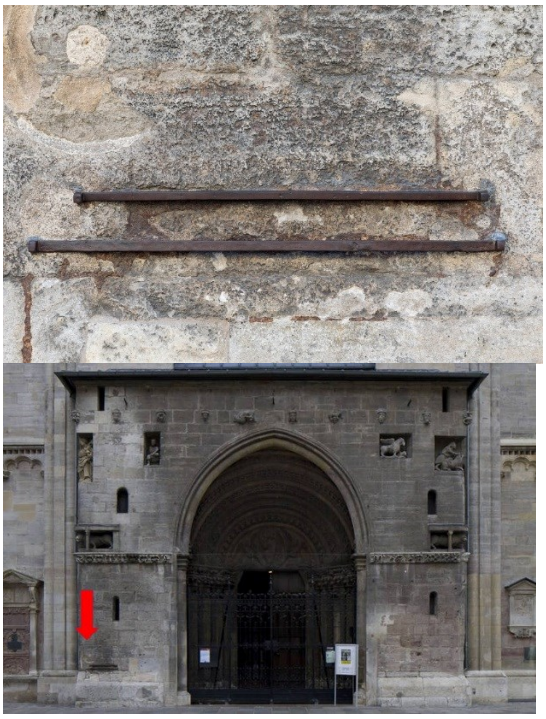
Weights and Measures

Many books about "Old Weights and Measures" describe the evolution from every village having its own customary measures to an Empire-wide common standard, unsurprisingly that of Vienna. A flurry of Decrees in the 1750s show Maria Theresia freed at last from the travails of the War of Succession and getting to grips with the evidently recalcitrant Tiroleans.

Length, weight

Secondary length and weight standards were sent from Vienna to all provinces, and their use mandated. When the *Hofstelle* (the assembly that advised the Governor) in Tirol was commissioned on 11 February 1752 to introduce uniform dimensions and weights, the Estates (Nobility, prelates, cities and peasants) initially hesitated because at that time a variety of different dimensions and weights were in common use. Despite this, Maria Theresia "expressed her will" on 26 January 1754 and the law was passed in 1756. It was also stipulated by law that traders should be checked at least twice a year in order to check compliance with the official standards.

The picture below on the left shows a set of standard Vienna *Loth* weights; they nest together into the largest. The largest is stamped with the letters W I E N; a double-headed eagle; and the number 874 which will be that of the set, not the user. 32 Vienna *Loth* made one Vienna Pound, called the *Pfund*; for postal calculations the 31st and 32nd *Loths* were ignored.



The pictures on the right shows the Vienna Standard length measurements - they are iron bars set into the outside wall of Stephansdom in Vienna, to the left of the big west doors (and red-arrowed in the lower photo). The ends of the bars protrude forwards, creating a ⊔ shaped space, and measuring rods had to fit exactly into it. The round mark on the wall above them used to be the Vienna Standard Bread Measure - bakers whose loaves were too small were ceremonially ducked in the Danube.

From 1 January 1876, mail both internal and foreign was supposed to be weighed in the Zoll- (ie Customs-) *Loth*. 30 of these made one *Zollpfund* which weighed 500 gram, so 1 *Zoll-Loth* = 16.67 gram.

Accuracy

(Thanks to RM for this!) Trade has always been a driver for accuracy so local guilds would try to ensure members were not getting short-changed, and merchants would have been the first to pressurise for consistency, especially in the jewellery business. This led to the use of reference weight and measures in places like town halls. The attached appendix shows that the pound had different weights in different cities.

