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A CALCULATING JOLLY BALANCE

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In 1911 a recording Jolly balance was described[1] by which the determination of specific gravity was greatly simplified, only two readings and a single division being necessary. Since that time this balance has been introduced in many mineralogical and research laboratories where the determination of the specific gravity of minerals or solids must be frequently made. Of the research laboratories using one of these balances mention must be made of that of the Champion Porcelain Company of Detroit. In that laboratory it became necessary several years ago to make very rapid determinations of the specific gravity of some of the minerals used in the manufacture of spark plug porcelain. In order to reduce the time necessary for such determinations the balance was further perfected by a member of the research staff who devised a calculating attachment. It soon became known to me that such an attachment had been worked out but up to the present time I have not seen it. Furthermore a description of that calculating attachment has never been published.

In the fall of 1925 I devoted considerable time to the further development of the balance, as described in 1911, with the thought of devising a calculating attachment. After this improvement had been worked out, drawings of the earlier device used in the research laboratory of the Champion Porcelain Company were placed at my disposal through the courtesy of Dr. J. A. Jeffery. The principle used in both of these attachments is the same. The balance to be described marks a decided advance over the 1911 model and is a mechanical improvement over the one perfected in the laboratories of the Champion Porcelain Company, for it is not only a calculating instrument but may also be used for the actual naming of the mineral under consideration.

[1]Kraus, Edward H., A NEW JOLLY BALANCE, *Am. J. Sc.*,(1911) XXXI, 561–563; also EINE NEUE JOLLY'SCHE FEDERWAGE ZUR BESTIMMUNG DES SPECIFISCHEN GEWICHTS, *Centr. Min., etc.*, (**1911**), 11, 366–368.

