

WEINTRIT Adam¹History of the nautical mile²**INTRODUCTION**

The concept of a mile, a unit of length, comes from the time of the Roman Empire. Then it was introduced to use as distance unit called *milia passum*, which meant a thousand steps marching Roman legionary, hence the name of the Roman mile. Since the days of the Roman Empire the name mile permanently entered into almost all languages within the European civilization, was in common use, although its length was taken differently in different countries and different periods.

With land-based distance measurements, the concept of mile as distance unit was moved to use in navigation at sea, where its length was associated with the linear length of one minute of latitude. Mile used in navigation was also varied in length, depending on the period and the standards applicable in different countries.

In times of universal unification, uniform system of weights and measures and international agreements on existing standards, maritime distance unit, which is a mile, is seen as an anachronism, and perversion. But until then adopted length of International Nautical Mile 1852 m still does not offend people connected with the sea and is used by almost everyone.

There are a lot of different miles, some of them are measures of a fixed length, such as: geographical mile, International Nautical Mile (INM), statute mile, other of variable length dependent on the latitude of location of measurement, such as: nautical mile or sea mile.

This article briefly presents the fascinating story of a mile, this very remarkable unit of length commonly used in shipping.

1. MEASUREMENT OF THE DISTANCE ON SURFACE OF THE EARTH

Why are there 5280 feet in a mile, and why are nautical miles different from the statute miles we use on land? Let's take a look at the origins of a few units of measure we use every day.

The basic concept of the mile originated in Roman times. The Romans used a unit of distance called the *mille passum*, which literally translated into "a thousand paces". Since each pace was considered to be five Roman feet—which were a bit shorter than our modern feet—the mile ended up being 5000 Roman feet, or roughly 4850 of our modern feet.

If the mile originated with 5000 Roman feet, how did we end up with a mile that is 5280 feet? Blame the furlong. The furlong wasn't always just an arcane unit of measure that horseracing fans gabbed about; it once had significance as the length of the furrow a team of oxen could plow in a day. In 1592, British Parliament set about determining the length of the mile and decided that each one should be made up of eight furlongs. Since a furlong was 660 feet, we ended up with a 5280-foot mile.

So if the statute mile is the result of Roman influences and plowing oxen, where did the nautical mile get its start? Strap on your high school geometry helmet for this one.

Each nautical mile originally referred to one minute of arc along a meridian around the Earth. Think of a meridian around the Earth as being made up of 360 degrees, and each of those degrees consists of 60 minutes of arc. Each of these minutes of arc is then 1/21,600th of the distance around the earth. Thus, a nautical mile is 6076 feet.

We have to decide what unit of measurement we would like to use for measuring the distance: miles or metres. While the measure of one meter has been strictly defined, miles seem to be made of

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chewing gum. In marine navigation we used or still use several quite different miles of variable length, such as: nautical miles, sea miles, International Nautical Mile (INM), geographical mile and statute mile.

1.1. Geographical Mile

Distances on the surface of a sphere or an ellipsoid of revolution are expressed in a natural way in units of the length determined by 1 minute of arc, measured along the Earth's equator. This unit is known as the Geographical Mile. Its value is determined by the dimensions of the spheroid in use. We will use it throughout in our treatment of navigational methods. Its length varies according to the ellipsoid which is being used as the model but, in these units, the radius of the Earth is fixed at a value of $108,000/\pi$.

For the 1924 International Spheroid this equalled 1855.4 metres [AMN, 1987]. Any greater precision depends more on choice of standard than on more careful measurement: the length of the equator in the World Geodetic System WGS-84 is 40,075,016.6856 m which makes the geographical mile 1855.3248 m, while the International Astronomical Union standard IAU-2000 takes the equator to be 40,075,035.5351 m making the geographical mile 1855.3257 m, almost a millimeter longer.

