for heating and other purposes.

Each baraque, it will be seen, thus gives sleeping accommodation for twelve men. Every provision has been made for the comfort of the invalid. A rope suspended from the rafter over the bed permits him to raise himself; a chair back is provided when he wishes to sit up; a small slate is tacked over the bed to receive any memoranda the physician or nurse may want to make. In short, the baraque is remarkably complete. And yet, when ready for transportation, it weighs, with all its furnishings, only about 2,500 pounds, and has the great advantage of being all in large pieces. There is absolutely nothing to get lost, for everything is fastened securely in place. It is also probable that the baraque will be utilized to some extent by the health authorities of several American cities, in order to provide comfortable temporary hospitals in case of epidemics. It furnishes, indeed, pleasant accommodation for a number of purposes, where shelter of a temporary or semi-permanent character is required. The inventor is to be congratulated for the distinction he has won in the face of European competition and for the material aid he has rendered to those whose mission it is to save life.

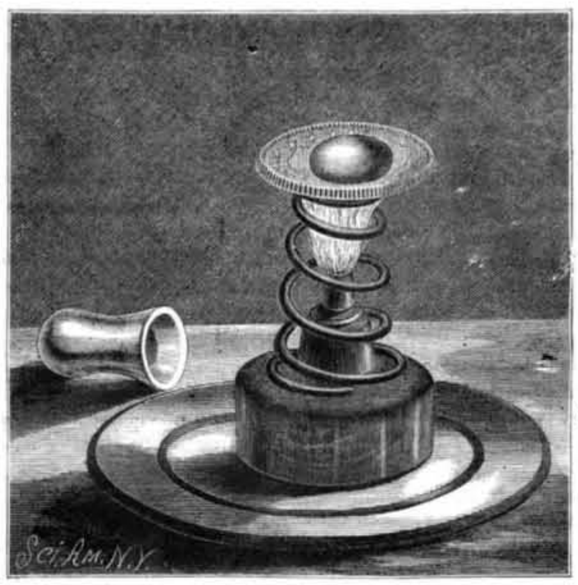
THE SPHEROIDAL STATE OF WATER.

T. O'CONOR SLOANE, PH.D.

Water, when not in contact with anything, or when the force of adhesion is not called into action, generally may be said to assume the spheroidal state. This means that it gathers itself together into a mass approximating more or less closely to the shape of a sphere. In the experiments with lycopodium, illustrated in our last issue, an instance of this was shown where solid globules of water rolled about freely upon a surface strewn with the substance in question, and preserved a shape approximating to that of a sphere. These globules were in the spheroidal state, strictly speaking, but not so in the usual application of the term. It is commonly restricted to those cases in which a high temperature in the immediate vicinity of a mass of water is the proximate cause of its assuming this form.

Every one has noticed that when drops of water fall on a hot range they do not spread out and evaporate, but, instead, form little balls and roll about on the hot metal until they disappear or roll off. The hotter the range, the more perfect is this effect. The experiment illustrated in the cut is the development of this phenomenon.

A cup of bright metal, preferably of considerable thickness, is to be provided. This is most readily made



THE SPHEROIDAL STATE OF WATER.

out of a silver coin, a quarter or half dollar or a silver or trade dollar. The coin is placed over a hole, bored through a solid piece of wood, the hole being of nearly its own diameter. A piece of hard wood, cylindrical, with rounded end, is held with its rounded end upon the coin and driven down by several hard blows with a hammer. This hollows or cups the coin. If a silver dollar is used, it should be hammered until a cup nearly a quarter of an inch deep is formed. A quarter dollar will answer if an eighth of an inch in depth.

A support has now to be provided, and this is readily made out of wire. In the cut a helix of somewhat heavy wire acts as standard. For heat, an alcohol lamp may be used, and it is for such that the spiral support is especially adapted. But there is no necessity for an alcohol flame. A common gas flame will do perfectly. In this case the cup can be held in a cleft piece of wood, which will last some time before it is completely destroyed by the heat. The arrangement shown is very neat. The spiral is made of such size as to fit snugly around the neck of the lamp, and is open enough not to seriously interfere with the flame.

When all has been thus arranged, the lamp is lighted. After a few minutes' burning the wire will frequently begin to show a red heat in its upper coil. But before this occurs the cup may be considered ready. A little water must be poured into it, a teaspoon being a convenient implement for this purpose. Instead of at once beginning to boil, as might have been expected, the fluid collects into an oblate spheroid, and, rolling about from side to side, lies upon the hot surface without a sign of boiling. As long as the lamp is lighted this continues, except that the globule grows smaller and smaller, and after a considerable interval disappears.

However familiar with the phenomenon, it is difficult to avoid the impression that the lamp is at fault, and that the coin is not hot enough to evaporate the water faster. But this is corrected by observing the anomalous form that the water assumes, and by the second phase of the experiment, that shows itself when the lamp is extinguished. The cup is to be made quite hot, and a large globule of water introduced, and the lamp extinguished. For some time nothing new is seen. The globule rolls about restlessly from side to side as before, until the heat falls sufficiently, when it suddenly loses its shape or collapses, fills the cup, and bursts into violent ebullition. If all is rightly proportioned, it will boil away completely, leaving the cup dry. In other words, the cup will not boil water until it becomes cool.

The explanation is not so simple as it was formerly considered. It was in the older textbooks asserted that the water rested on a cushion of steam, and so did not come in contact with the metal. This is measurably true, but the present theory is a modification of this, and asserts that it rests on a "Crookes' layer" of steam—a layer whose molecules beat back and forth from metal to water, and so prevent them from touching each other. It is known that they do not touch, as light can be seen under the globule when a flat plate is used in place of a cup. But if a mere steam cushion were the separating agent, it would not be clear why it is not squeezed out, requiring more and more steam to replace it, so as to exact a most rapid evaporation of the drop, instead of the slow one that actually takes place. The Crookes' layer, with the disposition of the component molecules to vibrate or oscillate in straight lines, does away with much of the difficulty.

The peculiar condition of water has often been invoked to explain boiler explosions. The assumption was, that in such cases the water by excessive heat was kept from contact with some of the plates until the heat fell enough for contact to be established, when the rapid evolution of more steam was supposed to effect the explosion. If, however, the relative weight of a boiler and the water contained are considered, as well as the high specific heat of water and the low specific heat of iron, the explanation will appear a very poor one.

Many other substances can be brought into this state, water being by no means the only one. Even solids rapidly subliming may form and rest upon a similar protective Crookes' layer. Thus solidified, carbonic acid gas may be held in the hand or in the mouth without injury, because there is no contact. If by pressure such contact is established, a severe "burn" is produced by the intense cold. The solid is continually evolving carbonic acid gas, that maintains a Crookes' layer and prevents it from touching the skin.

By use of a powerful lamp and larger cup, considerable amounts of water may be thus treated, and the experiment performed with increased effect. In such cases, a very peculiar phase is the increasing violence of the final ebullition. If the cup is of heavy metal, the boiling that begins slowly grows more and more violent, until the water is exhausted, or nearly so, producing a regularly increasing or crescendo sound. The general proportions given by the coin cup described may be followed in making larger ones, and copper may be used instead of silver, with good results.

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For a Rust Joint.

For making a rust joint that will bear heat, cold, and rough usage, the following formula has been highly recommended: Ten parts iron filings, three parts chloride of lime, and enough water to make into paste. Put the mixture in between the pieces to be joined and bolt them together, leaving until dry. After twelve hours the cement has been known to break off the solid iron.