西方原版教材与经典读物·科学系列

SCIENCE READERS

科学读本 6

〔美〕文森特·默奇（Vincent Murche）/著

天津出版传媒集团
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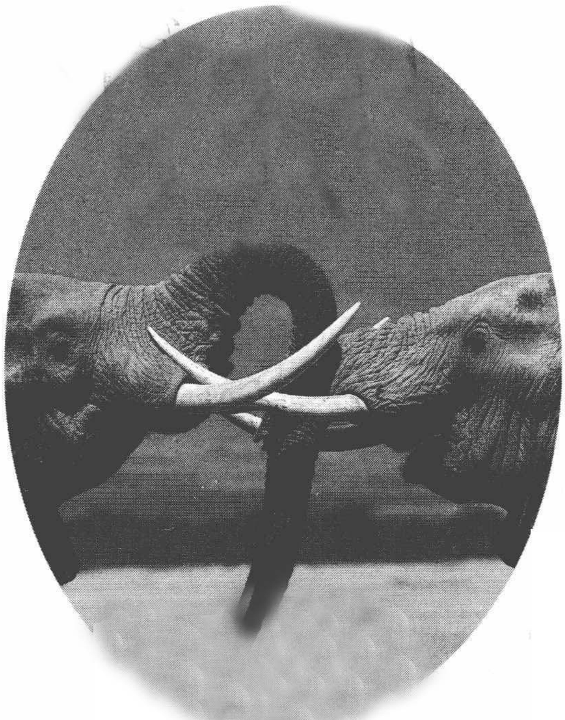

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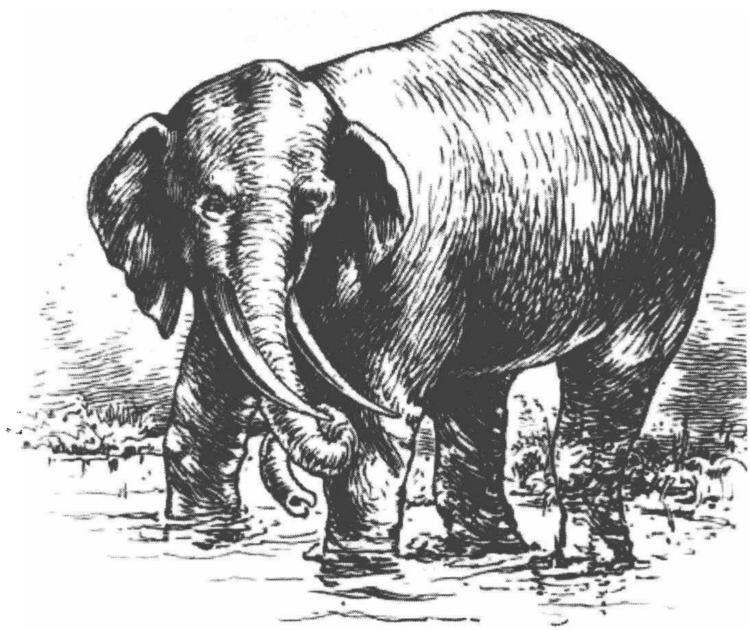
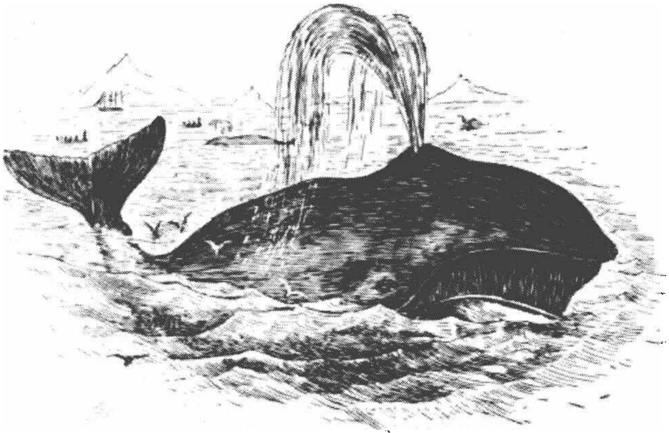




Lesson 01

The Forces of Nature

The examinations were over, the class promotions were all made, and the boys (especially those of the upper classes) were looking forward with considerable eagerness to the new year's course, on which they were about to embark. None were more eager and enthusiastic than our young friends the two cousins, whom we have watched with so much pride and pleasure year after year.

