NOVEL LIFE-SAVING APPARATUS.

BY OUR ENGLISH CORRESPONDENT.

Experiments have been carried out in the port of Hamburg with a novel apparatus devised by a German inventor for rescuing sailors who have fallen overboard. The results have proved so completely satisfactory that it has since been adopted by the German Admiralty, and arrangements are now being completed by which every naval vessel will be equipped with one or more of these appliances. The apparatus, as may be seen from the accompanying illustration, is of a very simple character, comprising a cylindrical cage, built up of rope ladders disposed around the periphery of the circular framework. There are in all six of these ladders anchored top and bottom to iron hoops and with a supporting hoop midway between the end pieces. When extended in the manner shown, the cage is about 13 feet in height by some 4 feet in diameter.

The floor of the cage is built up of rope netting of fairly close mesh, to afford an easy foothold, while at the top the rope side members of the ladder are continued to form a cone terminating in an iron ring, by means of which the whole apparatus may be slung from a hook working with a block and tackle. When not in use the whole folds up into a small space, collapsing much after the same manner as a Chinese lantern, so that it can be stowed away in any convenient spot.

In the case of an accident, such as the capsizing of a pinnace or a sailor falling overboard, a davit or spar carrying a block and tackle is run out over the ship's side and the pulley rope made fast to the top of the cage, which is then thrown toward the scene of the accident. The act of throwing causes the cage to distend to its fullest extent, so that the man in the water can grasp either a rung of one of the ladders or climb to a position above the water on the outside of the cage, the hoisting tackle being manipulated so as to keep a sufficient length of the cage well above the water, so that the rescued man can secure a safe position. The advantage of the apparatus is, that it can be used for saving a number of men simultaneously with the least trouble, being simply thrown in their midst, when it is easily grasped by all, so that the risk of drowning is minimized. Even in the event of one or more of the immersed men being non-swimmers, risk of drowning is reduced, since the appliance can easily be hauled toward the helpless by one who is a swimmer, or trained toward the spot by means of the spar tackle to which it is attached. For use in tropical waters, where the seas are infested by marine foes, it is especially useful, since there is sufficient space between the ladders to allow rescued persons to make their way into the interior of the cage. This done, the cage with its human freight is simply hauled up out of the water by the block and tackle, swung round, and safely deposited upon the deck.

It will thus be seen that the device is very simple, both in design and operation, and that it dispenses with all preliminaries. Upon large warships it can be stowed, with the hoisting rope attached, in various out-of-the-way places on the upper deck, ready for instant casting overboard by hand. The rope can be attached to the spar block and pulley tackle while the drowning are grasping the appliance, and the device immediately hoisted and swung inboard. The central hoop not only prevents the rope ladders from bulging or becoming entangled, so that when thrown out the cage expands immediately, but it is also useful for the attachment of a steadying line held from the deck during the hoisting and hauling-in operations.

ROAD BUILDING BY THE UNITED STATES IN CUBA.

BY WILLIAM ATHERTON DU PUY.

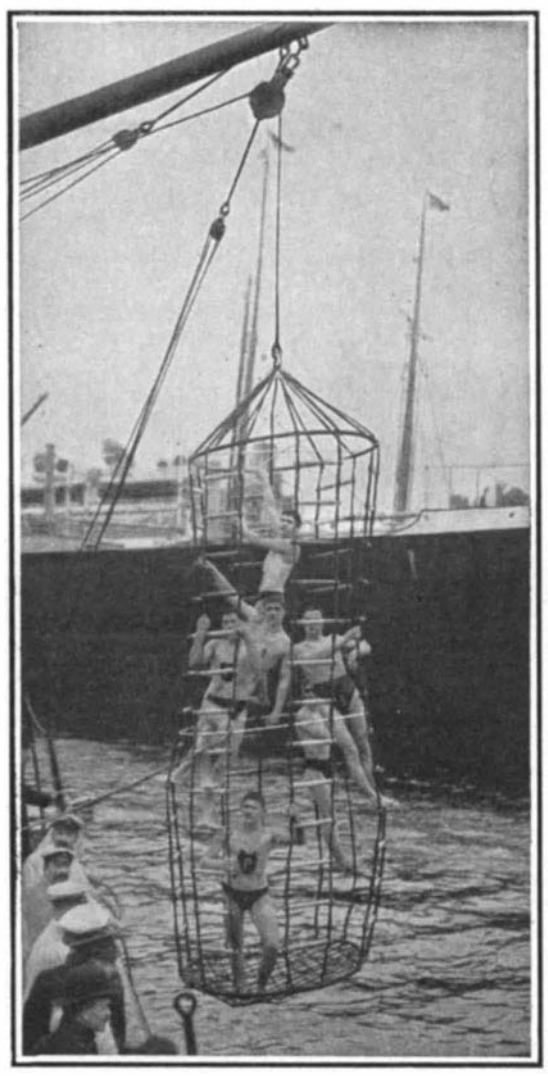
Were the people of the six provinces of the island of Cuba to lay about them in search of a fitting memorial to be erected to the provisional government so recently brought to an end in that West Indian republic, they might go far and fare worse than in carving a traction train in bas-relief around a concrete pedestal bearing a road roller rampant.

