and possessions which [he took?]." This version differs slightly from the one offered by Mr. Pinches, but not as to the revolt of the troops of Astyages, his delivery to Cyrus, and the capture of Ecbatana.

The accounts of Nabonidus and of Cyrus vary somewhat. The language of the former implies a battle in which Cyrus defeated the Medes and captured Astyages, but does not mention a revolt, nor the capture of Ecbatana, the Median capital. The account by Cyrus, being the state annals, is likely to be the more exact, and enters more into detail than that of Nabonidus; but the two are not at all contradictory. All that Nabonidus wished to record was the overthrow of the Median power and the capture of their king, and it was unimportant whether this took place in battle or by mutiny. It may be that he did not know the details of the war, or it is possible that one division of the Median army gave battle, while another mutinied and delivered Astyages to Cyrus. There is an apparent difference in the two accounts as to the date of the capture of Astyages. According to the Cyrus text, this event took place in the sixth year of Nabonidus, while Nabonidus says that it occurred in the 'third year.' It is, however, not clear from what point Nabonidus reckons, — perhaps from the date of his dream.

There is nothing in either of these accounts to show whether Cyrus was in any way connected by birth with Astyages. As to the relation of the countries of Media and Persia at this time, it is clear, from the language of Nabonidus, that Persia was a very small power; and if the word 'his servant' (*aradsu*), as applied to Cyrus, means the servant of the Medes, the conclusion would be that Cyrus was a tributary king to the Median power. This agrees with the statement of Herodotus (i. 107), that Cambyses, the father of Cyrus, was considered by Astyages as of respectable family, but inferior to an ordinary Mede. Nicolaus of Damascus also makes Persia subject to Media (Müller, *Frag. hist. Gr.*, iii. 399, Fr. 66).

It is certain that the mystery surrounding the relations of the Median and Persian courts and people can never be cleared up with the aids hitherto possessed. Nothing but the contemporaneous literature of these peoples themselves, and of neighboring peoples, can ever solve the problem. In another inscription Cyrus calls himself the king of Babylon, son of Cambyses king of Anšan, grandson of Cyrus king of Anšan, descendant of Šišpiš king of Anšan, royal offspring (V. Rawl. 35). This language is, however, not inconsistent with the tradition, so strongly represented by the Greeks, that the Persians were tributary to the Medes. To leave the government of subject nations in the hands of native kings was the rule in the later centuries of the Assyrian empire, and the Medes may well have practised the same policy. It was sufficient that the vassal king sent his yearly tribute, and, on proper occasion, kissed the foot of his master; but further than this was not required, and he was regarded as king in his own tribe or nation.

A word as to Anšan and Anzan. These are geographical terms, — the first a city; the second apparently a land, because preceded by the sign for a country. But since this sign often represents a city also, it may well be that Ansan and Anzan are only two different ways of writing the name of the same place. This seems to be also the opinion of Professor Sayce (*Trans. soc. bibl. arch.*, iii. 475). Probably there was both a city and a country Anšan, or Anzan. But what was Anšan? In the same inscription Cyrus calls himself king of Anšan and king of Persia (Parsu, *Trans. soc. bibl. arch.*, vii. 155, 159). Possibly Anšan, or Anzan, was originally the name of a tribe, city, and district, to which Cyrus and his family belonged.

Another temple which Nabonidus restores is the celebrated temple of the Sun-god at Sippar. Nebuchadnezzar, he relates, had restored this edifice, and had sought for cylinders, but without success. But Nabonidus was determined to find the inscription of the founder of the temple; and his search was rewarded, for, at a depth of eighteen cubits, he came across the cylinder of Naram-Sin, son of Sargon, which no king preceding him had seen for 'three thousand two hundred years.' According to the custom of the kings, he placed an inscription of his own by the side of that of Naram-Sin. As the date of Nabonidus was about 550 B.C., that of Naram-Sin would go back to 3750 B.C. But even at this time civilization must have been far advanced, for Sargon, the father of Naram-Sin (if the same as the Sargon of Agane), had in his library an astronomical work comprising seventy tablets. With this ancient date would agree the statement of Sargon II., king of Assyria 721-705 B.C., that three hundred and fifty princes had preceded him on the throne (Cylinder inscription, l. 45), and the long list of Babylonian kings, numbering, before the tablet was broken, two hundred or more.