Beam balances have been in use for millennia, but rely for their accuracy on exact arm length between pivot points. But actually it's only that the half-lengths from the pivot point are equal - which is easier to achieve than an exact length. More to the point is the weights. The equivalence of weights can be assured by balancing them against each other and swapping them from side to side. For a crudish beam balance from, say 1700, I would argue that the limiting factor was probably friction in the pivot points. I doubt that could be much better than $\pm$0.01g. Then you have to question the 'traceability' of the weights against some reference. It looks as though this would also be a limiting factor, probably by a similar amount in this time period. What the 'traceability chain' was like back then I know not, but there was probably a set of reference weights sitting in the mayor's office - individual to that town. I'd figure another $\pm$0.01g at best. By 1800 things would probably have been a lot better and by 1850, good balances could probably weigh to 1mg. All this assumes that the weights were kept clean and free from oxidation/corrosion, and not acid etched away by handling, so your average heavy thumbed greengrocer's weights might be much less accurate than those in a post office. In terms of total uncertainty on a post office desk, I doubt if a ½oz (14g) weight would be accurate to better than $\pm$0.05 g if that. If the machine is not a lever balance but based on spring systems, I can imagine it would be much less accurate than this.

When the metric system was set up and adopted, conversion factors from the existing units were calculated that would have more significant figures than the accuracy of weighing. Typically, documents show metric equivalents of old units to 0.001g. But your average balance would be a lot less accurate than this. There was no such thing as a roaming trading standards officer or a mobile calibrator. So while it might have been scientifically possible to measure quite accurately, I suspect the local practice could be quite at variance if a calibrated weight were applied. Add to that the confusion on going from one town to another ☺

Distance

Distance was at various dates measured in post-stages or post-stations; in *Stünde*; or in the Austrian Meile. A "post station" was manned by a Postmaster, who had to maintain a stable of horses suitable for carrying the rider with the mailbags. They had to be up to the job, and the Postmaster was forbidden to wear them out by hiring them for agricultural tasks. The stations were spaced about 2 Meilen (2 x 7.5km) apart, the distance a horse could gallop without stopping; in rough territory they were closer. Depending on the urgency of the mail, the rider would either rest at the station, or shortly before arrival would blow the appropriate signal on his posthorn to have a fresh horse waiting ready saddled for his arrival. A stage is simply the journey from one station to the next - remember the fence post rule: between x stations there are only x minus one stages.

A *Stünde*, also called a *Wegstünde*, was the distance an adult might reasonably be expected to walk in one hour, which will be different in Burgenland (which is flat) compared with Alpine territory (which isn't). The variously-defined League is sometimes equated to the *Stünde*. The *Wegstünde* is today used in walking guides, in which an adequately fit adult will be able during 1 hour by the clock to ascend 300m or descend 500m or walk 4km horizontally; these are combined in a simple formula to calculate how long a planned walk will take. "Older and/or less fit walkers will take longer." There is of course a German standard describing this: DIN 33466, *Wegweiser für Wanderwege*. The Scottish equivalent is Naismith's Rule, which is less demanding.

The Roman Mile was 1.482km. The English mile was always 1760 yards, but the length of a yard varied over the centuries until in 1959 the English mile was redefined as a derived metric unit of 1.609344km exactly. Then come the Scottish mile of 1.81km; the nautical mile of 1.852km; the Irish mile of 2.048km; the Swiss mile of 4.808km; the Bavarian mile of 7.420km; the geographical mile also of 7.420km; the Bohemian mile of 7.480km; the Prussian or German land-mile of 7.5325km, sometimes 7.500km; the Hungarian mile of 8.353 km; and the Baden mile of 8.88889km. The Austrian Meile was 7.58593536km (sometimes called the Post Meile; originally defined as 4000 Vienna Klafters each 6 Vienna feet (0.3161m) long);

It was normal in the 19th Century to define conversion factors to many more significant figures than could be achieved in reality - the Meile conversion is "accurate" to $\pm$5mm, 1 part per million. You are unlikely to come across the radar mile; it's a unit of time, that required for a radar pulse to travel 1 mile and return: 10.8

microseconds. Nor will the light-year trouble you philatelically - it's an astronomical (and astronomically large) unit of distance, that travelled by a photon in one year: 9 460 730 472 580 800 metres, since you ask. For even larger distances use the Parsec (30 856 775 814 913 673 metres) or in extremity the Gigaparsec.

The metric system was adopted in Austria by a law signed on 23 July 1871, published on 2 March 1872, and effective from 1 January 1876. When the countries of Europe were changing to metric measurements, it emerged that over 60 different definitions of 'mile' were in use, from 1.5km to 11km; the Norwegian was the longest.