A QUAINT DIVING APPARATUS OF THE EIGHTEENTH CENTURY.

BY C. FIELD.

The diver in his round goggle-eyed helmet, leaden-soled boots, and bloated-looking India-rubber suit, is a more or less familiar object at our great seaports, especially those which are the headquarters of the Royal Navy. The diver is a recognized member of the ship's company of every man-of-war of the present day, and a very useful person he is, well earning the extra pay which is bestowed on him when his services below water are required.

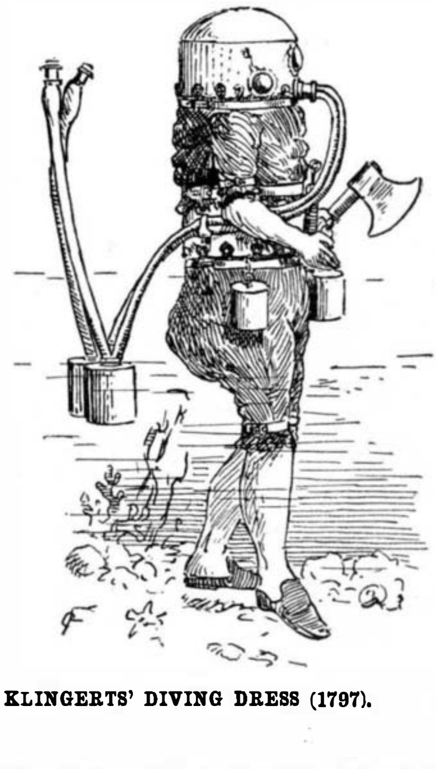
This, by the way, is not a new thing in one sense, for in the records of the Spanish Armada there is mention of a "diver" being sent from one ship to another. But this diver was probably only a man who was expert in swimming and diving, and not provided with a special diving dress enabling him to stay under water for long periods. Still, it would seem that there have been attempts to provide such a dress from very remote periods indeed. Old medieval manuscripts now and then give drawings of more or less impossible costumes directed to this end, and in many of them pipes to convey air from the surface to the diver's mouth are clearly represented. Probably, though, most of these were never really constructed or experimented with, and may rather be received as the author's ideals of what in his opinion might be invented. It was probably some contrivance of this kind that the famous Friar Bacon had in his mind when he asserted, as he did in his writings, that he could travel on the bottom of the sea with the same ease and safety as he could on dry land! A German, Francis Kessler, writing in 1617, describes what he terms a suit of "diving armor," showing that the necessity for protecting at least some portion of the body against the pressure of the water was beginning to be recognized. Again, there is a very "tall story" in Martin's "Philosophia Britannica" about a man down Devonshire way who invented some species of leathern diving dress which contained half a hogshead of air as well as himself. So successful was this invention, according to the above account, that he could walk about at the bottom of the sea, explore any wreck, and "deliver out the goods." He is stated to have carried on this business for a number of years, and amassed a large fortune thereby. But here in our illustrations we have what seems to have been a really practicable diving apparatus, which may well have formed an important step in the evolution of our modern and perfected diving dress. It was invented toward the end of the eighteenth century by C. H. Klingerts, of Breslau in Prussia, and it is related that a "huntsman" of the name of Joachim descended into a deep and rapid part of the River Oder clad in this dress on June 24, 1797, where he sawed and cut up logs of wood and showed how things could be attached to tackles below water and then hauled to the surface.

The armored portion of the dress consisted of a peculiarly-shaped helmet and a species of body cuirass. The former was constructed of copper and strengthened by iron bands on the inner surface; the latter was made of tin plate similarly strengthened.

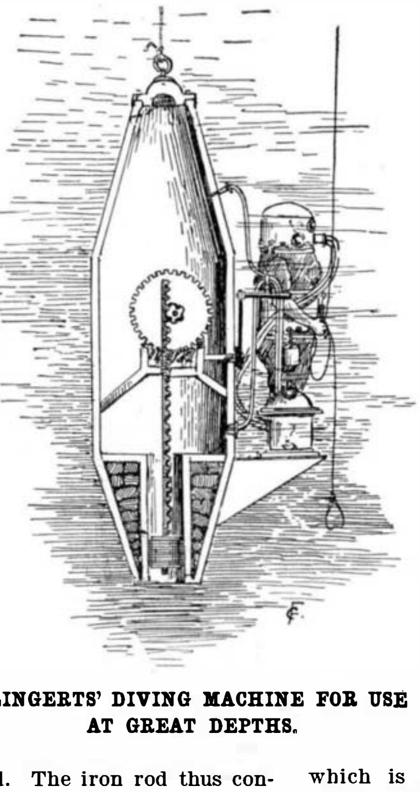
The flexible part of the dress was made of waterproofed leather, and the tubes for the supply of air were also leather sewn around coiled brass wire. Each air pipe was fitted with a cylindrical receptacle for the moisture arising from the condensation of the breath, which are shown at the back of the figure in the accompanying sketch. Weights were suspended at the diver's waist in order to preserve his equilibrium when under water.

