ALUMINUM SURVEYING INSTRUMENTS

Professor Gerald A. Willett, Jr. of the School of Engineering of the University of Idaho has requested information about surveying instruments made of aluminum. He notes that in 1904 Howard B. Carpenter ordered specially constructed aluminum instruments for the survey along the Bitteroot Range on the border between Idaho and Montana. One was a solar transit manufactured by Young and Sons and the other a large Burt Solar Compass produced by W. & L.E. Gurley.

The following account of aluminum surveying instruments has been compiled by Murray Kamrass, an associate of the National Museum of American History of the Smithsonian Institution.

One of the earliest references to the use of the new metal for surveying instruments appeared in an item entitled "Aluminist" in the January 1864 (Volume XVIII) issue of the *Scientific American.* The writer, a civil engineer and surveyor of Helena, Montana, suggested that if used in the production of engineering and surveying instruments, aluminum would offer significant advantages. He calculated the additional cost of an aluminum "compass telescope" with aluminum selling at one dollar an ounce and added that he would be willing to pay the difference of cost for the substantially decreased weight.

The February issue of the same periodical published a response to "Aluminist" from L. Berger, an instrument maker of Roxbury, Massachusetts. He claimed that the weight reduction that would ensue with the replacement of brass with aluminum would impair the accuracy of the instrument. He went on to add, however, that cost was the primary factor preventing the use of aluminum in the manufacture of instruments.

The first aluminum transit of record was made by the firm of W. & L. E. Gurley of Troy, New York and displayed at the Centennial Exposition held in Philadelphia in 1876. The instrument was described as having a 7-1/2 inch graded circle and a weight of 8 lbs. 10 oz. The instrument was acquired by Walter Washabaugh, a civil engineer of Charlottesville, Virginia. After having had more than fifty years of field service, it was acquired by the Gurley firm and retired to its museum in Troy.

After 1876 the Gurley catalogues included an offer to regular patrons that aluminum transits would be made to order. The direct electrolytic process for extracting aluminum invented ten years later, in 1886, resulted in a drastic decrease of the price of the metal.

Young & Sons announced in their 1892 catalogue that the firm would make aluminum instruments on demand, but that it does not, "as yet, desire to endorse this metal as being suitable for the *whole* instrument." By 1911, however, Young & Sons was making "the non-working parts of Transits and Levels of a patented Aluminum Allogy."

Aluminum instruments were produced and exhibited at the Columbian Exposition held in Chicago in 1893 by several makers. Among these were the firms of W. & L.E. Gurley, Keuffel & Esser, Buff & Berger, and James W. Queen & Co. Each of these makers, except for W. & L.E. Gurley, advertised that they would make aluminum instruments to order. They noted, however, that they did not recommend them, and that their smaller brass transits were to be preferred if lightness of weight was an important factor to the user.

Aluminum surveying transit made by Keuffel & Esser of New York. It was taken to the North Pole by the American arctic explorer Commander Robert E. Peary (1856-1920) on his fourth voyage 1898-1902, during which he reached 87 6' N., only 174 miles from the Pole, before he had to turn back. In the collections of the National Museum of History and Technology, Smithsonian Institution. (Photos courtesy of the Museum).

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After World War I the alloy duralumin, and methods for heating such alloys, were developed for aircraft structures, providing a new material for intrument making.

In 1925 W. & L.E. Gurley announced in an article in the *Engineering News-Record* that the firm intended to market aluminum alloy transits. The one-piece frame, standards, top plate and spindle were to be made by a combination of drop forging and die casting methods. In producing the design, engineers at Gurley collaborated with engineers of the Aluminum Company of America. However, ALCOA insisted that Gurley idemnify them against any losses if the casting proved to be unsuccessful.

The first successful casting was made in July 1927, and a patent was awarded to Gurley in 1933. Although the major components of the instrument was made of aluminum alloy, brass or bronze was required for some parts, such as bearings, bushings and screws. An aluminum alloy transit weighed 9 lbs. while a brass transit of comparable size weighed 14 lbs., a difference in weight of five pounds.

The Gurley catalogue stated that the aluminum alloy was superior to other materials. It claimed further that despite their lightness of weight, aluminum transits were less subject to vibration than brass instruments. In the following years the Gurley firm used aluminum alloy for the production of the major structural components of their reconnaissance, mining and explorers' transits. Nonetheless, Gurley continued to manufacture the heavier and more precise transits of their "Hell Gate" line of brass and bronze.

In the years 1940-41 W. & L. E. Gurley undertook a development contract for the United States Army Corps of Engineers to produce two transits equipped with lighting for night surveying, a requirement of Army artillery. Inasmuch as Gurley was already tooled up for the production of aluminum transits, the development instruments were also to be made of aluminum, although the applicable Army specifications for the transits called for brass.

Gurley continued to produce aluminum instruments until the end of 1980. Now a division of the Teledyne Corporation, the Gurley firm has discontinued making surveying instruments, although the company continues to sell them. **PS**