pleasing to the eye, but in respect to standard weights the severely plain is to be preferred as reducing the number of points exposed to wear and tear.

Some more standards of Queen Elizabeth's time, A 1-cwt. Standard. The "cwt." is not now a legal denomination. The 56-lb. was the heaviest weight which was sanctioned for trade purposes until 1879, when the "cental," or 100-lb. weight, was legalised. Note that the 100-lb. weight is not a hundredweight, paradoxical though it seem—another flaw in the Imperial System. We have a weight of 100-lb. and a hundredweight of 112-lb.

The other objects shown are a standard bushel and a standard yard. These relics are kept in the Jewel Tower, Westminster, of which an outside view will be shown later.

Another set of old standards preserved in the Jewel Tower: Gallon, Queen Elizabeth; Gallon, Henry VII.; Bushel, Henry VII.; Corn Bushel, Henry VII.; Gallon, Queen Elizabeth.

A set of Tower Standard Brass Weights of the time of Queen Anne, which are to be found at the Royal Mint, Tower Hill. The weights claim especial attention, as they were made under the direction of Sir Isaac Newton, who was Master of the Mint.

The standards legalised in 1824, when the Imperial System was adopted, had been in the custody of the Clerk of the House of Commons since 1758. After the burning of the Houses of Parliament in 1834, certain of the standards were found in the ruins. These ancient standards are now taken care of by the Clerk of the British House of Commons. Here we have a view of them:—

32-lb. Troy weight 1758.	Original Standard of the Imperial Stone. 1758.	16-lb. Troy weight 1758.	32-lb. Troy weight 1758.

Secondary Standard Yard
Standard Yard, 1760.) 1
Standard Yard, 1758.) 2

The key shown was also found in the debris after the conflagration.

This is an outside view of the Jewel Tower, Westminster. It now forms part of the Standards Department of the Board of Trade, 7 Old Palace Yard, and is used as a depository of Standards and Balances. For this purpose it is particularly suitable, as, owing to the thickness of its walls, it is free from vibrations, and practically it is immune from destruction by fire. It is stated to have been built in 1350 during the reign of Richard II, and is the only portion of the Old Palace of Westminster which has come down to our times in its original form.

A still more ancient depository of Standards is the Pyx Chapel, in the eastern cloister of Westminster Abbey. Formerly, and probably as far back as the Norman Period, the "King's Standards" were housed in the Pyx Chapel, and not only standards, but Royal treasures were lodged there, as Dean Stanley tells us, "under the guardianship of the inviolable sanctuary which St. Peter had consecrated and the bones of the Confessor had sanctified."

A view of the entrance to the Pyx Chapel. The massive double doors were formerly secured by six locks, three on each side, each set of keys being in the custody of a separate officer.

The "Trial of the Pyx" is now held annually at the Goldsmith's Hall, when an examination takes place of the justness of the gold and silver coins of the realm as issued for the past year. It doubtlessly takes its name from the Pyx Chapel, where, at one time, the assays of gold and silver were kept.

So far we have noticed but two kinds of weighing instruments—the even-armed balance and the steelyard. The question naturally arises: Could heavy loads be weighed by either of these means? In the case of the even-armed balance, given a beam long enough and strong enough, and pans sufficiently large, any load, of course, might be weighed. But, apart from the difficulties of manufacture, weights to the amount of the load would have to be provided and handled; hence the capacity of this type of scale has comparatively narrow limits. For heavy charges the steelyard obviously has the advantages.

This is a specimen of an old cart-weighing machine, part of which still exists at Soham, Cambridgeshire. It is a large steelyard fitted into the supper storey of a house. The chains which depend from the outer end were fastened round the cart and proportional weights were attached to the other end inside the room, until the vehicle was just hoisted from the ground. Before this operation took place the horse, of course, was removed from the shafts.

The only remaining portion of the machine is the steelyard, and passers-by, hazarding a guess at what it is, often say that it is an old gibbet upon which malefactors were hung.

The chain and cart have been worked in, to aid to a better understanding.

Another old cart-weighing machine.

Another specimen, the steelyard being of a more artistic character than the preceding one.

This method of weighing heavy loads, although satisfactory enough in its way, was slow and cumbersome, and ill-adapted to its purpose. From the construction of the machine it is clearly obvious that a strain exceeding two or three tons would be, in most cases, dangerous. The growing demands of commerce and industry rendered other and better means in this matter imperative. For the ease, facility and accuracy with which the heaviest loads can now be weighed we are indebted to John Wyatt, who was the first inventor of the "Machine for weighing loaded carts."

During a large part of his lifetime Wyatt worked at the famous Boulton Foundry, Soho. It is a coincidence that this place is now occupied by Messrss. W. & T. Avery, Ltd.