It was closely related to the nautical mile, which was originally determined as 1 minute of arc along a great circle of the Earth [Greenhood & Alexander, 1964], but is nowadays defined as exactly 1852 meters. The US National Institute of Standards and Technology (NIST) notes that: "The international nautical mile of 1 852 meters (6 076.115 49...feet) was adopted effective July 1, 1954, for use in the United States. The value formerly used in the United States was 6 080.20 feet = 1 nautical (geographical or sea) mile." A separate reference also identifies the geographic mile as being identical to these international nautical miles (and slightly shorter than British nautical miles, which were identified as being equivalent to 1853.184 meters). The unit is not used much, but is cited in some United States laws (e.g., Section 1301(a) of the Submerged Lands Act, which defines state seaward boundaries in terms of geographic miles). While debating what became the Land Ordinance of 1785, Thomas Jefferson's committee wanted to divide the public lands in the west into "hundreds of ten geographical miles square, each mile containing 6086 and 4-10ths of a foot" and "sub-divided into lots of one mile square each, or 850 and 4-10ths of an acre".

The Danish and **German geographical mile** (*geografisk mil* and *geographische Meile* or *geographische Landmeile*, respectively) is 4 minutes of arc, and was defined as approximately 7421.5 metres by the astronomer Ole Rømer of Denmark. In Norway and Sweden, this 4 minute geographical mile was mainly used at sea (*sjømil*), up to the beginning of the 20th century.

1.2. The International Nautical Mile

The international nautical mile was defined by the First International Extraordinary Hydrographic Conference, Monaco (1929) as exactly 1852 metres. This is the only definition in widespread current use, and is the one accepted by the International Hydrographic Organization (IHO) and by the International Bureau of Weights and Measures (BIPM). Before 1929, different countries had different definitions, and the United Kingdom, the United States, the Soviet Union and some other countries did not immediately accept the international value.

Both the Imperial and U.S. definitions of the nautical mile were based on the Clarke (1866) spheroid: they were different approximations to the length of one minute of arc along a great circle of a sphere having the same surface area as the Clarke spheroid. The United States nautical mile was defined as 1853.248 metres (6080.20 U.S. feet, based on the definition of the foot in the Mendenhall Order of 1893): it was abandoned in favour of the international nautical mile in 1954. The Imperial (UK) nautical mile, also known as the Admiralty mile, was defined in terms of the knot, such that one nautical mile was exactly 6080 international feet (1853.184 m): it was abandoned in 1970 and, for legal purposes, old references to the obsolete unit are now converted to 1852 metres exactly [Weintrit, 2010].

1.3. Nautical Mile

A nautical mile is a unit of measurement used on water by sailors and/or navigators in shipping and aviation. It is the average length of one minute of one degree along a great circle of the Earth. One nautical mile corresponds to one minute of latitude. Thus, degrees of latitude are approximately 60 nautical miles apart. By contrast, the distance of nautical miles between degrees of longitude is not constant because lines of longitude become closer together as they converge at the poles.

The *nautical mile* was originally defined as one minute of arc along a meridian of the Earth [Maloney, 1978]. Navigators use dividers to step off the distance between two points on the navigational chart, then place the open dividers against the minutes-of-latitude scale at the edge of the chart, and read off the distance in nautical miles. The Earth is not perfectly spherical but an oblate spheroid, so the length of a minute of latitude increases by 1% from the equator to the poles. Using the WGS84 ellipsoid, the commonly accepted Earth model for many purposes today, one minute of latitude at the WGS84 equator is 6046 feet and at the poles is 6,107.5 feet. The average is about 6076 feet (about 1852 meters or 1.15 statute miles).

In the United States the nautical mile was defined in the 19th century as 6080.2 feet (1853.249 m), whereas in the United Kingdom, the *Admiralty nautical mile* was defined as 6080 feet (1853.184 m) and was about one minute of latitude in the latitudes of the South of the UK. Other nations had different definitions of the nautical mile, but it is now internationally defined to be exactly 1852 meters.

Each country can keep different, arbitrarily selected value of the nautical mile, but most of them use the International Nautical Mile, although in the past it was different.

The unit used by the United Kingdom until 1970 was the British Standard nautical mile of 6080 ft or 1853.18 m.

Today, one nautical mile still equals exactly the internationally agreed upon measure of 1852 meters (6076 feet). One of the most important concepts in understanding the nautical mile though is its relation to latitude.

1.4. The Sea Mile

The sea mile is the length of 1 minute of arc, measured along the meridian, in the latitude of the position; its length varies both with the latitude and with the dimensions of the spheroid in use.