A third temple, which Nabonidus restores, is that of the goddess Anunit at Sippar. By digging he found the inscription of the last king who had restored the temple, *Šaggašti-Burtaš*, son of *Kudûi-Bêl*, about 1050 B.C. Anunit, goddess of this temple, seems to be the planet Venus as morning and as evening star.

These two celebrated temples at Sippar are mentioned several times in the cuneiform literature. From Berosus, also, we know that the people of Sippar were devoted to the worship of the sun, for he calls the place 'city of the sun' (*ἐν πόλει ἡλίου Σιππάρους*). It was also, no doubt, as a part of this worship that the people of Sippar, whom the Assyrian king settled in the land of Samaria, burned their children in the fire (2 Kings, xvii. 31). D. G. LYON.

OCEAN WATER AND BOTTOMS.

THE ocean explored by the Norske Nordhavs expedition, 1876-78, was a part of the North Atlantic lying to the west and north of Norway. The sea-water was especially studied in order to ascertain, if possible, whether the relation subsisting between its

component parts varies sufficiently to admit of determining its fluctuations by the most exact analytical methods, and whether, in that case, it were possible to deduce some definite rule regarding them.

As the result of the analyses, L. Schmelck concludes, "The hypothesis which assumes the ocean to consist throughout its entire depth of one homogeneous fluid, in which the most accurate of chemical analyses shall fail to detect dissimilarity of composition, has received from the experiments here described probably stronger confirmation than from any that have gone before them." Some of the most interesting results are tabulated as follows, the first table showing the mean amounts of certain substances in sea-water at various depths, and the second showing the same for different parallels of latitude: —

I.

	Surface.	Bottom.	Intermediate depths.	Mean value.
Specific gravity	1.0265	1.0265	1.0266	1.0265
Chlorine	1.930	1.933	1.934	1.932
Calcium oxide	0.0576	0.0581	0.0577	0.0578
Magnesium oxide	0.2205	0.2207	0.2200	0.2203
Sulphuric oxide	0.2211	0.2208	0.2223	0.2214

II.

	80°–71°.	71°–66°.	66°–62°.
Specific gravity	1.0264	1.0265	1.0268
Chlorine	1.929	1.937	–
Calcium oxide	0.0580	0.0579	0.0577
Magnesium oxide	0.2190	0.2219	0.2205
Sulphuric oxide	0.2208	0.2210	0.2223

The mean value of the salts occurring in sea-water is given as follows: —

$CaCO_3$,	$CaSO_4$,	$MgSO_4$,	$MgCl_2$,	KCl,	$NaHCO_3$,	NCl.
0.002,	0.1395,	0.2071,	0.3561,	0.0747,	0.0166,	2.682.

Hence 100 parts of dry sea-salt contain —

$CaCO_3$,	$CaSO_4$,	$MgSO_4$,	$MgCl_2$,	KCl,	$NaCO_3$,	NaCl.
0.057,	4.00,	5.93,	10.20,	2.14,	0.475,	76.84.

The ocean-bottom studied is especially interesting from the amount of present and past volcanic and glacial activity in the lands surrounding it. Here, as elsewhere, depth was found to be the principal factor in determining the character of the deposits. Along the coasts of Norway and Spitzbergen, generally at a less depth than five hundred fathoms, the bottom was found to be covered with a more or less plastic gray clay. Its coarseness or fineness varies considerably; and grains of quartz, as a rule with rounded edges, constitute the chief portion of the mineral particles in it. At the approximate depth of from five hundred to a thousand fathoms, a brown clay is found, forming a transition from the gray clay to the true oceanic deposits.