This because of the fact that one of the greatest accomplishments of the *régime* of the provisional governor, Charles E. Magoon, representing the United States, has been the opening up of the island from end to end, and in a dozen places from coast to coast laterally, with excellent macadamized roads built on the most approved modern principles. Some of these roads follow the course of old ones that had been graded in a desultory way by preceding Spanish and Cuban administrations; but for the most part they replace cart-cut tracks through the thickets, that were barely passable in dry weather and entirely useless during the long rainy season. They replace the pack-train of donkeys with the automobile, and bring easy communication to the fertile acres of the entire country, much of which has been hitherto completely isolated. They open up the arteries of trade to sections that for hundreds of years have stagnated for a lack of ability to get their produce to market.

When Governor Magoon went to Cuba and began looking about to find in what manner he might permanently benefit the people and lift them from the deplorable financial condition in which he found the mass of them, he immediately hit upon the matter of roads. He argued that the island could not prosper unless it were given an opportunity to get to market its tobacco, sugar, and fruits.

Despite the poverty of the people, he found that there was money in the treasury of the government; for the revenue sources of the nation yielded funds plentifully. There was, in fact, $13,000,000 in the treasury, and its disbursement for the greatest benefit of the quasi-republic was placed in the hands of the governor. His decision was for roads, and there was a short shift before he got actively to work.

The old roads had come into being when the pack trains followed the winding trails of the cattle; and the carts eventually followed these. In laying them out there was no disposition to follow the shortest line between two points. There were no bridges over the streams, and the freshets constantly washed out the palm trees that the natives threw into the river beds to make a crossing possible. For a considerable part of the year no wheel could pass these roads and pack trains floundered through mud holes up to the stirrups. All gayly caparisoned, the animals burdened with foolish saddles that were a load in themselves, and led by the "bell jack," these pack trains often be-



HOISTING AND SWINGING LIFE-SAVING CAGE TO SHIP'S DECK.

came pitiable spectacles before the journey's end was reached.

The Cubans also use a most unserviceable cart called a *carreta*—a large, clumsy, two-wheeled affair capable of bearing a heavy load. Its chief drawback is its tire, which is particularly narrow, and cuts deep into the muddy road. The wheel is set loose on the axle, and when the driver finds himself stuck, he rocks the affair back and forth until the wheels by their motion have dug themselves out, when he drives on, leaving the trap he has made for the benefit of the next traveler. From two to ten oxen are used on these carts to pull a load that should be readily handled by two mules; and days are taken to make trips that should be accomplished in hours.

The provisional governor realized the unusual difficulty of building permanent roads in Cuba, where the rains are torrential and the wet season lasts from May to November and the dry season from November to May. The conditions demanded that if the road was to last it must be above all a good road. The roads were laid out approximately as the crow flies, from Santiago de Cuba at the extreme east end of the island to Los Arroyos de Mantua in the west. At frequent intervals spurs were run to the coast towns on either side; and the whole was brought into one articulated system. The roads were graded in such a way that nowhere was the incline more than 6 per cent. The site was first plowed and leveled with an easy crown to the center. On top of this surface was placed six inches of rock in pieces as big as a man's two fists. Above this came four inches of broken stone the size of an egg, and then a final covering of fine surfacing stone, which filled all the voids. The road was then compacted by a heavy steam roller.

