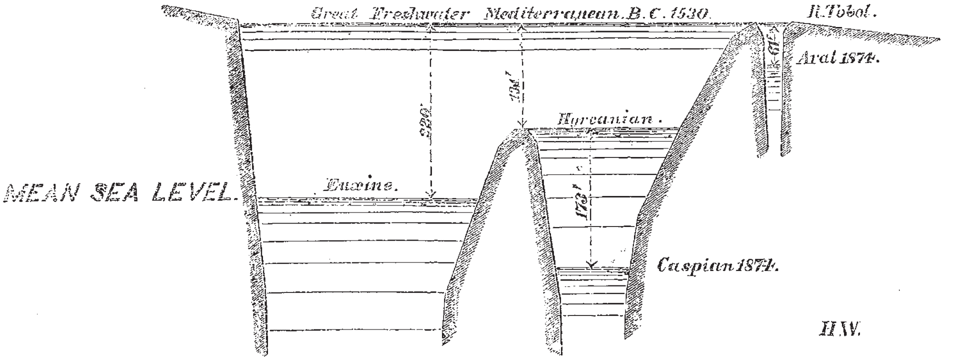
flow could still take place in a northerly direction also from Lake Aral. Some sixteenth century maps show the river Obi flowing out of the lake of Kitay, which is one of the names of Aral; and by such an overflow may be explained that supposed irruption of Ocean into Asia which the most ancient Greek and Latin authorities have recorded. Nor would the demonstration of the possibility of this overflow in any way affect the reputation either of Herodotus or of Aristotle, who both maintained the isolation of the Hyrcanian from the ocean; for the overflow from Aral might or might not have taken place during a series of years, depending as it did upon the magnitudes of the annual floods of the rivers which supplied it, at the epoch when the winter broke up, on the highlands of Central Asia.

It was estimated in the note on the Hyrcanian Sea that when the Oxus discharged directly westwards, the waterspread of Lake Aral and the lands drowned by its overflow might have added about 70,000 square miles to the area of 140,000 square miles, which is possessed by the Caspian of to-day. If 30,000 square miles be added besides, for the volume which Oxus, Ochus, and Arius probably supplied, the total area of the Hyrcanian Sea would have been about 250,000 square miles, which would have formed a waterspread almost reaching up to the ridge which divides the Caspian from the Black Sea, *i.e.* the level of the largest possible Hyrcanian Sea may have been 89 feet above mean sea-level, in the lowest of the two basins which formed it. The observations of Pallas have, however, placed beyond doubt that the ancient limits of the Caspian were situated at a much higher level than this; and since these limits, which are delineated in a map illustrating his works, did not owe their existence to the overflow from Aral, in conjunction with the volumes of water delivered by the rivers of the Caspian basin, they must have been formed by water flowing out of the Euxine basin. And this latter could not consequently have had at such a time a communication with the Mediterranean Sea.

We know that at the present day a very much larger volume than is required to compensate its surface evaporation is contributed by the various rivers supplying the Black Sea, and passes thence through the Bosphorus into the Sea of Marmora. Before this escape existed, the level of the Euxine would have been higher, and the surplus waters would have overflowed to the east by the channel of the Manytsch into the basin of the Caspian, whose level would, in turn, have been raised. The united waterspread of the two basins would have continued to rise, until the surface evaporation equalled the supply of water



it received; or until it found an escape into a lower level, and this latter circumstance was the one which almost certainly occurred, and in a northern direction.

The part of the ancient shore of the Caspian, which Pallas has delineated, and which is situated at a point called Cholon Komyr, in latitude 45° 30′ 25″, and longitude (east from Greenwich) 44° 51′ 34″, has a height of 221 feet above the sea (*b*). In other words, the great inland sea of fresh water, which extended from the western shores of the Black Sea to the eastern shore of Lake Aral, had its surface precisely on the level at which, it has been stated, there is a strong presumption that Lake Aral could overflow to the north and form a junction with the Frozen Ocean by the drainage lines of the Tobol and of the Obi. Under all the circumstances it is scarcely hazardous to say that this presumption becomes all but a certainty; and that the height of the low ridge, which divides the drainage on the north of Lake Aral, will eventually be found to be 220 feet or less, at its lowest point, above sea-level.