But Wyatt's lot was that of many inventors. It was whilst suffering imprisonment for debt that his mind was busied with devising a readier means of weighing loaded carts than then existed. By 1744, at the latest, he had brought his weighing machine to a practical success, and the first machine seems to have been erected in Snow Hill, Birmingham.

A weight-note used for the machine in Snow Hill is here shown.

This is a picture of a model of Wyatt's machine, belonging to Messrs. H. Pooley & Son. Wyatt declared his machine would weigh "a load of coal or a pound of butter with equal facility and with nearly equal accuracy." The counterpoise weights were hung from a projection of one of the underground levers, and were necessarily large and clumsy when compared with similar weights with which we are familiar.

A sketch of the levers of Wyatt's machine, showing the principle on which it was constructed. Instruments of this type are known as compound lever machines.

In tracing the history of the compound lever machine, America comes to the front. In 1831 Messrs Fairbanks took out their first patent for the machine which is now usually known by the name of "Fairbanks."

Here we have it contrasted with Wyatt's machine. The pillar which encloses the connecting rod, and supports at a convenient height the registering steelyard, is the striking difference and signal improvement.

A modern compound lever machine of small capacity.

A modern compound lever machine of large capacity. It is, perhaps, in the steelyard or weight recording part of the machine that most improvements have taken place.

There are steelyards without any loose weights; steelyards which will print on a ticket the ascertained weight; and in some cases the steelyard is replaced by a graduated dial provided with an indicating finger.

Canal or barge machine, as used in America. The contents of canal boats here in England are ascertained by gauging.

The counter machine: In the counter machine the pans, it will be observed, are fixed, and above the beam. When weights are placed on the pans, as shown—that is, at obviously unequal distances from the centre pivots, equilibrium must still be maintained. This is a necessary condition in all weighing instruments with fixed pans, and in an official test any machine which shows an appreciable variation owing to the weights being placed in different positions, is rejected as incorrect.

Professor Roberval, a French mathematician of the 17th century, invented in 1670 a balance after the style of the view exhibited. Its striking peculiarity is that when equal weights are placed at unequal distances from the centre axis, equilibrium is still maintained. The seeming paradox which it illustrates caused the contrivance to be considered as a mechanical wonder. For more than a century it continued to be regarded merely as a scientific curiosity. Yet it embodies the principle of the counter weighing machine. Wherever the weights may be placed a pull is set up in the top beam and a thrust in the lower one, and as these forces counteract one another, there only remain the two forces acting through the upright sides of the parallelogram. The original Roberval balance may be described as a jointed rectangle with projecting arms, the whole being free to move up or down. It is apparent that whatever position the rectangle assumes the projecting arms remain parallel, and hence move through equal distances. As the amount of mechanical work done by any force is proportional to the distance through which it moves, it follows that the two weights, being equal, perform the same amount of work, and hence produce equilibrium. Ninety per cent. of the counter machines now in use are constructed upon the Roberval principle. There are two other kinds to which short reference is made.

This shows the design of a Beranger balance, without the box which usually encloses the working parts. There are subsidiary beams, as will be seen, and these are linked to the main beam. In principle it somewhat resembles the compound lever weighing machine. The Beranger balance is to be seen most in druggists' and confectioners' shops. Owing to the large number of bearings, these machines cannot be advocated where fine weighing is desirable.

The Torsion balance was first produced in America. In this balance the knife-edge centres and their bearings, viz., the working parts of all lever scales, find no place. In their stead are pieces of wire stretched to a high degree of tension. The advantages claimed for this system are durability and less liability to derangement.

A Torsion balance, as occasionally used by chemists. These are very seldom seen now.

As distinct and separate from lever weighing machines, there is the spring balance known to everyone. Between the alteration of form of an elastic body, and the force by which it is actuated, a certain relationship exists, and the extent of the alteration of form enables us to compute the magnitude of the force. The elastic body used in the construction of scales is a spiral spring. The spring balance manufacture was commenced about the year 1760 at Bilston by Mr. Richard Salter. Hence the name Salter balance. There are several types of these balances.

This shows the interior of a well-known form, where the pan is above the spring. Into the merits and demerits of spring balances there is no need to enter. The subject has only to be introduced at a meeting of Inspectors of Weights and Measures in order to secure a discussion of the liveliest character.

AUTOMATIC WEIGHING MACHINES.

The constant repetition of certain processes of weighing, such as the sorting of coins, the making up of packages, and the checking of grain from ships, has led to many endeavours to devise means of accomplishing them in an automatic manner.

Automatic sorting scales have been successfully used in mints and banks for more than half a century. This is a view of the automatic scales used at the Mint, London. These scales weigh the coins with the greatest accuracy, and, moreover, separate the light from the heavy ones.