The cream and blue limestone of the country furnished the material for the roads. The roads are of a universal width of 34 feet, of which the pavement covers 16 feet. All the culverts are made of concrete. The bridges are modern steel structures such as the island never saw before. The right-of-way was ditched to prevent inundation, and swamps were drained where they interfered with the work. At intervals of fifteen miles there is a road house, at which is stationed a caretaker and the employees who maintain the road. Here also are being grown the trees that are to be set out all along the roadway; and which in this climate will in a few years convert it into an arch of dense, green-topped shade.

The work of the roads coming as it did at an opportune time, had a remarkable influence upon the people. They were in desperate financial straits and were threatened by all sorts of civil warfare. In the west, for instance, the latest of the revolutions, "The Little War," had broken out in August, 1906. The progress of hostilities in this section attracted to it the floating population which is ever looking for trouble. Just then work on the government road at good wages was offered, and friend and foe went to work side by side and hostilities were forgotten.

For two years the work of road building went forward unceasingly and the steady employment and the steadily added opportunity to market produce began to make themselves felt. From the weird valleys of Cabezas, Simidero, Luis Lazo, and San Carlos, the homes of the mythical *mogotes*, from which comes the cream of the Vuelta Abajo tobacco, there is to be heard the song of prosperity. In the Mantezuelo valley, where grows the yellow tobacco leaf, so highly prized as wrappers, and which furnishes the Havana tobacco most used in the United States, the fertile lands are giving an ever-increasing yield of their choice product. The Ocean Beach tract, owned by Canadians, is supplying such fruit for export as it never produced before; and in Pinar del Rio the fields of sugar cane wave unmolested and the five great mills grind without cessation. Everywhere new life has been given to the country, and it has largely come about through the roads which are an asset that even revolution may find itself unable to destroy.

The construction of these excellent roads has made Cuba particularly attractive to automobilists and particularly to those of the United States who wish to follow the pastime during the winter months. A typical highway is to be found in one of the cross roads that leads from Pinar del Rio through the far-famed Viñales Valley to the seaside at Esperanza.

The road winds through rich fields of tobacco dressed in vivid green, and passes patches of yucca, malanga, and sweet potatoes. By the side of the streams and under the shade of the mango and aguacate trees are the huts of the natives with naked brown children running about, and lustrous-eyed *señoritas* flirting with the task of keeping house. Higher up, the hills grow more precipitous, and one marvels at the steep cliffs upon which are clinging the native huts, and at the patches of cultivated land, access to which can be had only by climbing ladders. But this is the particular soil which gives to tobacco that quality so highly prized by connoisseurs, and it is worth the many inconveniences of access and residence involved in its cultivation.

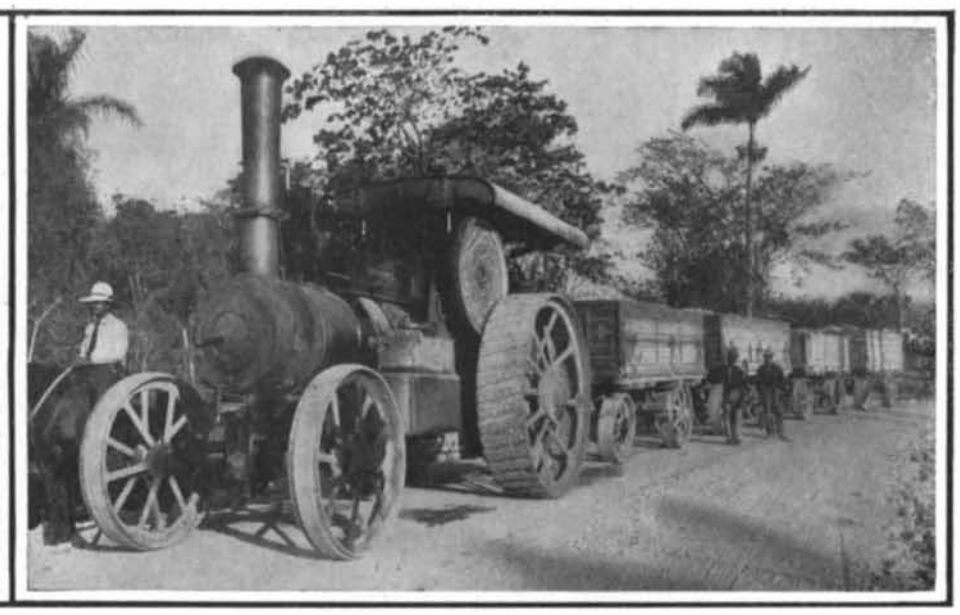
The wonderland, however, lies beyond the crest of the divide, and beyond the bloody field of the Battle of the Guias from which blood trickled into the clear streams below in 1896. For, around a sudden bend, one drives abruptly into the Valley of Viñales, nestling among those peculiar monolithic mountains that the natives term *mogotes*, and which the geologists declare to be unequaled in their class the world over.

