principle of combined changes of leverage affords a favour­able means of employing an unchanging weight to balance others, both greater and less than itself ; and at the same time admits of the parts necessary to produce powerful and sustained resistance being practically formed within con­venient compass. The self-adjusting power thus generally obtained is regulated in the rate of its increase by a defi­nite construction of the curves, which are formed to cause equable as well as progressive resistance, by which means the balance is moved through equal angles by equal weights. The graduated scale extends to three quadrants, more or less. The chief advantage of the balance is, that it com­bines this lengthened primary movement with equable gra­duation and unyielding mechanical construction. The different sizes of which it is made have each an appropri­ate form of curve. The least is fitted for the minute sub­division of small weights ; the next indicates to four or sixteen ounces ; and larger sizes range to twenty, fifty, 100 pounds and upward. In the adjoining figure, the spiral arms, which before are in the same vertical plane, and merge into one continuous curve, here occupy different planes; but being united by an interme­diate rod, which passes through the upright of the stand, they have simultaneous move­ment The dial is fixed to the bearing-frame, and the pointer is carried round by the axis. The graduation, which in this form may be prolonged to any desirable extent, occupies a full circuit. In other re­spects, the description already given is alike explanatory of both balances. There are some minutiæ which give refinement to their action ; but as these are used only in particular machines, they are not represented, and need not be described in detail. A deli­cately constructed modification of the instrument is also ar­ranged to shew, on inspection, and without the use of eke- weights, the specific gravities and weights per cubic inch of different fluids.

III. *Self-adjusting Balances, which derive their resisting Power from the Elasticity of Metals.*

Under this head may be mentioned Coulomb’s torsion-balance, formed of brass wire, the twisting and untwisting of which is applied to the measurement of small forces. It is described under Balance, p. 307. Hydbodynamics, p. 76, and Mechanics, p. 401. The dynanometer for the measurement of larger forces, and applica­ble also to the ascertainment of weight, is explained at the conclusion of the article Dynamics. That of Mr Veitch is represented and described in the article Agriculture, p. 355.

The spring is supposed to have been applied to the pur­poses of weighing about the year 1690 or 1700. About this period the dynanometers of Graham and Desaguliers were superseded, first by Monsieur Leroy’s of the Aca­demy of Sciences, who applied to the purpose the compres­sion of a spiral spring; and next by Monsieur Regnier’s, in which the distention of an elliptical one was adapted to the same end, both springs being then also in use as ba­lances. The spring-balance is constructed in a variety of modified forms ; but in all of them the weights under ex­amination are caused either to bend a plain spring, or to compress or extend an elliptical, semi-elliptical, or spiral one ; or both to compress and extend the spring when form­ed to admit of this. The amount to which any of these descriptions of spring yields to different stated weights, is shewn on a graduated scale properly situated for the purpose. The principle of extension is preferable to the other, inasmuch as it is put in operation by simpler and less complex means ; and when the weights to be examined are large, the elliptical spring should be adopted ; but when these are of a moderate amount, the spiral form is best. For many purposes the spring-balance is a convenient in­strument, but not a lasting one. The spring, when fresh and unused, is equable in its successive yieldings, but is liable to variations, which cause it gradually to lose cor­respondence with the divisions. It is affected by tempe­rature, and weakened by use; and if overstrained or cor­roded, its power and quality are materially changed. In some balances an extra spring is introduced to adjust these irregularities; but this should be omitted, as its opera­tion increases the chance of error, without removing the cause ; for though the pointer, when displaced, may he re­stored by it to zero, there are then two acting springs changed in position, quality, and strain, while the line of graduations remains as it was derived from the original elas­ticity of the leading spring.

In this balance, by Mr Marriott of London, the spring is formed into an arbitrary curve, and is placed in a shallow brass box behind the dial, which latter is here sup­posed to be transparent ; one end of the spring is fixed to the upper side of the box, and the other end to the head of the rod which carries the hook. Near the same point of this rod is also attached the head of the rack-plate, which, as the hook be­comes loaded, is lowered by the spring and turns the pinion, and with it the pointer, which indicates the weight.

When in use, the portion of the spring to the left is extend­ed, and that to the right compressed ; and during descent, the rack is kept in gear with the pinion by a screw-pin at its right side.

This balance, by Mr Salter of London, is re­presented in the annexed figure, the index-plate in front being supposed transparent. It is formed of a spiral spring, which is contained in the up­per part of a cylindrical case, behind the index-plate. One extremity of the spring is fastened at the head of the instrument, and the other ex­tremity is fixed to the rod which carries the poin­ter and the hook or scale. The spring extends in proportion as the hook is loaded ; the pointer at the same time shewing the weight on the gra­duated front. Mr Salter subsequently made some alterations, which he patented ; most of them however relate to minor details, and need not be described.

IV. *Self-adjusting Balances, whose progressive Indications are regulated by the Properties oj' Fluids.*

Under this head may be included several of the various instruments for ascertaining specific gravities, which are described under Hydrodynamics, p. 22-25. Although most of these require eke-weights to complete their range of indications, they are nevertheless of self-adjusting cha­racter ; their principle of adjustment depending on the dif­ferent depths to which fluids of varied density permit the graduated stem of the instruments to sink. Here also may be mentioned Mr Harris’s electrometer, described un­der Electricity, p. 658, a balance in which the resist­ance is obtained by the accumulating power which an elongated counterpoise acquires when caused to emerge from a fluid ; the same principle being further illustrat­ed under the article Gas-Light, p. 353—54, where its ap­plication to the progressive balancing of the gasometer is explained.