Of the various automatic weighing machines used for trade purposes, the best are based upon the principle of the even-armed balance. Their design is, therefore, of the simplest, and it is only the mechanism which is necessary for the serving and shutting-off operations that makes them appear complicated. As in the simple beam scale, the receiving receptacle is suspended from one end, and the counterpoise from the other. At the instant that the weight of the material poured into the receiver equals the weight of the counterpoise, the beam begins to move. This automatic movement is utilised to shut off the supply, empty the receiving vessel, return it to the filling position, and also, in some cases, register the weighing on a counting apparatus. In the case of granular substances which flow freely, all these operations can now be performed with rapidity and accuracy. With substances of a cohesive nature, such as flour, moist sugar, cocoa, etc., the difficulty is to secure a steady flow from the feeding hopper.

The ubiquitous penny-in-the-slot machine is really no more automatic than any ordinary platform machine fitted with a dial. The only part that the penny plays is to liberate the index finger so that you may read off the weight.

To combine weighing and computation so that not only the weight of the goods, but also their value, may be ascertained, is certainly a desideratum. The Americans have introduced several machines which perform this double function.

STIMSON COMPUTING SCALE.

Description: When the weight is placed on the goods-pan a drum inside the cylinder revolves. The extent of the movement is regulated by springs, and varies, of course, according to the weight placed on the pan. The weight of the goods is read off in the space in the middle. Running horizontal to this is an opening which discloses figures marked on the revolving drum. Below this horizontal space or window, and marked on the outer frame, are the prices per pound, ranging generally from 2½d. to 2s. 6d. When the weighing is completed, if the article being sold is worth, say, 11½d. per pound, the value of the goods on the pan will be shown in the horizontal space immediately above the 11½d. mark. The openings for the weight indications and the money indications are protected by glass.

The machinery by which the integrity of our weights and measures is maintained, and by which, in a practical sense, sixteen ounces make one pound, twenty fluid ounces one pint, and thirty-six inches one yard, is worth notice.

First of all there are the Imperial Standard Pound and the Imperial Standard Yard. These are the units from which are derived all our weights and measures; the gallon being legally defined as equivalent to 10lbs. of pure water at 62 deg. Fahrenheit.

The Imperial Pound is of platinum, with a groove or channel round it for the insertion of the points of the ivory fork by which it is to be lifted. You will observe that it is severely plain in design, and free from sharp edges.

The Imperial Yard is a solid square bar of bronze or gun-metal, 38 inches long, and one inch square in transverse section. Near to each end a cylindrical hole is sunk to the depth of half an inch, and at the bottom of this hole is inserted a gold pin or plug about one-tenth of an inch in diameter. Upon the surfaces of these plugs fine lines are cut in opposite directions so as to determine the centre points, the interval between these centre points gives the measure of the length of the Imperial Yard. The charge of the Imperial Standards is entrusted to the Standards Department of the Board of Trade, and exact copies of them are deposited in the British Houses of Parliament, at the Royal Observatory, in the Royal Mint, and with the Royal Society. In the event of the Imperial Standards being lost or injured, they may be legally replaced by reference to or by the adoption of these copies. The fatality, therefore, which, in 1834, befel the then existing Imperial Standards when the Houses of Parliament were burned, is now, practically speaking, impossible.

The Standards in the Houses of Parliament are immured in the wall of one of the staircases of the House of Commons. The spot is indicated by a brass tablet, and once every twenty years these copies are disentombed for the purpose of being compared with the Imperial Standards. The other copies of the Imperial Standards must be compared with each other once every ten years, and once in every twenty years with the Imperial Standards. Although the result of these periodical tests discloses variations scientifically appreciable, yet the discrepancies are of a give-and-take character; there is no set tendency in one direction or the other.

The local authorities who administer the Weights and Measures Acts, and appoint the Inspectors of Weights and Measures, are called upon to provide for the use of their officers the necessary standards, and these are termed local standards.

The illustration gives an idea of the equipment of a Weights and Measures office in this respect.

In the case of British local standards of weight, they must be re-verified by the Board of Trade at least once in every five years, and in the case of measures, once every ten years. These re-verifications are endorsed upon a parchment indenture which is issued by the Board of Trade. It is against these local standards that the weights and measures used in trade are tried. The latter are, therefore, it will be seen, linked up and kept in true relationship with the Imperial Standards.

A uniform design of stamp is used by all British inspectors. It consists of a crown, the Sovereign's initials, and a number. The number identifies the district of the inspector. Where practicable, the mark of verification is struck either directly on to the instrument, or on to a lead plug inserted in the same. Glass or earthenware measures are stamped by means of a sandblast.

By these machines, which are generally worked by power, a blast of sand is forced through a stencil-plate on to the surface of the measure, which thus receives an indelible impression of the desired mark.

The aid of the balance has not escaped the attention of the advertising expert or of the designer of picture postcards. Many instances of this will probably spring to the mind. A few samples by way of conclusion may be given:

1. Figure of Justice.
2. Ogden's advertisement.
3. "Hachette" Almanach.
4. "Running down the scale."