balance, on concave arcs, situated one on each side of the lever OM. These arcs are formed on the upper end of a block, which rises from and is fixed to the bottom of the box. The lever is again crossed at M, by a fulcrum hav­ing its angle pointing upward ; and from this angle a re­ceiving scale for the weights is hung by a shears or double ring. In cases where it is wished that the machine when unloaded should preserve equilibrium, the lever OM is pro­longed to the left, and loaded at that end, to the extent requisite to balance the weight of the levers.

A side view of BK, one of the limbs of the crooked lever AKB is here given, in the direction of the diagonal BD. The lever, as shewn in the figure, is kneed to an extent sufficient to admit of the an­gular points of the fulcra be­ing placed in the same hori­zontal line. The other limb AK is of the same shape. The form of the entire lever AKB is thus easily understood. Its companion lever DIC is of the same construction. The limbs of the levers are therefore so shaped that the fourteen sharp bearing parts of all the fulcra are situated, during equilibrium, in one ho­rizontal plane. These bearing parts, and the parts they bear against, are all formed of polished steel.

If now EA be supposed a tenth part of the length of EK, then 100 pounds placed on the platform, or on the wheel-tracks, and pressing therefore on the studs E, F, G, H, will be sustained by ten pounds of an upward pressure at IK. And if, again, OL be a tenth part of LM, the ten pounds of upward pressure will be given by one pound placed in the receiving scale at Μ. These proportions are assumed, for easy arithmetical illustration ; but in the prac­tical construction of the machine, the distance between the resting points at E, A, and at O, L, is made to bear a greater ratio to the distance between the resting points at E, K, and at L, M, than has here been supposed. Instead of using a receiving scale, the lever OM may be prolonged to the right, and graduated as a steelyard. And in ma­chines where an upward instead of a downward pressure is given at M, the lever OM is prolonged to the left, and the fulcrum L and its resting-block removed to N.

Machines consisting of variously modified systems of levers have been used for a considerable period. The one above described is that generally employed. The arrange­ment of the levers is well conceived, and exactly suited for the purpose to which the machine is now chiefly applied. Its first contrivance and employment is said to have been for weighing the riders of race-horses.

The beam of this balance consists of two rods, at some distance apart, but united so as to move together. The scales are supported above this rectangular beam ; the ris­ing and sinking of the frames in which they rest, and by which they bear on the knife-edges at each extremity of the beam, being regulated by a parallel movement, the levers of which are placed in the stand of the balance. It is understood to have been of French invention, and is a convenient form of machine ; but the bearings, which are numerous, and liable to be somewhat displaced, give rise to considerable friction, and occasionally to slight derange­ments of the leverage. Some improvements on it in these respects were patented by Mr Poupard of London. In his machine there are still however three parallel knife-edge bearings, three circular ones, and other sources of friction, which, from the con­struction necessary for the proper ascent and descent of the scales, cannot be avoided. The working parts of the machine are mostly cased up to protect from dust. In the annexed figure, some of these casings are omitted, that the representation may be properly intelligible.

II. *Self-adjusting Balances, which derive their Power of pro­gressive Resistance from Properties strictly mechanical.*

Under this head we place Ludlam’s balance, introduced about 1760, and an improved modification of it, named the bent lever. Ludlam’s is described under Mechanics, p. 371, and the bent lever under the article Balance.

This balance, by Mr Brady of London, is provided with different points of suspension for the scale, and is a mo­dification of the bent lever one. In the upper end of its lever are three cavities, at different distances from the centre of move­ment, from any of which the scale may be hung. For each cavity there is a separately graduated arc. The three arcs are placed one above another, and move through an open­ing in the bar or shears which car­ries the receiving scale, the edge of the bar serving the purpose of a pointer. When the scale is hung from the cavity next the upper end of the lever, the beam becomes ho­rizontal, each ounce, as far as two pounds, being indicated on the upmost arc. When hung from the middle cavity, each alternate ounce, as far as eleven pounds, is indicated on the middle arc ; and when hung from the remaining cavity, each quarter pound, as far as thirty pounds, is indicated on the lowest arc. In point of principle it differs from the bent lever thus far, that the acting mass of the counterpoise is altered (for the most part increased) by the accumulating weight of the gra­duated arcs and their strengthening stays as they pass the vertical line from the centre.

The balance by Mr Dampier of Ware is in this respect the reverse of Mr Brady’s. Here a circular disc or wheel is employed, which, as it turns on its centre, is balanced in any position, and therefore neither adds to nor diminishes the acting mass of the counterpoise, which is hinged on a round stud placed in the rim of the disc. The scale is simi­larly attached to the rim of the disc, a little more than a quarter circumference intervening between the two studs. The pointer is formed in the suspending frame or stand which supports the axis, and the graduations are marked on the upper part of the circle. This construction is a modi­fication both of the bent lever and Ludlam’s balance, and, in cases where the weights to be examined are of small amount, is preferable to the former.

The foregoing self-adjusting balances are placed to­gether, as being nearly allied, and having a similar extent of movement, viz. something short of a quadrant.

In this balance (manufactured by Messrs Milne, Edin­burgh), the opposing arms are formed of grooved eccentric, or spiral curves. These are acted on by the cords or flat chains which suspend the counterpoise and receiving scale, and are thus caused to move round on their common axis, which is placed in the pole of the curves. In the annexed figure the dial is sup­posed to be transparent, and being fixed in front to the curved balance, moves along with it. The pointer is station­ary, and is fastened to the shears or fork which suspends the balance, and indicates on the dial as it passes round. By the changes of leverage which oc­cur in the course of revolution, the counterpoise rises from a small power to a greater ; while the scale, in pro­portion as it becomes loaded, contracts throughout from a greater leverage to a less. This general