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Tools of the Geology Trade and Their Origin

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ABSTRACT

Tools of the trade help a geologist in the field to measure, describe, and record data about rocks and their position and spatial relationships. We explore some of the trademark tools of a geologist and the origin of each tool.

INTRODUCTION

Geology is built upon observations of the natural world. Geologic field work, with few exceptions, remains the primary source of data in the solution of geologic problems, and involves collecting data about the spatial distribution of rock units and structures in order to develop an understanding of the geologic history and distribution of rock units in a particular region. A variety of tools have been developed to aid geologists in their exploration of the Earth, and no self-respecting geologist would head into the field without most of these tools.

If I had a Hammer: Story of the Estwing G-pick

In the good ol’ days a geologist actually went to the field and looked at the rocks and the standard field equipment was the Estwing hammer (the G. pick) (fig. 1). But, few geologist then, and those who still use the hammer were or are now aware of the origin of the hammer and its name.

Ernest O. Estwing was born in 1884, and immigrated from Öland, Sweden to Rockford, Illinois when he was 16. There,
industry provided employment attracting the immigrant skilled woodworking Swedes. As Estwing pursued the carpenter trade in Rockford, he noted the problem his fellow Swedes had with the frequent breakage of the then wooden-handled hammers. Seeing a remedy for this, first in his home he produced a one-piece steel forged hammer, and then subsequently in 1923, set up a manufacturing company that produced the hammer in quantities.

Thus the Estwing hammer was born. Where the claw of the carpenter’s hammer was, he made either a point (for hard rocks) or a chisel edge (for soft rocks). Initially the steel handle was covered by leather strip segments, but later it was padded with a heavy duty sponge rubber covering. Advertisement for the hammer noted this was ‘The first choice of rock hounds and geologists the world over.’ Estwing also produces a variety of other geological field items including a double face engineer’s hammer and a Geo/Paleo Pick.

Ernest Estwing, founder of the company, always was interested in rocks and had a large collection in his basement at home. Overcoming production and financial problems and a great depression and a world war, Estwing became a major manufacturing company. Ernest died at the age of 97, but lived long enough to see his G-pick make two trips to the Moon. His son, Norman, took over the firm, which is still a very much a going concern.

Show Me the Way:
Story of the Brunton Compass

Geologists have few field tools, but one of the most important besides the Estwing G-Pick is the Brunton compass (fig. 2). Any geological feature requiring a direction or inclination, such as a strike and dip, fault orientation, or glacial striae can be
made with the Brunton. The compass can be set for any inclination so that the direction read is the true one.

Figure 2. The Brunton compass.

A Canadian mining engineer, David William Brunton invented and patented the Brunton Pocket Transit in 1894. He developed the idea of the compass that also could measure angles while working in Colorado in the mining industry. The hand-held compass was contracted to be manufactured by a Denver watch maker, but since 1972, it has been manufactured by a group in Riverton, Wyoming.

Brunton was born in Ayr, Ontario in 1849, and died in Rochester, Minnesota in 1927. He was president of the AIME in 1909-10. He was honored by the the American Institute of Mining, Metallurgical, and Petroleum Engineers (AIME) with the first Saunders Gold Medal for Distinguished Service in Mining in 1927, and in 2004, was inducted into the Mining Hall of Fame. He published only two short papers - one in 1888, and the other in 1905. As noted by von Bitter (1995) ‘...he would, no doubt, be pleased with the advances made and would probably wonder how the next century will change and improve his still-widely used pocket transit.’

Measuring the Vertical: Locke’s Hand Level Story

John Locke, Sr. was a medical doctor, botanist, educator, and inventor (fig.
3). He also served in the U.S. Navy as an Assistant Surgeon after graduating from Yale. Later he worked as a geologist in Ohio and Iowa. Locke was born in Fryeburg, Maine in 1792, and died in Cincinnati, Ohio in 1856.

He had the knack of fixing things and was especially interested in how they worked and were put together. In 1850, he patented the Locke Hand Level (fig. 4), which is used by field geologists to measure vertical thickness.

![Figure 3. The Locke Hand Level.](image)

By knowing your HI (height of instrument; the measurer’s eye height above the ground) vertical differences can be measured fairly accurately.

![Figure 4. By knowing your HI (height of instrument; the measurer’s eye height above the ground) vertical differences can be measured fairly accurately.](image)

**Seeing in 3D: Geology in Three Dimensions**

At one time the stereoscope and view cards were found in every American home. The first stereoscope viewer was created in 1833 by Sir Charles Wheatstone (1802-1875), a British inventor who was born in Gloucester, England and died in Paris, France. The first images used were drawings and later photographs. In 1859, Oliver Wendell Holmes developed a compact, hand-held viewer and Joseph L. Bates of Boston made improvements and manufactured them.

