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An Egyptian surveying instrument - by Amelia Carolina Sparavigna

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In 1906, an Italian archaeological mission lead by Ernesto Schiaparelli, found a tomb of the New Kingdom, which had survived intact until the discovery. In this tomb, Kha and his wife Merit were buried. Kha was an architect and an important supervisor at Deir El-Medina, during the 18th Dynasty [1]. Nowadays, coffins and items of the tomb are kept at the Egyptian Museum of Turin [2], with a small wooden statue of the architect (Fig.1). Kha had for his afterlife, some tools that he used for his job as supervisor. Among them we can see a wooden cubit that can be folded by hinges. Since wood was the preferred material for the cubit rods of architects [3], quite probably this cubit was the one that Kha handled during his job. Besides the rulers, Egyptians had several other tools for masonry, such as plumbs, levels and squares [1,3]. As ours, the Egyptian plumbs consisted of a suspended plumb bob [3].

Among the items of the Kha's tomb, one is unique (see Fig.2). The label tells that it is supposed to be the case of a balance scale, or the scale itself. Due to its form and related moment of inertia, it is better to reject the hypothesis that this object can be a sort of balance. The complex decoration of the case suggested me that this is a protractor, able then to determine directions and measure angles [1]. The decoration (Fig.3) has a 16-fold symmetry of a compass rose with 16 leaves. Outside this rose there is a polygonal line with 36 sides. As discussed in [1], the fraction 1/16, corresponding to one leaf of the decoration, is a component of the Eye Of Horus, a symbol defined during the Old Kingdom to represent the number one. The number of the sides of the polygonal line corresponds to the number of Decans, the 36 groups of stars which rise in succession from the horizon due to the Earth revolution.

Considering the case as a protractor, this is a quite interesting gauge having two scales, one based on Egyptian fractions, the other based on Decans.

To show how to use the Kha's protractor, we can consider the measurement of the angle of an inclined plane. Note that the case has a lid (Fig.2). Let us remove the lid; the case has a perfectly straight side that can be put on a smooth surface, as shown in Fig.4. When the surface is horizontal, using a plumb to have the vertical direction, one of the directions of the rose of Fig.3 coincides with the direction of the plumb. If the surface is inclined, the direction of the rose is inclined forming an angle with respect to the vertical. This angle is equal to the angle of the inclined plane. Therefore, architect Kha could have used his tool, with the contemporary use of a plumb, for a practical measurement of inclination.

Let us be even more specific and concrete: we can use the Kha's protractor to measure the stair angle of buildings, as, nowadays, the universal protractor - a tool available at most hardware stores - is used to determine this angle. The procedure is the following; a straightedge is laid across a minimum of three steps (see Fig.5). The universal protractor is put on the straightedge and the angle determined with a plumb. In the case that the flight of stairs is very long, it is necessary to measure the stair angle at two or three different places along the run to check that the angle remains constant on all the flight of stairs. A modern universal protractor for masonry is shown in Fig.6. Note that the modern tool has the same shape as the object found in the Kha's tomb. In fact, during his job as supervisor, Kha had surely the need of surveying the constant inclination of stairs.

To conclude this discussion, let me propose a comparison of the decoration of this Egyptian item with that of a compass rose of directions. The rose I use is that we can see in a table of Surveying from the 1728 Cyclopaedia [4,5]. This rose has two scales. As shown in Fig.7, we can go back from the compass rose to the Kha's rose, with small adjustments. May be, the origin of the design of the compass rose is in the ancient Egyptian tools.

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