This constituted the ordinary diving dress as invented by Klingerts; but in order to make sure of a copious air supply when working at exceptional depths, the inventor contrived a special apparatus for use in combination with his diving dress, which is shown in the second drawing. This consisted of a reservoir of considerable size, made of stout metal. It was in the form of a cylinder with conical ends, and had a bracket or platform at one side of it on which the diver stood and on which also was placed a lantern for the illumination of his work on the sea floor. The whole affair, complete with the diver in position, would just float, its weight being about equal to the volume of water it displaced. It was ballasted in the lower part to keep it in a vertical position. When the diver wished to descend, he hove round on the winch handle beside him, which by means of a worm pinion revolved the wheel in the center of the machine, which in its turn pulled up a piston which moved in a cylindrical opening at the base of the apparatus, and so decreased the volume of air in the interior and caused the machine to descend. A reversal of this process was necessary when the diver wished to return to the surface. This peculiarly-shaped reservoir contained air enough to keep the diver supplied for the space of two hours. When it came above water, a lid or cover at the top was removed, the vitiated and exhausted air was pumped out by means of bellows and fresh air allowed to replace it, the cover was fastened down, and the machine was once more ready to dive.

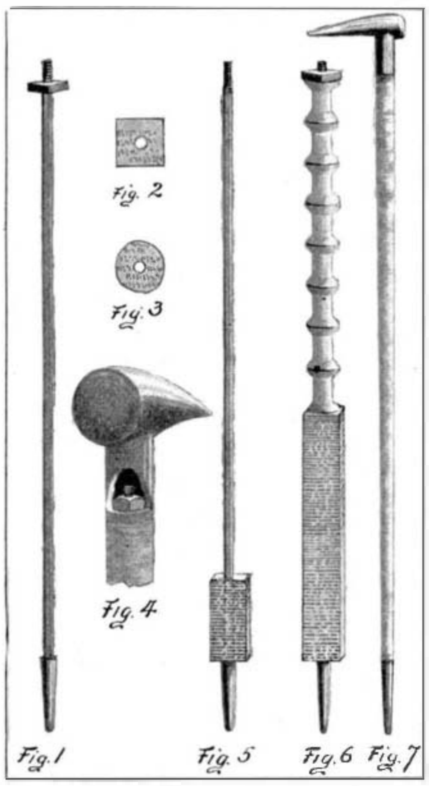
It was an ingenious piece of mechanism, but there does not appear to be any record of its use. It is interesting to note, by the way, that the principle of rising and sinking by enlarging and reducing the bulk of air in the machine was one that had been suggested as long ago as the reign of Elizabeth, when an ex-naval gunner, William Bourne by name, proposed it for a submarine boat that he designed, and it was tried not many years back in the Campbell-Ash submarine boat, one of the many attempts made toward the end of the last century to solve the problem of submarine navigation.



KLINGERTS' DIVING DRESS (1797).



KLINGERTS' DIVING MACHINE FOR USE AT GREAT DEPTHS.



HOW A CANE WAS MADE OUT OF COPIES OF THE SCIENTIFIC AMERICAN.

HOW TO MAKE A PAPER CANE.

A convict confined in the Utah State prison has sent to the Editor a handsome paper cane, which, he states, was made from old copies of the SCIENTIFIC AMERICAN. The tools by which this cane was made are so few and the method employed is so simple that a boy with a little patience can produce similar canes out of old papers.

The core of the cane is a steel rod of octagonal cross section, ¼ of an inch to 5-16 of an inch in diameter, and about 3 feet in length. One end of the rod is threaded to receive a nut; the other end is provided with a ferrule of iron or steel. The iron rod thus constituted is shown in Fig. 1.

