water through one degree Fahr.,—and if we then consider what a small amount of chemical action is necessary for the production of a considerable quantity of heat—how much heat, for instance, a little oil burned in a lamp will yield, while, at the same time it gives off vast quantities of light—I say if these two considerations be put together, surely a great part of our difficulty will be removed—for the direct antecedent of muscular action being chemical force, the disproportion that seemed to exist between them will no longer appear so striking.

2. That the animal body should be far superior to any machine of mere human contrivance as an economist of force, is nothing more than we should expect, and may fairly infer from its origin, being planned and formed by a Mind and Hand so infinitely superior in wisdom and power to those that work among us. And it must be regarded as a result of this economising that so great a proportion of the force given off takes the form of motion, which as we have seen is a much cheaper form of force—so to speak—than any of the rest.

(To be continued.)

ART. XXXIV.—*A cheap Spirometer.* By W. E. Bowman, M.D., Montreal.

A cheap spirometer may readily be made from two tin vessels similar in shape to a length of stove pipe, but closed at one end; the one being 19½ inches long, and 6 inches in diameter, and the other 18 inches, and 5 inches in diameter. The latter may be graduated into spaces of 8 cubic inches with our ordinary gallon measure, which contains 231 cubic inches, and consists of 8 pints of 16 ounces each, the oz. measuring 1.8 c. inches.

Having placed the smaller vessel perfectly upright, measure into it a gallon of water less half an ounce, and with a rule ascertain the precise distance from the surface of the liquid to the brim of the vessel, then placing this measure outside of the tin, mark the height of the water as 230 c. inches. In a similar manner with half a gallon and 10¼ fluid ounces, mark 134 c. in.

Next divide the space between these two points into 12 equal parts which will be measures of 8 c. inches each, and with the compasses continue the graduation upwards and downwards, placing the figures on the inverted vessel as in margin. If its diameter be everywhere alike, the measure must be correct, its accuracy however may be easily tested by the annexed subdivisions of the same measure. The pulleys and counterpoise may now be adjusted for the graduated tin.

Next fill the larger vessel with water so that the smaller may be just covered when inserted into it, and mark the height of the water on the inside of the larger tin. Then raise the small one gently until the 174 c. in. line appears even with the surface of the water, and make a second mark of its level. Finally put the third graduation in the large tin when the smaller is raised completely out of it.

Lastly affix two or three feet of flexible tubing, and a mouth piece to the top of the small tin, and the spirometer will be ready for use.

The graduation inside of the larger vessel is to detect and obviate any differ-