A Short History of Scales and Weights.

Read before the Wisconsin Pharmaceutical Association, by A. C. MORRISON.

In recording the development of weights and measures, which necessarily includes the means of ascertaining the force of specific gravity upon any object, and the apparatus by which weight is estimated, if full justice is done to the subject, volumes in folio would be needed. It will, therefore, be necessary to cover the subject as regards early history in a more cursory manner than would be wished by the conscientious compiler.

The word weight and the word gravity are nearly synonymous. Gravity is the force which attracts everything within the radius of this planet toward the centre of the earth, which is commonly called the centre of gravity, at which point the force of the gravity of the world is at equilibrium, balanced by equal attraction in every direction. As is well known, this common acceptance of the word gravity is in error, as every planet, every sun, every constellation, and the universe itself, has its own centre of gravity, towards which objects are drawn by an almost incomprehensible attractive force in direct ratio to the bulk, density, and distance of the object from this centre, and these objects are restrained from falling to this centre and into a fiery chaos by the centrifugal force of their own motions above it.

The absolute weight of any object, then, is its attraction without other influences toward the centre of gravity; and the pressure exerted by this object, if restrained from approaching the centre of gravity, is weight. There are innumerable means of ascertaining weight. Among them is the astronomical method of weighing a world or a sun by arithmetical deductions from its known motions, density, and bulk; but as in this article we have to do more especially with the ascertainment of terrestrial weights and their use in commerce, we are obliged, on the score of brevity, to confine ourselves to weights and measures as established by usage, legislative enactment, or the customs of a locality, and the establishment of the specific gravity exerted upon a given object by comparison with these standards; and this brings us directly to that simplest of all means—the balance. If a horizontal bar be attached by means of a flexible support to a given point, exactly in the centre, it will remain horizontal, owing to the neutralization of the force of gravity exerted on either end by the other. It is then said that it is a perfect balance. Attach to this a standard of weight established by either of the means above described and the influence exerted will draw the bar into a horizontal position. Attach to the other end of the bar a weight exactly equivalent to the standard previously fixed, and if, for instance, that standard be what is commonly designated as one pound, the balance is again established; and as it will not be established until the weight at either end is exactly the same, we know that the article attached in the second instance is one pound. The scale is, therefore, called a balance, and offers us the simplest solution of the difficulty of ascertaining relative weights. The balance is unquestionably the earliest means of ascertaining weight, and almost all commercial and practical methods of ascertaining weight are based upon this principle. Even the hydrometer simply finds its equilibrium and the liquid establishes its balance and thus tells with certainty the specific gravity of a liquid, from which the weight of a given quantity of liquid can, by comparison with the known weight of water, be ascertained.

The Bible gives us many instances of the use of the balance, and it is extremely difficult to fix its earliest beginnings, which seem to be lost in the mists of antiquity; and it is strange also to be obliged to assert that modern civilization, while it has immeasurably improved in accuracy the means of ascertaining weight, relies still chiefly upon the early principle of the balance.

The steelyard, as it is commonly called, came into use as an improvement on the ordinary balance, as far as history knows, with the Romans, although it probably did not originate with them. This apparatus differed from the ordinary balance in the fact that one end of the horizontal bar was much thinner than the other, which enabled its makers to place means of suspension nearer to the large end before equilibrium was established. By using a single weight it therefore became possible, by means of a scale marked on the long end, to ascertain several weights, basing the calculation upon the distance as marked on the scale from the centre of gravity. Thus, the weight which two inches from the centre of gravity would weigh a certain amount would, ten inches from this centre, balance a very much larger weight, owing to the principle of the lever which is brought into play. This made possible the ascertainment of the weight of any commodity to a nicety, without the constant change of weights which was necessary to establish the equilibrium of the common balance. Modern scales are, in a large measure, based upon the principle of this Roman steelyard, although many modifications have been introduced.

There is a balance called the Danish balance, and used in commercial matters in countries near the Baltic, which differs from the steelyard in this—that the counterpoise is fixed and the pivot movable, whereas in the steelyard the pivot is fixed and the counterpoise, or balance in weight, is movable. The beam is graduated in a contrary direction to that of the steelyard in order to adapt it to this change, and the beam has to be slid forwards or backwards, according to the weight to be counterpoised. In the common balance, the steelyard, and the Danish balance, the beam is straight, but there are others called the bent-lever balances, in which the weight is suspended from a bent arm and counterpoised by a heavy knob at the other end, and the heavy knob is made to indicate the weight of the article attached to the bent arm.

There are a large number of important contrivances called spring balances, weighing machines, and dynamo meters, whose object is to indicate pressure, weight, or force in various ways, but it would be impossible to describe them within the limits of the present paper, as many of them are very intricate. It is curious to recollect that the modern steam gauge, which indicates the pressure of steam, is simply a weighing-machine; and so on, in innumerable fields, the weighing machine presents itself to us most unexpectedly.

At this point, it is well to digress to the subject of acknowledged standards of weights and measures. Throughout the world, in every nation, and it might almost be said in every community, different standards and weights are used to express a given quantity, length, or weight of commodities, but we have more to do with avoirdupois, troy, and the metric system, and, for the purposes of this article, it will be necessary to confine ourselves to these three. King Edgar, of England, in order to establish uniformity throughout his realm, where the utmost confusion prevailed, enacted certain decrees in the year 975, a work more completely done by William the Conqueror, who ordered that all weights and measures in the kingdom should be stamped. Richard the First, in the year 1197, established the yard, which was a measure exactly equalling the length of the arm of the preceding monarch, Henry the First. King John confirmed the legality of the then weights and measures in the Magna Charta. We gain our first knowledge of what the exact standard of English weights was from the statute of Henry the Third, in 1266, which declares "that an English penny shall weigh thirty two wheat corns in the midst of the ear, that twenty pence shall make one ounce, twelve ounces, one pound; that eight pounds do make a gallon of wine, that eight gallons of wine do make a London bushel, which is the eighth part of a quarter." It appears that the wheat corn was the first standard of weight in England, and it is supposed that the metallic weight called a grain was used as the representative of a wheat corn, and that the modern troy grain is nearly the same. After a time the pennyweight was reduced from thirty-two to twenty-four grains, twenty pennyweights made an ounce, and twelve ounces, one pound. This was called the troy pound, and became the standard of English weight, consisting of 5,760 grains; but still legislation could not insure uniformity in weights, for there was the moneyer's pound, consisting of 5,400 grains, the avoirdupois pound of 7,000 grains, and the old commercial pound of 7,600 grains. In the time of Elizabeth, a standard of the avoirdupois