The *mogotes* are huge limestone pillars, hundreds of feet in height, which stand sentinel-like on the plain, solitary, isolated and seemingly altogether out of place in such a gentle landscape. Strange tales are told among the natives of the mythical origin of these columns; but the scientist tells a story that is little less strange in its import. He says that once, in the long ago, there was a huge cave in what is now this valley, within which great stalactites and stalagmites were formed, which, uniting in the course of ages, formed massive pillars that supported the roof of the cave. As the ages passed the surface was eroded and finally the roof fell in. Passing time wore away the soil, the hills disintegrated, and the general level was greatly reduced. But the pillars were made of sterner stuff and have remained.

In the valley itself the *veguero*, as the tobacco grower is called, has cultivated his field in patchwork fashion. His thatched hut stands in crannies under the cliffs or, again, bravely out in the open, a dot in the plowed ground. Roads and bridle paths line the level surface of the valley. The place looks like a child's sand map, decorated with stiffly straight trees.

The Old Way.

The Cuban driver is not alarmed at the predicament of his cart here pictured, which is mired within reach of the new road soon coming to his rescue via the big bridge just up.



A traction train on an American-built road.

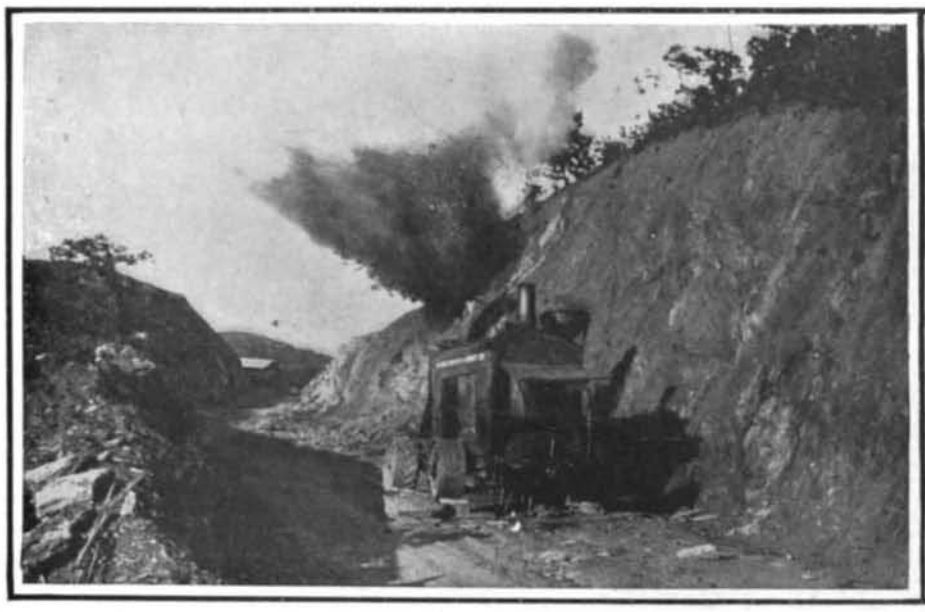
The present provisional administration inaugurated, in the spring of 1907, the present plan of improvements, making use of previous studies and modifying them to meet modern requirements.

A typical bit of old road, worn wagon-deep.

View on the route of the new Luis Lazo-Guane highway, at a point twelve miles from Guane, near the Macurijes River. To the right are typical huts of tobacco growers.

