units in a somewhat more complicated way. If a body is moving at the rate of ten feet a second and some time after is moving at the rate of fifteen feet a second, it is gaining velocity, but the rate at which it is gaining velocity—the acceleration—is greater if it takes only a minute to gain the five feet a second than if it takes an hour, and still greater if it takes only a second to gain that velocity. The accelration of five feet per second per hous locity. The acceleration of five feet per second per hour minute, and still less than five feet per second per second. Hence it is seen that acceleration involves time twice. It is just as inexact to speak of an acceleration of five feet a second as to speak of a velocity of five feet. In other words, it is just as necessary in acceleration to bring in time *twice* as it is in velocity to bring it in *once*. In that system of units in which unit velocity is a foot per second, the unit of acceleration is a foot per second per second. This unit has no name, just as the unit of velocity has no name.

Velocity and acceleration involve the units of length and time; density involves the units of length and mass. In this case, length is involved *three* times, unit densely being unit mass contained in unit volume which is unit length cubed. In the French system unit density is the mass of one gram in a cubic centimeter, and water at 4 degrees C. has this density; there is no substance known of which one pound occupies a cubic foot, or a cubic inch and no substance has a density of unity in the English system. The density of substance compared with that of water is the specific gravity and this is more commonly determined and is sometimes *called* the density. In the French system of units the number denoting the specific gravity is really the number for the density; in the English system it is not.

In the consideration of force, pupils will need illustrations of various kinds in order to enable them to see that unless there is acceleration there is no force acting; because, since friction is always with us, the natural tendency is to think that force is necessary to *keep* a body moving at the same rate. That force varies as mass is not so difficult an idea; it is easier to move a pound than a hundred weight; it is easier to push a small boy than a big man. But in time it ought to be quite clear that force involves both mass and acceleration and nothing else.

Unit force gives unit mass unit acceleration. In the English units, unit force gives to one pound an acceleration of one foot per second per cesond. This expression is so long that a special name is given to this unit of force which is called a poundal. But unless the pupils have something more tangible than a definition such as the above, they will have little conception of what is meant by a poundal. Our conception of force is most closely connected with some strain on the muscles. The force which is called a *poundal*. But unless the pupils pound in our hand. But a pound mass if allowed to fall gains a velocity of 32 feet a second in a second (therefore has an acceleration of 32 feet per second, per second) so that a pound *weight* is 32 poundals and a poundal is the weight of half an ounce, or half the weight of a letter which in pre-war times would go for two cents, but now, unfortunately, requires three cents postage.

The French unit of force gives an acceleration of one centimeter per second, per second to a gram and is called a dyne (from the Greek word for force). The *weight* of a gram is 980 dynes and so a dyne is about the weight of a milligram or approximately one-fiftieth the weight of a postage stamp.

The simplest conception of work is that given by lifting a weight; and the work done depends upon the weight lifted and the distance through which it is raised. The ordinary unit of work is the foot pound or the work of raising a pound one foot. Work, then, may be defined as the product of the force acting and the space through which it acts. Now the pound weight is not the unit force, but the poundal; and therefore unit work (in the foot pound second units) is the foot poundal, which is one thirty-second of the foot pound.

Corresponding to the foot pound is, in the French system, the gram centimeter, and correspounding to the foot poundal is the dyne centimeter. A special name is given to the dyne centimeter. It is called an erg (from the Greek word for work) and is the work which would be done in lifting the weight of one-fiftieth of a postage stamp a centimeter high. It would require a good many ergs of work to load a ton of hay upon a wagon.

Now in foot pounds or foot poundals we seem to be multiplying two units and it might be thought that we can no more multiply six feet by four pounds than we can add six feet and four pounds or than we can multiply six apples by four plums. This is true; and it is only in a conventional sense that we can multiply feet by pounds. What we are really getting at is how many pounds can be raised one foot, or what number of feet one pound can be raised by the work required to raise four pounds six feet. It is the same kind of convention as allows us to divide feet by seconds to arrive at velocity.

If units are understood up to this point there should be no further difficulty. Work which we have expressed in terms of force multiplied by length can be expressed in terms of mass and velocity; for there is merely an algebraic transformation in changing the one into the other.

Power is derived from work. It is work divided by time. Horsepower is expressed in foot pounds per second or per minute. The electrical unit, the watt, is just a special unit of power and it is not difficult to derive the units of electricity if the units we have discussed are fully understood. Lessons on units must be combined with