"There is just one thing more to do," said Mr. Wilson, "and then we can settle down to work. We must have the desk brought into our new room. Put your shoulder to it, Fred, and push it along. What! can't you move it?" he said again, as he saw Fred exerting all his strength to no purpose. "One or two of you help him. That's right; you can push it along easy now."

Sure enough they did go easily—in fact a little too easily, as boys very frequently do; for Mr. Wilson was just in time to prevent them from running the desk into the glass front of the museum cupboard. This he did by pushing hard at the side of the desk, so as to change the direction in which it was moving, and make it veer off sideways. Then by exerting all his strength, and pushing in the opposite direction to that in which the boys were pushing, he brought the desk to a standstill, and the cupboard was saved. It was all the work of a minute, and the boys scarcely knew what had happened till Mr. Wilson said sternly, " Boys, you should be more careful; I did not wish you to push like that." After they had got to work, however, he thought over the little incident, and determined to make use of it to introduce his first lesson in the new science course.

When the time for the lesson came round, he began by calling the attention of the class to the moving of the desk, and showed them that in order to move the heavy body at all it was necessary for them to make an effort—to put out their strength. "Whenever we lift a heavy weight, whenever we set a body in motion, whenever we stop a body that is already in motion, we are conscious of exerting some effort. The name which we give to this effort is force. We say that force is any cause which tends to move a body, to change the direction of its movement, or to arrest it when in motion. The particular kind of force which you used just now in moving the desk was your own bodily strength. This we call muscular force.

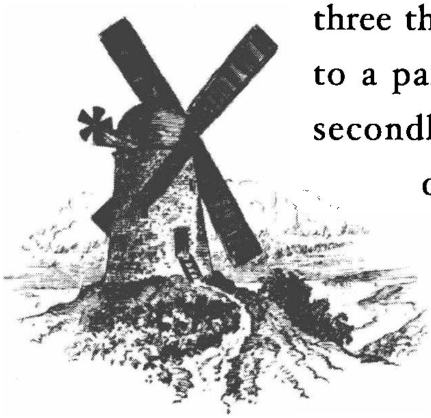
"Fred tried to move the desk alone, but he found his muscular force was not sufficient, and I called upon some of you to help him. Uniting your exertions with his, and pushing in the same direction, you were able to propel the desk along the floor, but as soon as I began to push it at the side there was a change in the direction of its movement, and when I pushed in the opposite direction to you, it had the effect of bringing the desk to a standstill. I was exerting muscular force as well as you; that force, acting on a certain point of the desk, was able to change the course of its movement; when applied at another point it arrested its movement altogether.

"Man, in his primitive state, learned first to use this muscular force. In fact, the only force he employed was his own muscular force, and that of the animals he subdued. Savage nations of today know very little of any other forces beyond this.

"But civilized man gradually learned, and is learning still, that there are many wonderful forces existing around him, and his ingenuity teaches him how to utilize them. His observation soon taught him, for example, that wind is a force, and after a time he learned to turn this force to account in various ways. In like manner, things floating down a stream suggested to him the force of running water, and this became, through his ingenuity, another powerful working agent.