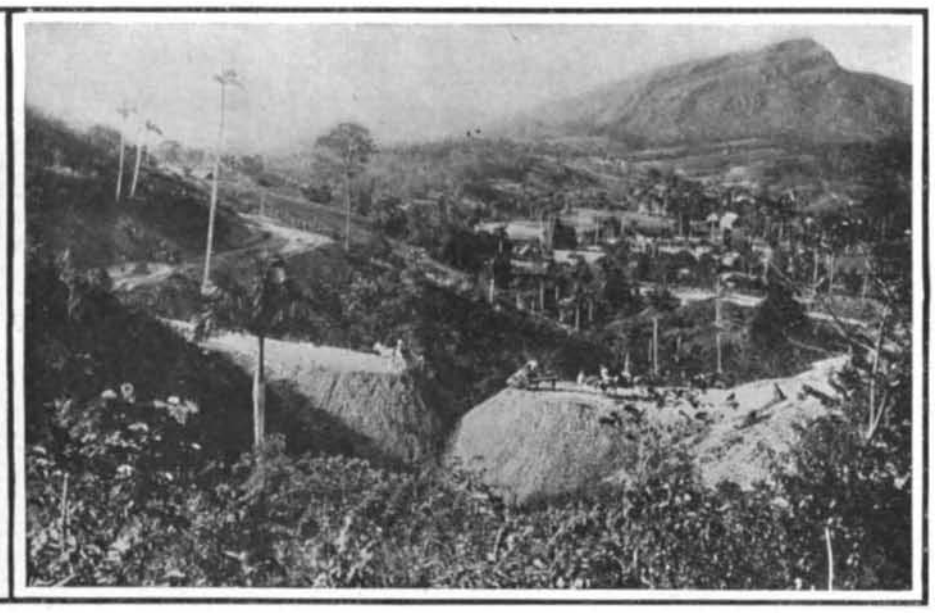
On the Pinar del Rio-Viñales-San Cayetano-Esperanza road.

Limestone cliffs flanking the hills of San Vicente. This is tobacco country; not genuine Vuelta Abajo, but semi-vuelta; so good that few save most discriminating smokers detect the difference.



Between kilometer posts 10 and 18 on the Pinar del Rio-Luis Lazo road.

A deep cut. Crossing the hills between Pinar del Cerro by a road whose grade does not exceed six per cent.

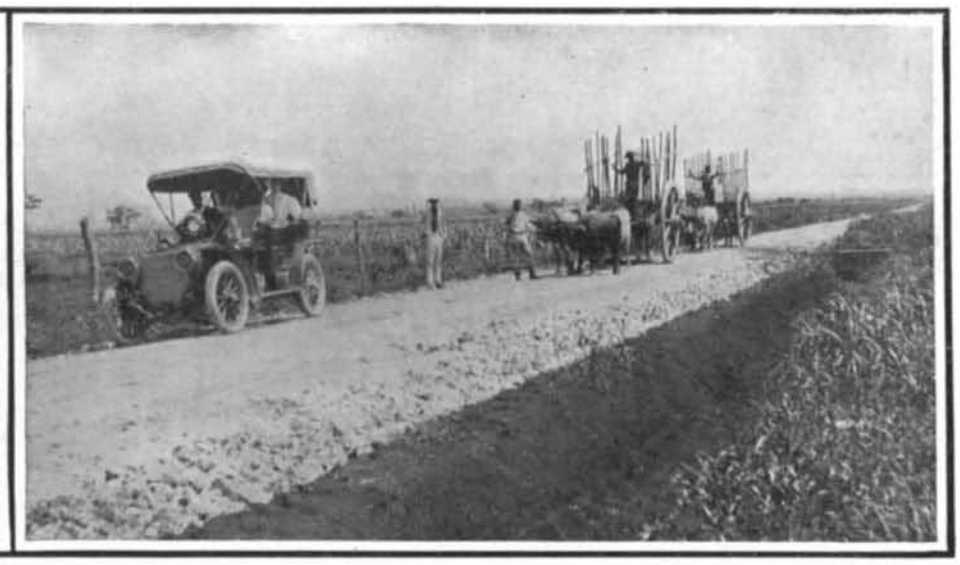


Cut and fill between kilometers 10 and 18, Pinar del Rio-Luis Lazo road.

Note the fertile patches of cultivated land in the bottoms. The old means of transport was by pack train. Even the bullock carts abandoned the roads.

On the Pinar del Rio-Viñales-San Cayetano-Esperanza road.

The road here lies in the level country between the Organos and the north coast.



The Duran Road across flat lands approaching Batabano.