The actual original separation of the Aral and the Caspian may thus be referred to the rupture of the Bosphorus, and to that consequent rush of waters from the Euxine into the Mediterranean, which is known as the Deluge of Deucalion. The immediate result of this cataclysm would have been a fall in the level of the Caspian from 220 to 89 feet above the sea; and though actually isolated from Lake Aral, it would have appeared connected with it by marshes, alimented by the overflow of the latter basin. Though the Caspian level still continued to fall, from surface evaporation, the aqueous character of the intervening bed of the drained-off waters would thus have been preserved for a long time, and such a condition will explain the probable difference in physical aspect which would distinguish the long since desiccated Aralo-Caspian region if it were subjected once more to an overflow of Lake Aral. The cessation of this overflow would have, in the first instance, hastened the drying up of the higher levels of the intervening country, and accentuated to the Orientals upon the shores of the higher sea that isolation of the two basins which the Europeans upon those of the lower were not, and in fact could not be, acquainted with until very long afterwards.

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(*b*) See note (*a*).

GUN-COTTON WATER-SHELLS

IN the published accounts of Field Artillery Experiments which are just now being carried on at Okehampton, in Devonshire, considerable prominence has been given to the formidable nature of the so-called water shells, with which practice has been carried on against rows of targets, in the form of "dummy" soldiers, representing columns of infantry, shrapnel shells and common shells, filled with gunpowder, having been fired in comparison with them.

The term *water-shell* denotes not a shell of special form or construction, but simply a new system of bursting shells of ordinary construction, elaborated by Prof. Abel nearly three years ago, by which the breaking up of cast iron shells into a large number of fragments and their dispersion with considerable violence is accomplished by filling the shell with water instead of with an explosive agent.

In a memoir communicated by Mr. Abel to the Royal Society in 1873,* it was pointed out that detonation was transmitted from a mass of dry compressed gun-cotton to distinct masses of the material saturated with water and separated from each other and from the detonating (or "initiative") charge by small spaces filled with water, the whole being enclosed in a case of stout wrought iron; and Mr. Abel stated that the suddenness and completeness with which detonation was transmitted through small water-spaces had suggested to him the possibility of applying water as a vehicle for the breaking up of cast iron shells into numerous and comparatively uniform fragments, through the agency of force suddenly developed in the perfectly closed shell, completely filled with water, by the detonation of a small quantity of gun-cotton or other similarly violent explosive substance, immersed in the water. Mr. Abel considered that if such a result were obtained, a shell or hollow projectile of the most simple construction could be made readily to fulfil the functions of the comparatively complicated *shrapnel* and *segment* shells which have been specially designed to furnish a large number of dangerous missiles when burst during their flight.

A few experiments with ordinary cast iron shells, spherical and cylindro-conoidal, afforded conclusive demonstration of the power possessed by water, in virtue of its slight compressibility, to bring to bear uniformly in all directions upon the walls of the shell, the force developed by an explosion which is made to occur suddenly in the completely confined water-space, and showed, moreover, that the disruptive effect was proportionate not merely to the amount of explosive agent used, but also to the suddenness of the concussion imparted to the completely confined water by the explosion. In illustration of the disruptive effect of water, the following results may be quoted from a number given by Mr. Abel in his memoir. A 16-pounder (cylindro-conoidal) shell, filled with 16 ounces of gunpowder, was broken by the explosion of this charge into 29 fragments. The detonation of a quarter of an ounce of guncotton confined in a shell of precisely the same construction and weight, the chamber being filled up with water and tightly closed, burst the shell into 121 fragments, which were violently dispersed. A corresponding charge of gun-cotton, confined in a third similar shell, the chamber being filled with air, did not burst the shell when detonated; the resulting gases found vent through a minute perforation in the plug or screw-stopper of the shell. One ounce of gun-cotton confined in a similar shell, filled up with water, broke it up into 300 fragments, but in addition there were 2 lb. 1 oz. of the shell almost pulverised by the force of the explosion brought to bear upon the metal through the agency of the confined water.