At nearly all depths below a thousand fathoms, and oftentimes at less depths, is a fine light to dark brown colored deposit containing minute white shells of the genus Biloculina, in size and shape like a pin-head. This shell gives name to the clay, which corresponds approximately to the Globigerina ooze of the Challenger expedition. The ground is taken, that the power of sea-water to dissolve the carbonate of lime of the foraminiferal shells is not owing to the greater amount of carbonic acid at great depths in the ocean; for the observations of Mr. Tornφe showed that the sea-water invariably reacted as an alkali, and hence the carbonic acid could not be free. Again: the latter was found to be about the same in the depths of the ocean as on the surface; while the general uniformity of composition of the sea-water, as shown by numerous investigations, renders it improbable that any deviation in amount of carbonic acid occurs; hence the power possessed by sea-water to dissolve carbonate of lime does not depend upon the greater or less proportion of free carbonic acid.

The bottom of the shallow ocean between Norway, Beeren Eiland, Spitzbergen, and Novaia Zemlaia, was found to be covered with a greenish-gray clay containing but few animal remains. Minute and generally sharp-edged quartz grains were the principal constituent. This deposit was termed the Rhabdammina clay, from a genus of Foraminifera which often abounds in that part of the ocean-bed. This clay, according to Schmelck, originates from the 'decomposition of quartzitic rocks,' especially those of Beeren Eiland.

Off the volcanic island of Jan Mayen, above the six-hundred-fathom line, occurs a deposit of dark-gray sand, and sabulous clay containing fragments of basaltic lava, olivine, augite, etc., which seem to have been derived from the volcanic *débris* of the island.

An important fact bearing on the question of the distribution of *débris* by bottom-currents in the ocean is the statement that "all samples of water brought up from the bottom were perfectly clear, without a trace of floating particles."

The occurrence of numerous stones and pebbles on the sea-floor, as well as not uncommonly a rocky bottom, is of interest. The pebbles decrease in size and number in going from the shore towards deep water. While rare in the deep water south of the 72d parallel, they are quite common in that to the west of Spitzbergen and Beeren Eiland, where drift-ice abounds. Out of three hundred and seventy-five stations, pebbles and fragments of minerals and rocks were dredged at a hundred and twenty-three of them, while at many others no sample of the bottom could be obtained on account of its rocky condition. Of especial interest is the finding of numerous fragments of flint and chalk, a fossil (belemnite) from the chalk, fragments of coal, and some striated stones. Other pebbles and fragments found were marble, limestone, granite of various kinds, sandstone, argillite, quartzite, flint, chalk, granitic veinstone, quartz porphyry, gabbro, basalt, pumice, amygdaloidal rocks; chloritic, hornblendic, quartz, mica, and other crystalline schists; calcite, quartz, mica, hornblende, felspar, asbestos, coal, olivine, augite, coral, shells of various kinds, rotten wood, etc.

Schmelck concludes that organic agency is a subordinate factor in the formation of the floor-deposits

of the northern ocean, as is volcanic *débris*, but that the chief portion of the material consists of the solid matter carried out to sea by drift-ice and glacial rivers.

M. E. WADSWORTH.

THE NATURAL HISTORY OF IMPLEMENTS.[1]