The paper to be used is cut into pieces about one inch square. By means of a hollow punch each piece of paper is pierced with a hole, the diameter of which corresponds with the diameter of the steel rod. These papers are slipped over the rod, very much as bills are held on a file, the first piece of paper resting against the top of the ferrule, which is about ⅜ of an inch in diameter at the top. Fig. 5 shows the rod with the pieces of paper slipped upon it. When five or six inches of paper, equivalent to about 1,500 or 1,800 pieces, are held by the rod, the nut is used to compress them into a solid, uniform mass. Since the rod is screw-threaded but 3 or 4 inches from its end, and the nut is far removed from the pieces of paper, discarded cotton spools are slipped over the rod, as shown in Fig. 6, in order to enable the nut to compress the paper. As the nut is turned, the pressure is transmitted through the spools to the paper. The nut can be turned either by means of a wrench or by means of a horn handle, with which the cane is to be provided after it is finished. This handle as shown in Fig. 4, is made of solid horn, recessed at one end to receive the rod. The opening is squared to fit over the nut.

The square pieces of paper are rounded off by means of a knife and rasp to the desired diameter. The cane is next sandpapered and then polished with emery cloth. A coat of oil is now applied, which when dry is polished with pumice stone. The polish thus attained is heightened with a little raw oil; and the cane is finished.

In the SCIENTIFIC AMERICAN SUPPLEMENT No. 353 will be found another method of making paper canes, the principle of which is substantially the same as that employed in making the cane illustrated.

Cost of Electric Traction in Europe.

In a discussion on the Valtellina electric railway before the Elektrotechnische Verein in Vienna, Mr. Ross pointed out that the data furnished enabled one to make a trustworthy estimate of the cost of running railway lines by electricity generated by steam. The Valtellina line is worked on the three-phase system, and the energy supplied from the station, including losses of every kind, has amounted to 50 watts per gross ton-kilometer.

The southern railway system of Austria is of a very similar character to the Valtellina line, and during the year 1900 the gross tons-kilometers amounted to 4,468,932,400, and the number of locomotive kilometers was 18,576,000. Assuming the electric locomotives to weigh 50 tons each, the gross movement on this line if electrically worked would be 5,955,012,400 tons-kilometers, which at 50 watts in the station per ton-kilometer would require 269,886,620 kilowatt-hours. At the outside a kilowatt-hour, including all losses, would be supplied at a steam-driven station for 1.2 kilogrammes (2.64 pounds) of coal, corresponding to a yearly consumption of 324,000 tons. Actually, the steam locomotives take 391,960 tons of coal per annum, so that with electric driving there would be a saving of 20 per cent in the annual fuel consumption.

As our readers know, the Valtellina line is worked on the three-phase system, the current being supplied to the motors at 3,000 volts. Both electric locomotives and electric motor-cars are run over the line, the passenger service being worked by the latter. These cars have four motors arranged for working in cascade. The main motors, working alone, drive the car at a speed of about 40 miles per hour; the normal speed with the motors in cascade being half this. The normal tractive effort at 40 miles per hour is 1.22 tons, but the maximum goes up to 3.74 tons, and with the motors in cascade a maximum tractive effort of 5.4 tons is obtainable. This cascade coupling of the motors is used in starting the trains, and also in working up a long incline at Chiavenna, where there are 3.1 miles of line with a gradient of 1 in 50. The locomotives are not arranged for working in cascade; they have four motors, and are designed to run at a normal speed of 18 to 19 miles per hour, which is maintained constant up hill and down. The tractive effort at this speed is 5.2 tons, which at starting runs up to 9.6 tons. These figures are based on calculation, but actually it is found that the tractive effort is really much greater.

OLIVER J. D. HUGHES.

Among the workshop devices of recent origin, is a little attachment which makes an excellent pipe-wrench out of an ordinary monkey wrench. It is a little block of hard steel with toothed sides which is designed to be placed against one or the other of the jaws of the monkey wrench, being held in place by means of a small spring. It can be used in any position which is required of an ordinary pipe-wrench, side work, or in cramped quarters. If it is desired to pull the wrench toward the operator the attachment is placed against the upper jaw, but otherwise it is placed against the lower jaw. It is said to take a firm hold on the pipe and to be very serviceable.