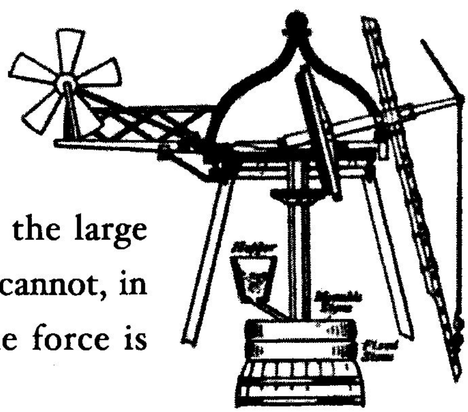
"In fact, science has taught man gradually to utilize these and other forces, such as gravity, cohesion, heat, steam, chemical force, magnetism, electricity. We group these all under the name of natural forces, i.e. the forces of nature.

"Let us go back once more to the work of moving the desk. When Fred tried to do it we might have noticed

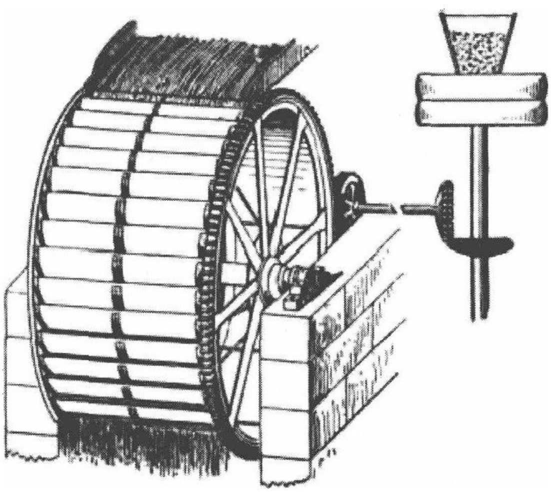


three things: first, he applied force to a particular part of the desk; secondly, he pushed in a certain direction; and, thirdly, when his own muscular force was insufficient, he increased it by the help of more force, and so did the work. In all our attempts to utilize a force, these same three things must be considered— (1) its point of application, i.e. the portion of matter on which it acts; (2) its direction; (3) its intensity or magnitude. In almost every instance a force can only be turned to account after we have altered it in one or other, or all of these particulars, to suit our requirements.

"This will be readily understood by a glance at the construction and working of a windmill or a watermill. The essential part of either mill is the great millstone, which has to be set in motion. The force to accomplish this work is, in one case, the wind, in the other the running water. The wind-force acts on the sails, the water-force on the large wheel; and the millstone cannot, in either case, move till the force is transmitted to itself.



"But not only must the force be transmitted to the stone, its direction must be changed. The sails of the one and the wheel of the other revolve vertically, the millstone horizontally. The whole contrivance of the mill is to effect these changes in the force, and so render it available for the work of grinding corn.



"We call any contrivance for transmitting a force from one point to another, or for altering the direction of movement, a machine."

Lesson 02

Elements and Compounds

"This morning we are going to commence a series of simple lessons in chemistry," said Mr. Wilson, and the boys were at once full of curiosity as to what they were to expect next.

"Let us begin with some of the red powder in this bottle. We call it red oxide of mercury. I think you know something about it already. I will put a little of it into this test-tube, and heat it over the flame of the Bunsen burner."

"You showed us this experiment once before, sir," said Fred, "and I remember that by heating the solid powder over the flame you can make it give off an entirely different substance—a gas—and that gas is oxygen."

"Quite right, Fred, and oxygen is now passing off from the red powder while I heat it. Our present business, however, is not to collect the gas for further experiment, as we did in our other lesson, but merely to show that it is coming off. How can I do this?"

"If you plunge a red-hot splinter of wood into the mouth of the tube, sir, we shall soon see whether the tube contains oxygen."

"Very well, my lad, you come and do it," said Mr. Wilson. Fred did so, and immediately the red-hot splinter burst into a brilliant glow, thereby proving the presence of oxygen.