"WHEN will hearing be like seeing?" says the Persian proverb. Words of description will never give the grasp that the mind takes through actual sight and handling of objects; and this is why, in fixing and forming ideas of civilization, a museum is so necessary. One understands the function of such a museum the better for knowing how the remarkable collection formed by Gen. Pitt-Rivers came into existence. About 1851 its collector, then Col. Lane Fox, was serving on a military sub-committee to examine improvements in small arms. In those days the British army was still armed (except special riflemen) with the old smooth-bore percussion musket, the well-known 'Brown Bess.' The improved weapons of continental armies had brought on the question of reform; but the task of this committee of juniors to press changes on the heads of the service was not an easy one, even when the Duke of Wellington, at last convinced by actual trial at the butts, decreed that he would have every man in the army armed with a rifle-musket. Col. Fox was no mere theorist, but a practical man, who knew what to do and how to do it; and his place in the history of the destructive machinery of war is marked by his having been the originator and first instructor of the School of musketry at Hythe. While engaged in this work of improving weapons, his experience led his thoughts into a new channel. It was forced upon him that stubbornly fixed military habit could not accept progress by leaps and bounds, only by small partial changes, an alteration of the form of the bullet here, then a slight change in the grooving of the barrel; and so on, till a succession of these small changes gradually transformed a weapon of low organization into a higher one, while the disappearance of the intermediate steps, as they were superseded, left apparent gaps in the stages of the invention, — gaps which those who had followed its actual course knew to have been really filled up by a series of intermediate stages. These stages Col. Lane Fox collected and arranged in their actual order of development, and thereupon there grew up in his mind the idea that such had been the general course of development of arts among mankind. He set himself to collect weapons and other implements till the walls of his house were covered from cellar to attic with series of spears, boomerangs, bows, and other instruments, so grouped as to show the probable history of their development. After a while this expanded far beyond the limits of a private collection, and grew into his museum. There the student may observe in the actual specimens the transitions by which the parrying-stick, used in Australia and elsewhere to ward off spears, must have passed into the shield. It is remarkable that one of the forms of shield which lasted on latest into modern times had not passed into a mere screen, but was still, so to speak, fenced with. This was the target carried by the Highland regiments in the low countries in 1747. In this museum, again, are shown the series of changes through which the rudest protection of the warrior by the hides of animals led on to elaborate suits of plate and chain armor. The principles which are true of the development of weapons are not less applicable to peaceful instruments, whose history is illustrated in this collection. It is seen how (as was pointed out by the late Carl Engel) the primitive stringed instrument was the hunter's bow, furnished afterwards with a gourd to strengthen the tone by resonance, till at last the hollow resonator came to be formed in the body of the instrument, as in the harp or violin. Thus the hookah or nargileh still keeps something of the shape of the cocoanut-shell, from which it was originally made, and is still called after (Persian, *nárjíl* = cocoanut). But why describe more of these lines of development when the very point of the argument is that verbal description fails to do them justice, and that really to understand them they ought to be followed in the series of actual specimens? All who have been initiated into the principle of development or modified sequence know how admirable a training the study of these tangible things is for the study of other branches of human history, where intermediate stages have more often disappeared, and therefore trained skill and judgment are the more needed to guide the imagination of the student in reconstructing the course along which art and science, morals and government, have moved since they began, and will continue to move in the future.

[1] Extract from a lecture on anthropology, delivered Feb. 21, at the University museum, Oxford, by E. B. TYLOR, D.C.L., F.R.S. From *Nature* of May 17.

THE INTELLIGENCE OF THE AMERICAN TURRET SPIDER.

AT the meeting of the Academy of natural sciences of Philadelphia, June 19, Rev. Henry C. McCook exhibited nests of Tarentula arenicola Scudder, — a species of ground spider of the family Lycosidae, properly known as the turret spider. The nests in natural site are surmounted by structures which quite closely resemble miniature old-fashioned chimneys composed of mud and crossed sticks, as seen in the log cabins of pioneer settlers. From half an inch to one inch of the tube projects above ground, while it extends straight downward twelve or more inches into the earth. The projecting portion, or turret, is in the form of a pentagon, more or less regular, and is built up of bits of grass, stalks of straw, small twigs, etc., laid across each other at the corners. The upper or projecting parts have a thin lining of silk. Taking its position just inside the watch-tower, the spider leaps out, and captures such insects as may come in its way. Nests had been found at the base of the Alleghany Mountains