![Sir Charles Wheatstone](image)

Stereo pictures were taken by a camera with two lenses, which provided two pictures about the distance apart of your eyes. Later, a camera recorded pictures in an overlapping sequence from a moving vehicle first with a film camera and now with a digital one. When viewed with a stereoscope your eyes blend the two views into one, and the image is perceived in three dimensions as with normal vision.

The third dimension is an important aspect in field geology. Some things are better observed that way, and to do so, the geologist can be equipped with a pocket stereoscope to view aerial photographs in the area of interest (fig. 5). These photographs are taken usually from a low-flying airplane (~15,000 ft), printed about 9x9 inches, and used in adjacent pairs to view features in 3D. Later, those data can
be checked in the office and collated in the laboratory to make a geologic map of the area. These photographs have been available since the early 1920s from various government agencies depending on their initial intended purpose.

Figure 5. Stereoviewer with aerial photos.

Walking Stick that Serves as a Measuring Pole: the Jacob’s Staff

A Jacob’s staff, which can serve as a walking stick, has been around for centuries. The staff usually 5 feet long and divided into five 1-foot intervals is a standard field item for the serious field geologist. The Jacob’s staff, along with a Brunton compass set for the dip of the beds can be used to measure true thicknesses of tilted beds (fig. 6).

Figure 6. Measuring a stratigraphic section utilizing a Jacob’s staff.

The name for the measuring stick is not certain. It may refer to (1) the Biblical patriarch Jacob, or (2) its resemblance to Orion referred to under the name Jacob in old sky charts, (3) or maybe to the Pilgrim’s staff which was the symbol of St. James (or Jacobus in Latin), or (4) simply its shape that of a cross.

The original Jacob’s staff, or cross-staff, was a single pole device credited to Levi ben Gerson (1288-1344), who was one of the leading Jewish mathematicians of the 14th century.

An early rendition of the staff is in a drawing of Johann Baptist Cysat (ca 1587-1657) holding a Jacob’s or cross staff. The cross staff was used to determine latitude by measuring the altitude of the North Star or sun. Now the Jacob’s staff is used primarily for measuring and supporting surveyor’s equipment.

Figure 7. Planetable with alidade.

Geological Field Mapping: Use of the Planetable and Alidade

Geologists do detailed mapping with a planetable (fig. 7) and alidade (fig. 8). A geologist holds the rod on the item of interest and the planetable man reads off the
elevation and distance with the alidade and records that data point on the map. The geologist records the geologic data at that station in a field notebook. Later, the geology or structure is sketched in depending on the problem.

Planetables apparently have been used since the 16th Century and the alidade was adapted from scientific and astronomical instruments. The word alidade means ruler in Arabic, in Greek it is dioptra, and fiducial line in Latin. An example of a surveying instrument in 1728, is an alidade on a circumferentor.

The planetable is set up in a place with good visibility to see the area to be mapped. Presumably information on elevation is obtained from a nearby geodetic marker or the problem assumes an elevation because it is not important to the problem, but only the relative changes in elevation in the area of interest. The table is leveled and oriented by a compass after the magnetic declination has been set. The alidade then is used to record the data at each station occupied by the geologist. The rod, usually 16 feet long, is marked off in intervals that are read by the instrument man giving the distance and with the angle information from the alidade an elevation is determined. That data point then is recorded on the map. Today, most of the mapping is done on topographic sheets with the GPS system for exact location.

Figure 7. Geologist using a planetable.

Figure 8. Alidade.

What Every Field Geologist Needs: Tools for Field Geology

For the past several issues, we have explored the origin and use of some of the geological field equipment. The well-equipped field geologists needs: an Estwing hammer, Brunton compass, Locke level (optional), Jacob’s staff, measuring tape, hand lens, camera, field glasses, maps, field notebook with pencil and sharpener, sample bags (optional), and depending on the survey, aerial photos and pocket stereoscope. The use of these items should be obvious and are pretty much self-explanatory. The camera, maps, and notebook are to record the data seen or collected. Much is left to be learned about geology ion the field. Let’s hope that the field days for geologists are not over.

Editor’s Note.

I completed my undergraduate geology degree while still on active duty in
the Army and was a bit taken back on the first day of instruction in my Introduction to Field Geology course. The instructor announced we would be going ‘to the field’ on the upcoming Saturday and there would be an ‘inspection’ prior to getting into the vans. I thought to myself, “Inspection? Right! Can’t wait to see how this goes!”

On Saturday morning we met in the parking lot in front of the Geology building and prior to boarding the vans, we were instructed to lined up single file and had to present our field book, map board and base map, pencils (including colored pencils), sharpener, eraser, hand lens, rock hammer, and Brunton compass. The inspection was not much different than field inspections in the Army prior to going on a combat mission, except the ‘tools’ were different.

Sadly, one student failed to bring a hand lens and another student didn’t have a hammer. As a consequence, both students were not allowed to board the vans and received a failing grade for the day’s assignment. A hard lesson was learned, but never again did a student show up without the proper field gear.

REFERENCES