"We know, then," continued Mr. Wilson, "that this solid, dry red powder contains the gas—oxygen. But what are these little silvery-white, shining globules all round the sides of the tube? They look like little balls of silver. They are not at all like the red powder we put into the tube. If we continued to heat the powder till we could get no more oxygen from it, and then stood the tube aside for a while to cool, we should be able to scrape off and pour out the shining little balls and leave the vessel empty. Moreover, as we poured out these tiny silvery balls, they would run together and form a little pool of liquid metal—the metal mercury. The red powder, therefore, which is a mass of minute solid particles, contains a liquid metal—mercury, and a gas—oxygen. We call it oxide of mercury.

"But not only so. It has been found to be impossible, either by still further heating the powder or by any other treatment, to make it yield anything but these two substances—mercury and oxygen. We say, therefore, that oxide of mercury is a compound substance; it is made up of two other substances—mercury and oxygen. The red powder may be actually made by heating the metal mercury in a closed vessel. The metal, as it is heated, robs the air in contact with it of its oxygen, the two substances unite, and form the entirely new body—oxide of mercury. The process is long and tedious, and takes two or three days to complete. Hence we shall not attempt to do it now. I merely want you to know that it can be done.

"Let us take another experiment. I have here two lumps of chalk. I will place one piece in the middle of the fire, where it is bright and red; and while it is heating we will deal with the other piece on the table.

"I want you to carry your minds back to an experiment I once showed you with some chalk by pouring over it dilute hydrochloric acid. I put the pieces of chalk into a bottle, covered them with water, and added some hydrochloric acid, till little bubbles began to form all round the chalk."

"Oh, I remember, sir," said Will. "You made the chalk give off carbonic acid gas; that was what the bubbles were. You collected the gas in a bottle that stood on the table."

"Perfectly true, my lad," said Mr. Wilson, "and I will do the same thing now, in a somewhat different way. As, however, I do not wish to collect the carbonic acid gas this time, but merely to show that it is actually passing off, it will be sufficient to put the chalk into a basin and pour the liquid over it. You can see the bubbles rising up through the liquid. Those bubbles are bubbles of carbonic acid gas, and that gas came from the solid chalk.

"Your earlier lessons have made you familiar with the fact that this carbonic acid gas is composed of two substances—the solid substance, carbon, and the gas, oxygen. We can make it for ourselves by burning carbon in oxygen. Therefore carbonic acid gas is itself a compound substance.

"Let us next turn our attention to the lump of chalk which I placed in the fire. I will take it out now with the tongs, and stand it on this iron tray.

"As soon as it is cool I will pour some of the dilute hydrochloric acid on it as we did on the other. It does not give off bubbles of gas as the other did, you see. Why not? The heat of the fire has driven off all the carbonic acid it contained, and the substance we have here now is not chalk. It is lime. In its present state we call it quicklime.

"So then chalk is a compound substance, made of lime and carbonic acid, and you have already learned that carbonic acid is itself a compound of carbon and oxygen. Chalk, therefore, consists of lime, carbon, and oxygen.

"Now, instead of dilute acid, I will pour water on this hard, solid quicklime. Watch what happens.

"The water instantly disappears—it seems to be sucked up by the quicklime; tremendous heat is generated, and the solid substance falls away in powder. This powder we call slaked lime.

"Let us see what has happened. The solid substance, quicklime, has become united with water. We say that the two have combined to form a new compound substance—slaked lime."

Lesson 03

The Blood and its Work

"We have learned, in the course of our lessons, a great many things, in a simple way, about our body, both in regard to its structure and the work it has to do.

We shall now enter into a more detailed investigation of the functions of the principal vital organs.

The body is a sort of living machine. Some part or other of it is always at work, night and day, sleeping and waking; for even when we are asleep the heart and lungs cannot rest—their work must go on, and that work must be guided and controlled by some part of the nervous system.

We know too, from our earlier lessons, that all bodily work is done at the expense of the substance of the body itself. Every act of our daily life, the movement even of a finger, the flashing of a single thought through the brain, or the blinking of an eyelid, destroys some of the substance of the body.

Think of a steam-engine at work. It is the fuel in its furnace and the water in its boiler that enable it to perform its work, but the living machine works at the expense of its own substance. Each little particle of brain,