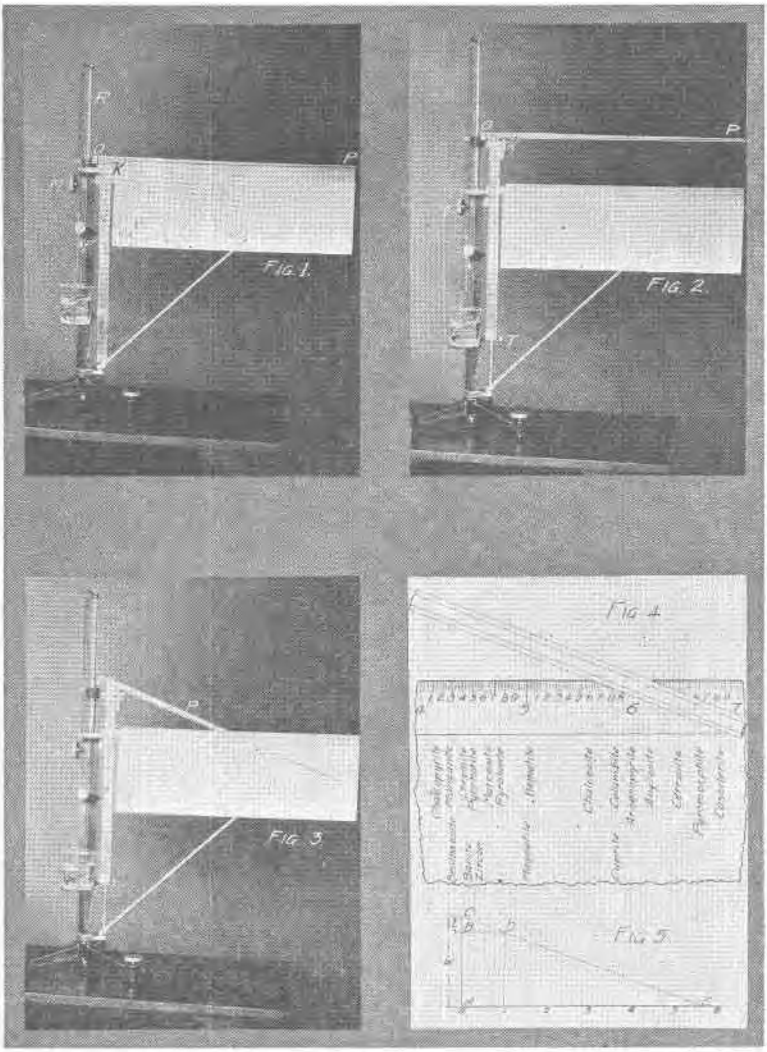
FIG. 1.
FIG. 2.
FIG. 3
FIG. 4
FIG. 5.
P

In describing the new balance use will be made of three photographs and two drawings. The new attachments consist (Fig. 1) of a horizontal graduated scale and a chart of mineral names both rigidly attached to the right side of the balance proper and supported by an inclined rod. Directly above the horizontal scale there is a movable pointer *P*, which pivoting at *O* rests on a knife-edge *K* (Figs. 1 and 2).

The balance is used, as described in the earlier papers, by bringing the horizontal sighting disk opposite the horizontal mark on the mirror directly back of the disk. This can be done approximately by adjusting the length of the rod *R*, and then accurately by the fine adjustment screw *F*. Figure 1 shows the balance after this adjustment has been made. The specimen to be determined is then placed in the upper scale pan. The sighting disk is again brought opposite the mark on the mirror, this time by turning the milled head *M* so as to drive the vertical support of the spiral spring upward and thus elongate the spring. Figure 2 shows that in this operation the movable pointer *P* also moves upward, the horizontal graduated scale and the chart remaining as in Figure 1.

When the sighting disk is again exactly opposite the mark on the mirror the screw *T* is tightened. The specimen is now transferred to the scale pan in water and the milled head *M* turned so as to shorten the spring until the sighting disk is for the third time opposite the mark on the mirror. In doing this the knife-edge *K* moves downward. This permits the pointer *P*, pivoting at *O*, to fall and assume an inclined position across the horizontal graduated scale (Fig. 3). The inclination of the pointer obviously depends upon the relative positions of the pivot *O* and the knife-edge *K*. The reading on the graduated scale where the pointer intersects its upper edge is the specific gravity of the specimen. The name or names of the minerals on the chart directly below this point indicate the probable identity of the mineral under consideration. Only common minerals have been listed on the chart shown in the accompanying cuts.

The mineral used for this demonstration was a specimen of crystallized chalcocite from Cornwall, England. The enlarged portion of the horizontal graduated scale showing the intersection with the pointer (Fig. 4) plainly indicates the specific gravity as being 5.61 and that the specimen should be chalcocite.

The mechanical calculation obviously depends upon the use of the similar triangles *CAE* and *CBD*, as shown in Fig. 5, where *CA* is proportional to the weight of the specimen in air (*W*) and *CB* to the loss of weight of the specimen in water (*L*). The unit used in the horizontal graduated scale is *BD*, the horizontal distance between the center of the pivot *O* and the knife-edge *K*. The following relationships between these sides of the two triangles now becomes obvious.

$$\frac{W(\text{weight in air})}{L(\text{loss in water})} = \frac{AE}{BD} = Sp.\,Gr.$$

$$BD = 1$$

$$\text{Therefore } Sp.\,Gr. = AE$$

The graduated scale used with the balance, as shown in the figures, permits of the determination of solids with specific gravities up to 12. For heavier substances the pointer *P* may be moved to the right so that the distance petween the pivoting point *O* and the knife-edge *K* (*BD* in Fig. 5) is reduced one-half. A properly placed hole is provided for this purpose. When *O* is in this half-way position the readings on the graduate scale must obviously be doubled, and it now becomes possible to determine values up to 24.

Where rapid determinations of the specific gravity of solids is a matter of routine, or where the time element is of great importance, this new instrument has many advantages over the older forms of jolly balances.

The attachments described in this paper were made by Mr. Ralph Miller of the Eberbach and Son Company of Ann Arbor, Michigan, to whom I wish to express my appreciation for his very expert assistance.

HYALOPHANE FROM FRANKLIN FURNACE, NEW JERSEY

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This barium feldspar was discovered at Franklin Furnace by the chemists of the New Jersey Zinc Company. A mass of coarse granular feldspar, dark red in color, was found in the old dump of the Parker Shaft and upon analysis showed the presence of more than 10 per cent of barium oxide. It is associated with the black