INTERNATIONAL SOCIETY OF ANTIQUE SCALE COLLECTORS

FULCRUM

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FULCRUM is the newsletter of ISASC(E), the International Society of Antique Scale Collectors (Europe). It is published in February, May, August and November. Contributions should be sent to the Editor, John Knights.

Weighing the World 2

In the last issue we looked at the experiment of 1774 to measure the mass of the Earth using the gravitational pull exerted by a Scottish mountain. In 1797 there was another attempt made using a similar principle but with a very different approach.

The man responsible for this experiment was Henry Cavendish, one of the most gifted scientists of his day. Cavendish was a famously strange character who nonetheless contributed much to the early knowledge of physics and chemistry. He was a member of the aristocratic Cavendish family who hold the duchy of Devonshire whose great baroque house at Chatsworth is one of Britain's greatest stately homes. The English system of *'primogeniture'* means that the eldest son of a noble family inherits the title plus the land, property and assets that go with it. The younger sons and their issue, in the 18th century, usually ended up as army officers, clergymen or wasters who simply idled, gambled and drank themselves to death. Henry was in this category but was definitely not military or ecclesiastical material. He was certainly independently wealthy but rather than spend his time in debauchery he devoted himself to the pursuance of knowledge.

He was eccentric to say the least, uncomfortable in company and singularly uncommunicative. He was probably on the autistic spectrum as we would now say. He did not even communicate with his servants verbally and issued instructions by leaving them notes.

He did however have a great mind and was responsible for some very significant discoveries. One of his experiments was to carry out his own measurement of the Earth's density and mass. He was clearly not the 'outdoorsy type' so there was no way he was trudging off to the Highlands of Scotland to perform his measurements. He rather carried them out in his own back yard using equipment that, unlike that of Maskelyne and co, actually resembled a weighing instrument as we would understand it.

Whereas the Maskelyne team needed a mountain to measure, Cavendish did basically the same experiment using two large lead balls of known mass (348-pounds, 158kg) These were suspended from cords near each end of a long beam hanging from a torsion cord of known shear modulus. Hanging from the ends of the beam were two smaller lead spheres (1.61-pounds, 0.73 kg) to act as attractants to the larger balls.

The forces involved were clearly going to be tiny so the torsion balance had to be remarkably sensitive and the whole experiment had to be isolated from any external influences likely to disturb the readings. The isolation was achieved by placing the whole set up inside a closed chamber with observations being carried out through inspection windows.

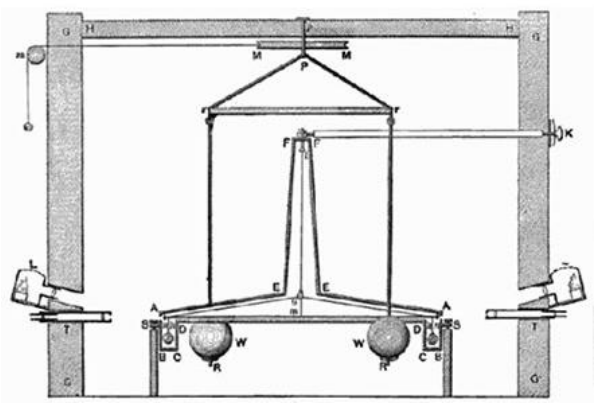
By observing and measuring the angles of oscillation of the 6ft (1.8m) wooden beam both before and after the large lead balls were introduced, the gravitational force being exerted

could, apparently be measured. Cavendish did derive a value from this although how it actually worked in practice I cannot imagine. The attracting force involved was vanishingly small, being some 1.74×10^{-7} N, or equivalent to the weight of a grain of sand. The beam with its lead weights would not have been insubstantial in mass and inertia which was suspended from a torsion filament of sufficient delicacy to be able to detect the tiny changes. The torque values exerted by the torsion filament had to be calculated to a remarkable degree of accuracy and the tiny angles that the oscillating beam achieved had similarly to be measured. This had to be done remotely, looking through the observation windows so it does boggle the mind how any meaningful results could have been obtained. We are told the measurements were carried out with the aid of magnifying telescopes and vernier scales at the ends of the beam. Given the types of variability that is found in the oscillations of a well engineered balance of precision it still all sounds a bit unlikely. He, despite any ill founded misgivings that I may have, came up with a value of 5.448 for the specific gravity of the world which was somewhat higher than the value obtained in the Maskelyne experiment of 4.50. The modern accepted specific gravity value is 5.515. He also came up with a decent approximation of the Gravitational Constant and of course the mass of the planet so he must have done something right.