The old makes way for the new—the ox cart for the touring car. Cane fields on either side

ROAD BUILDING BY THE UNITED STATES IN CUBA

In the midst of the valley is the town of Vañales, red-roofed, white-pillared, and incredibly clean and prosperous. It has its church and its barren square; its wide streets cross at right angles. Beyond the town the road leads on through La Abra (the gap) a narrow gateway opening into a smaller vale similar in its characteristics, and so on to the sea, a wonderland of quaint and queer arrangement of man and nature. This valley is typical of the fair land that the United States has brought into peace, serenity, prosperity.

PHOTOGRAPHING ANIMALS UNDER WATER.*

BY PROF. JACOB REIGHARD, UNIVERSITY OF MICHIGAN.

Attempts to photograph submerged objects with a camera placed in air can result in only partial success, and this but rarely. Failure is due to the fact that the photograph is made through the surface of contact of two media, water and air, of very different refractive powers. If this surface is not perfectly smooth the light from an object beneath it is, upon emergence, refracted unequally at different parts of the surface and can not form a clear image on the ground glass. Whether the water is smooth or rough its surface reflects a part of the light which strikes it, and thus acts as a mirror. This reflected light makes it impossible, except under unusual conditions, to obtain photographs of submerged objects. To obtain such photographs the surface of the water must be smooth and light reflected from it must not enter the camera.

If the camera with which submerged objects are to be photographed is to remain above the surface of the water means must be found (1) greatly to reduce the amount of reflected light entering the camera from the surface of the water, and (2) to render the surface of the water smooth. We may consider first the case in which the surface of the water is smooth, so that it is necessary merely to minimize surface reflection.

The method to be described is best adapted to objects in water not more than two or three feet deep, and the best results are obtained when the water is less than a foot in depth and when the camera is one that can be focused. Since the objects to be photographed are usually in motion, and since the surface of the water may at any time be roughened by a puff of wind, it is best to use a lens of a speed not less than *f* 8. The operator should first select the point from which the picture is to be taken. He should, of course, have the sun at his back or to one side. If possible he should stand on the bank or on some fixed support which extends above the surface of the water.

If the operator is unable to find a fixed emergent support he may make the exposure while standing in the water. The camera may then be held in the hand or may be supported on a tripod which rests on the bottom. As the legs of the tripod are likely to sink into the bottom they should be extended to their full length. Where the bottom is firm an elevated position may be obtained for the camera by using a tripod with legs some 10 feet long, such as dealers sell for use in making pictures of large groups. In such tripods one leg forms a ladder by which the camera may be reached.†

When the operator has placed his camera and roughly adjusted it, he should set up a screen to cut off the light reflected from the surface of the water into the camera. Any piece of dark fabric, a blanket, shawl, or for small objects even a coat, may be used.

The screen is mirrored in the surface of the water. The object to be photographed should fall within the limits of this mirrored image as seen from the camera. If it does not, the screen or the camera must be shifted until it does. The operator will see also the shadow of the screen. This should *not* fall on the object to be photographed. The screen should, if possible, be adjusted by slanting it or by moving one of the poles so that the sun strikes it nearly edgewise, but yet does not strike that face of it which is toward the camera. If this adjustment is properly made the shadow of the screen is a very narrow band, which lies beneath the screen and a little nearer the camera than its lower edge. The full sunlight then falls on the object while the rays from distant objects which would otherwise be reflected into the camera from the surface of the water are cut off. If the sunlight is permitted to fall on that face of the screen which is toward the camera, it is reflected from the screen to the surface of the water and thence into the camera. A picture taken under these conditions may show, besides the object under the water, also the screen itself, although this image of the screen is usually so faint that it does not interfere with the use of the picture for scientific purposes.

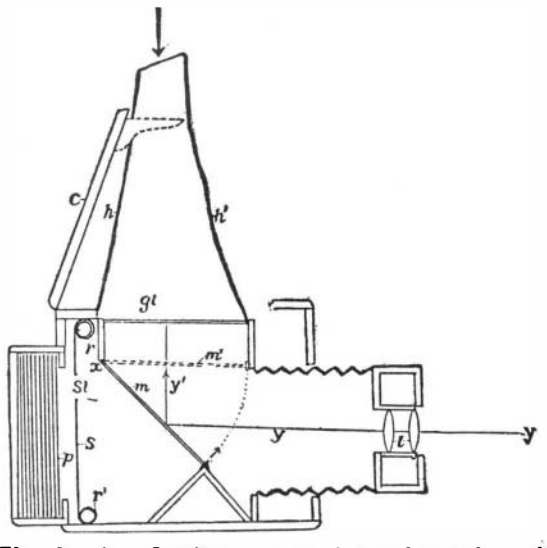


Fig. 8.—A reflecting camera shown in section with magazine plate holder attached.