The manner in which Mr. Abel has applied this system of bursting shells is very simple. The fuse which is used in field-artillery service for bursting shrapnel-shells or the common shell (when the latter is filled with gunpowder and used as a mine or an incendiary projectile), has fitted to it a small metal cylinder closed at one end, into which is tightly packed from a quarter to one-half ounce of dry compressed gun-cotton. The open end of the cylinder is closed with a screw plug containing a small chamber filled with fulminate of mercury, the upper side of which is in close contact with the fuse when the cylinder has been attached to the latter. To employ common shells as *water-shells* it is now only necessary to fill them completely with water, and then to insert and screw down firmly the fuse with its little detonating cylinder attached, when the detonating charge is fired by the action of the fuse, the shell is instantaneously burst into a large number of fragments by the concussion transmitted by the water.

Mr. Abel's prediction that this plan of bursting shells would be found most effective, is amply borne out by the magnificent practice made by the field-guns at Okehampton. Of the two batteries of Royal Artillery which have carried on the experiments during the past week, one has done more mischief with the "water-shells" than with the delicately constructed shrapnel, with the nature of which the gunners are intimately acquainted; while with the other battery of heavier field-guns the practice made was but little inferior. A little better acquaintance on the part of artillerymen with the new system of using shells will, it is anticipated, still further increase the deadly effect of these terrible weapons. Moreover, the water-shell has hitherto only been used in conjunction with a percussion fuse, while it is with the time-fuse that the shrapnel-shell is found the most effective. With the percussion-fuse the two shells are about on an equality, while the water-shell has the advantage of greater simplicity.

* Contributions to the History of Explosive Agents, Second Memoir, by F. A. Abel, F.R.S.—Phil. Trans. 1874, p. 373.

NOTES FROM THE "CHALLENGER"

THE following extracts from a letter dated Yeddo, June 9, 1875, addressed to me by Prof. Wyville Thomson, will, I think, interest the readers of NATURE :—

"In a note lately published in the proceedings of the Royal Society on the nature of our soundings in the Southern Sea, I stated that up to that time we had never seen any trace of the pseudopodia of Globigerina. I have now to tell a different tale, for we have seen them very many times, and their condition and the entire appearance and behaviour of the sarcode are, in a high degree, characteristic and peculiar. When the living Globigerina is examined under very favourable circumstances ; that is to say, when it can at once be transferred from the tow-net and placed under a tolerably high power in fresh, still sea-water, the sarcodic contents of the chambers may be seen to exude gradually through the pores of the shell and spread out until they form a gelatinous fringe or border round the shell, filling up the spaces among the roots of the spines and rising up a little way along their length. This external coating of sarcode is rendered very visible by the oil-globules, which are oval and of considerable size, and filled with intensely coloured secondary globules ; they are drawn along by the sarcode, and may be observed, with a little care, following its spreading or contracting movements. At the same time, an infinitely delicate sheath of sarcode containing minute transparent granules, but no oil-globules, rises on each of the spines to its extremity, and may be seen creeping up one side and down the other of the spine, with the peculiar flowing movement with which we are so familiar in the pseudopodia of Gromia, and of the Radiolarians. If the cell in which the Globigerina is floating receive a sudden shock, or if a drop of some irritating liquid be added to the water, the whole mass of protoplasm retreats into the shell with great rapidity, drawing the oil-globules along with it, and the outline of the surface of the shell and of the hair-like spines is left as sharp as before the exodus of the sarcode. We are getting sketches carefully prepared of the details of this process, and either Mr. Murray or I will shortly describe it more in full. . . .

"Our soundings in the Atlantic certainly gave us the impression that the siliceous bodies, including the spicules of Sponges, the spicules and tests of Radiolarians, and the Pustules of Diatoms which occur in appreciable proportions in Globigerina ooze diminish in number, and that