Henry Cavendish

A cut away view of Cavendish's apparatus set in its closed chamber with observations being performed from outside.

Cavendish's Torsion Balance



Forthcoming Events

Our autumn meeting and AGM has now been arranged for **Sunday 9th October** and will be held at a familiar venue, the Best Western Hotel at Kegworth. We used this establishment for a number of years before moving to the Hilton at Warwick and found it to be an excellent venue with a large meeting room and good catering facilities. We hope as many members as possible will be able to attend. A form is enclosed for interested members to complete and return.

This year is the 40th anniversary of the formation of ISASC so we need to celebrate this fact with a suitable theme for the occasion. If anyone has any ideas as to what they would like to see please advise a member of the committee.

Reminder

This meeting was announced in February, but it's not too late to register your interest.

For those who are wanting to have a get together before October, our good friend John Wintour is once again offering access to his vast collection on Wednesday 15th June. Catering will be laid on and it will be an opportunity to meet up and spend the day chatting and , maybe, indulging in a little commerce. Anyone interested in going to Alvington in June should contact John directly.

The Way We Were

Above is a delightful photograph of a grocer's shop as they existed before the days of the supermarket. Here loose products were weighed up in the presence of the customer and apart from some tinned and bottled items any pre-packing was carried out on the premises. This establishment has, by modern standards, a terrifying number of shop assistants and of course

some lovely scales. Each department had its own scale of a model suitable to the goods on sale. My first thought was that it was the interior of a shop in the UK in the 1920s or 1930s until I looked closely at the scales on the left hand counter. These are apparently, a Toledo pattern that, as far as I know, never made it to this side of the Atlantic. It is a very pleasing design with its large price computing cylinder and the pendulum resistant visible through the glass window (see below). The comparable machines in the UK at this time were made by Avery or Berkel and were somewhat more clinical in appearance with clean straight lines and all the interesting technical bits hidden away in the base or the cylinder. The shop appears therefore to be somewhere in the USA.

John Lound Collection

The large collection of our late esteemed member John Lound is being put on the market by his family.
The collection, consisting of a large number of historic scales, weights and publications, is to be auctioned on **24th June 2016**, at

Tennants, The Auction Centre, Leyburn, North Yorkshire, DL8 5SG

Tel: +44 (0)1969 623780

Fax: +44 (0)1969 624281

Email: enquiry@tennants-ltd.co.uk

In addition to the main collection there is a quantity of spares for scales including porcelain scale plates, knife edge steel, agate bearings etc that have not yet been catalogued.

Statues with Scales

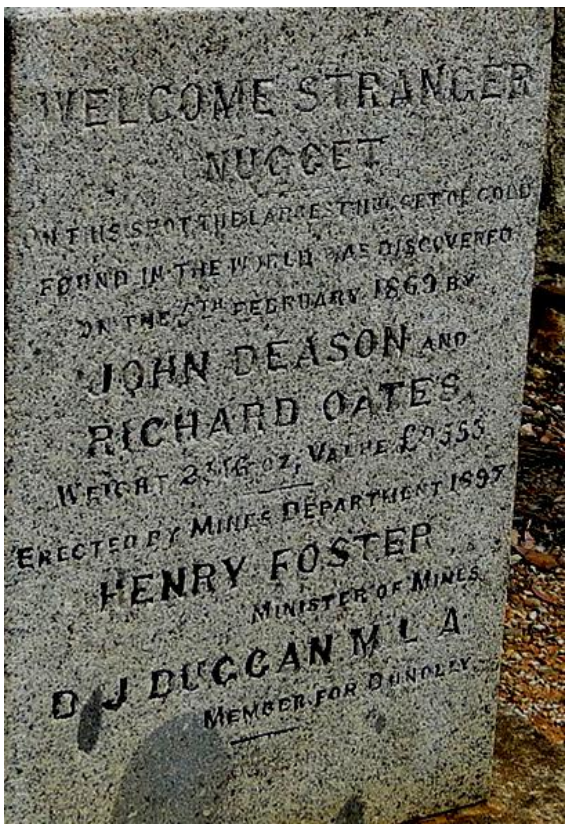
Following the feature on statues holding balances in the last edition it has been pointed out to me that all these figures are based on the character **Themis** who is sometimes described as the Greek goddess of justice and therefore appropriate for sticking on top of judicial institutions.
Themis is actually described as a Titan rather than God and was the personification of order and natural law (I recall sitting through an entire film called Clash of the Titans and came out quite confused as there weren't actually any Titans in it) In classical art she is simply represented as a standing or seated figure but as time went by she acquired the scale, sword and, sometimes, the blindfold that is now practically universal on courthouses and administrative buildings throughout the world.