gl, Ground glass; *h*, *h'*, hood; *l*, lens; *m*, mirror in position during focusing; *m'*, mirror, showing position during exposure; *p*, sensitive plate; *r* and *r'*, rollers of focal plane shutter; *s*, the shutter; *sl*, slot in shutter; *x*, hinge on which mirror turns; *y*, *y*, *y'*, ray of light traversing the lens and reflected from the mirror to the ground glass.

When the screen has been properly set the operator has merely to adjust the camera and make the exposure in the customary way. If the subjects are fish they will usually have been frightened away, but if the fish are engaged in nest building or in some other occupation that attracts them to a particular spot, they will, in most cases, return after a time varying from five minutes to an hour. The operator has merely to remain quiet until this happens. The photographer may focus his camera on the spot to which the fish is likely to return and then withdraw and operate the camera from a distance by pulling a string or pressing a bulb when the fish returns. The method is of most use in securing photographs of the nests and habitats of fish in shallow water, yet the writer has succeeded by means of it in making some satisfactory photographs of fish on the nest.

If the surface of the water is not smooth it may be made so by a water glass, which may be constructed as follows: A square frame is made of heavy galvanized iron, and measures 3½ inches deep and 12 inches on each side within. One of its edges (the top) is turned outward three-fourths of an inch and then downward one-half inch to form a lip. This stiffens the frame and tends to prevent water from slopping into it. The lower edge of the frame is turned outward about half an inch to form a flat surface, against which the glass, 13 inches square, is bedded in aquarium cement. After the glass is in position four trough-shaped pieces are soldered to the sides of the frame and to one another in the manner shown in the figure. The free edges of these pieces project inward beneath the lower surface of the glass and support it. Before the pieces are soldered into place cement is placed between them and the lower face of the glass. The whole border of the glass is thus bedded in cement on both surfaces and at the edge. To protect the glass when not in use a flat cover is provided, which fits against its lower face. Such a water glass may be floated over the object to be photographed and a screen set up independently of it, or the screen may be attached to the glass itself. For the latter purpose a piece of half-inch band iron may be bent to form the three sides of a rectangle, 8 by 12 inches, and this may be riveted as a bail (Fig. 7) to the inside of the frame, about 8 inches from one side. The bail should turn on the rivets so that it may be depressed into the frame when not in use. A screen may be formed by raising the bail and tying a piece of black cloth from it to the opposite side of the frame. In shallow, running water it is desirable to support the water glass from the bottom in order that it may not sink so much as to displace or distort the object to be photographed. It may be supported on four iron rods which run through metal sleeves soldered to the four corners of the frame. The rods may be fixed in any position in the sleeves by means of set screws, and may project upward far enough to support the upper edge of the screen.

The writer has used water glasses of this type varying in size from 1 to 3 feet square. The size most suitable for field photography is 2 feet square, since this may be transported by hand.

The method described is suited only to shallow water, where the camera may be supported from a firm substratum. In deeper water the unsteadiness of the boat would interfere with the manipulation of a water glass or a screen. It might be possible, however, to construct a boat of which the water glass and the screen should form constituent parts. The method described permits only of views at angles of from about 48 deg. to 90 deg. to the water's surface. Since it is not practicable to place the camera far above the water at these angles or to use screens of very large size, the pictures that may be taken are of near objects and the field covered by them is of limited extent. If a water glass is used, the camera must be near it and the field is limited by its frame. The method is, however, the only one known to the writer for certain kinds of work.

A camera for submerged use made after the ordinary type must be securely closed before submerging it in order to protect the lens and the plates from the action of the water. While the camera is under water it is not possible to remove the plates or plate holder in order to substitute a ground glass for them. In subaquatic photography the objects to be photographed are all near, and if instantaneous work is to be done the lens must be very rapid. It is therefore important to be able to focus accurately on the ground glass under water, and this might be accomplished by using two identical cameras (twin camera) united so as to form one instrument. One of these contains the plates and has a lens provided with a shutter. The other camera carries the ground glass. The same focusing mechanism operates both cameras, so that when a sharp image is formed on the ground glass of the one an identical image strikes the sensitive plate in the other when the shutter is operated. One of the cameras serves merely as a focusing finder of full size. A camera of this type properly constructed of metal could undoubtedly be used successfully under water, though it has the disadvantage of being unnecessarily cumbersome and expensive.