The Welcome Stranger

In 1869 two prospectors came upon the largest alluvial gold nugget ever found. It was discovered just below the surface of the ground at the base of a tree at a place known as Bulldog Gully in Victoria Australia. The nugget, as removed from the ground, had a weight of 3,523.5 troy ounces (241lb 9oz 11dr: 109.59kg). When refined it yielded some 2300 troy ounces of metal. An interesting aspect of this story that is usually mentioned

A bullion balance somewhere in the United States of America

in the telling is the fact that there were no scales of sufficient capacity to weigh the whole nugget and it had to be broken into three pieces on a blacksmith's anvil before they could find out how much it actually weighed. I would imagine the prospect of having to weigh a nugget of this magnitude would scarcely have occurred to the assayers so a balance of more than modest capacity would not have been deemed necessary. Even when divided into three, however, they would have been dealing with lumps of 30 or more kilograms which suggests that a balance of perhaps, 100 lbs capacity must have been available. They should have had one like the American bullion balance shown lower right. That's big!



The inscription on the memorial commemorating the discovery of the Welcome Stranger nugget

Soul Man

I have long been aware of the myth, story or allegation, it is difficult to know which, that the human soul has a weight. There has even been a value assigned to this ethereal attribute, which is apparently accepted by members of the spiritualist community. It is currently expressed, in metric terms, as 21 grams.

This story dates back to the beginning of the 20th century and is based on certain experiments (I use the term loosely) carried out by a doctor called Duncan McDougal who was in charge of a tuberculosis clinic at Haverhill Massachusetts USA. Having found a Fairbanks platform scale in the clinic, as you do, he decided to undertake some somewhat bizarre and creepy experiments, to test his, long held, theory that that the human soul had a tangible weight value that could be detected as a loss of body weight when the soul departed.

His method, which was not wildly sophisticated, consisted of identifying a patient who was close to death and, with a singular lack of respect for the near deceased, hauling the unfortunate person on to the scale platform. He carried out a quick weighing and after a certain amount of hanging around waiting for the hapless patient to actually die, repeating the weighing. Dr McDougal claimed to identify a weight loss which was (this being 1901 America) just under an avoirdupois ounce.

He carried out this experiment on 6 patients in all after which he claimed to have confirmed that the weight of the human soul was ¾ ounce. This was presumably an average figure as all weighing experiments, in my experience, exhibit a degree of natural variation. It is not altogether clear which type of scale he used, as accounts seem to vary. One version suggests it was a large dormant machine of the type displayed in the Old Depot Museum at Dayton Washington (see below, unfortunately missing its iron poises) with a minor bar value of some ¼ or ½ lb or so. If this were the case it would be highly optimistic to be stating, with any degree of certainty, that values of less than an ounce could be accurately identified under the conditions in which the experiments were carried out.

The whole exercise has been widely discredited for all number of reasons over the years but the value of 21 grams is still widely associated with the
weight of the human soul.

SOUL HAS WEIGHT, PHYSICIAN THINKS

Dr. Macdougall of Haverhill Tells of Experiments at Death.

LOSS TO BODY RECORDED

Scales Showed an Ounce Gone in One Case, He Says—Four Other Doctors Present.

Special to The New York Times.

BOSTON, March 10.—That the human soul has a definite weight, which can be determined when it passes from the body, is the belief of Dr. Duncan Macdougall, a reputable physician of Haverhill. He is at the head of a Research Society which for six years has been experimenting in this field. With him, he says, have been associated four other physicians.