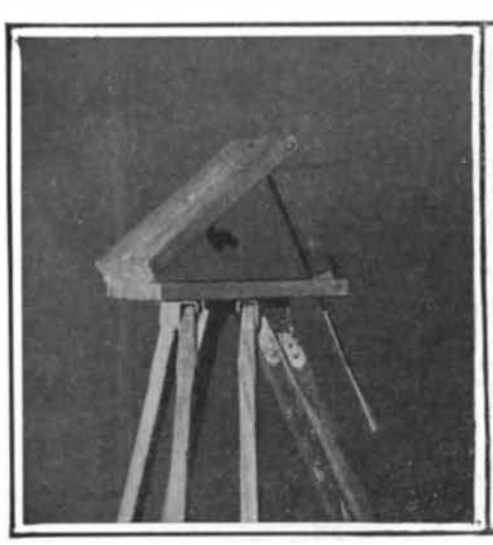


Fig. 5.—Tripod top by means of which the camera can be inclined at any angle.

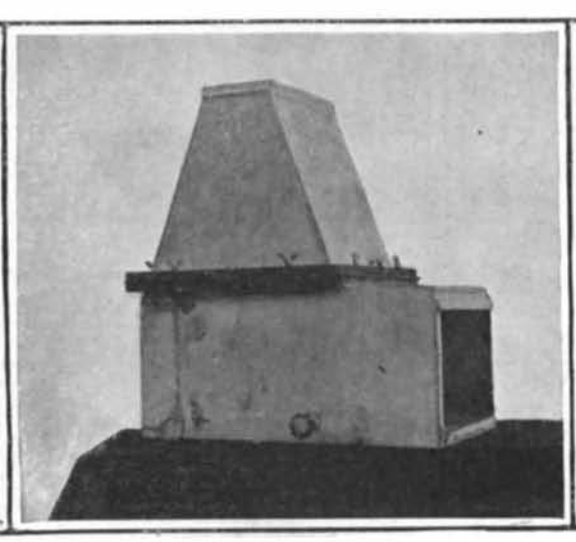


Fig. 6.—Watertight box to contain submerged camera.

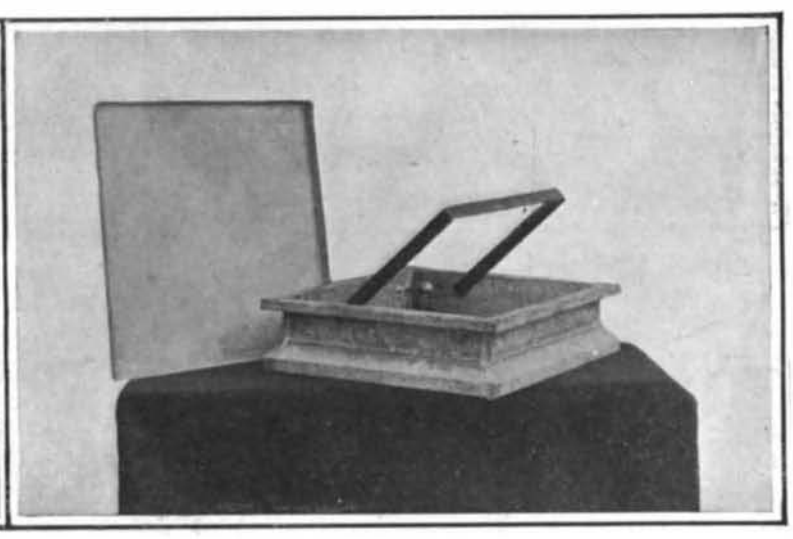


Fig. 7.—Reighard water glass for observation or photography of objects under water.

PHOTOGRAPHING ANIMALS UNDER WATER.

* Abstracted from "The Photography of Aquatic Animals in Their Natural Environment," a bulletin published by the Bureau of Fisheries. The complete bulletin will appear shortly in the SCIENTIFIC AMERICAN SUPPLEMENT.

† A detailed description of the construction of the tripod top will be found in the original.