The sea mile is an ambiguous unit, with the following possible meanings:

In English usage, a sea mile is, for any latitude, the length of one minute of latitude at that latitude. It varies from about 1842.9 metres (6046 ft) at the equator to about 1,861.7 metres (6,108 ft) at the poles, with a mean value of 1852.3 metres (6077 ft). The international nautical mile was chosen as the integer number of metres closest to the mean sea mile.

American use has changed recently. The glossary in the 1966 edition of Bowditch defines a "sea mile" as a "nautical mile". In the 2002 edition [Bowditch, 2002], the glossary says: "An approximate mean value of the nautical mile equal to 6080 feet; the length of a minute of arc along the meridian at latitude 48°."

The sea mile has also been defined as 6000 feet or 1,000 fathoms, for example in Dresner's *Units of Measurement* [Dresner, 1971]. Dresner includes a remark to the effect that this must not be confused with the nautical mile. Richard Norwood in *The Seaman's Practice* (1637) determined that 1/60th of a degree of any great circle on Earth's surface was 6,120 feet (vs. the modern value of 6080 feet). However, he stated: "if any man think it more safe and convenient in Sea-reckonings" he may assign 6000 feet to a mile, relying on context to determine the type of mile.

1.5. The Statue Mile

When it needs to be distinguished from the nautical mile, the mile may be described as a "land mile" or "statute mile". The statute mile is the unit of distance of 1,760 yards or 5280 ft) 1609.3 m. The difference between a mile and a statute mile is historical, rather than practical [Thompson, 2008].

Hundreds of years a mile meant different things to different people. It became necessary, eventually, for a mile to be the same distance for all concerned. During the reign of Queen Elizabeth I,

a statute was passed by the English Parliament that standardized the measurement of a mile, thus giving rise to the term 'statute' mile. The measurement of a mile at 5280 feet is now accepted almost everywhere in the world. In British English and common usage, "statute mile" describes the distance established by a 1593 Act of Parliament, but in formal American English "statute mile" refers to the US survey mile. Foreign and historical units translated into English as miles usually employ a qualifier to describe the kind of mile being used but this may be omitted if it is obvious from the context, such as a discussion of the 2nd-century Antonine Itinerary describing its distances in terms of "miles" rather than "Roman miles".

The mile is an English unit of length standardized as exactly 1.609344 kilometres by international agreement in 1959. With qualifiers, "mile" is also used to describe or translate a wide range of units derived from or roughly equivalent to the Roman mile, such as the nautical mile (now 1.852 km exactly), the Italian mile (roughly 1.852 km), and the Chinese mile (now 500 m exactly). The Romans divided their mile into 5000 feet but the greater importance of furlongs in pre-modern England meant that the statute mile was made equivalent to 5280 feet or 1760 yards in 1593. This form of the mile then spread to the British-colonized nations who continue to employ the mile. The US Geological Survey now employs the metre for official purposes but legacy data from its 1927 geodetic datum has meant that a separate US survey mile ($^{6336}/_{3937}$ km) continues to see some use.

2. THE ABBREVIATION OF MILE

There is no commonly accepted international standard symbol for the unit nautical mile. The preferred abbreviation of the IEEE is nmi, while M is used by the BIPM, UKHO and the maritime authorities of the USA and Canada. For aviation use, the preferred abbreviation of the ICAO is NM. The abbreviation Nm or nm, though conflicting with the SI symbol for the nanometre is also in widespread use.

The mile was usually abbreviated **m.** in the past but is now written as **mi.** to avoid confusion with the SI metre. The mile has been variously abbreviated—with and without a trailing period—as m, M, ml, and mi. The American National Institute of Standards and Technology now uses and recommends mi in order to avoid confusion with the SI metre (m) and millilitre (mL) [Butcher, 2014]. Derived units such as miles per hour and miles per gallon, however, continue to be abbreviated in the United States, United Kingdom, and Canada as mph, mpg, etc. rather than mi/h or mi/gal.

3. HISTORY OF THE MILE

The nautical mile was historically defined as a minute of arc along a meridian of the Earth (North-South), making a meridian exactly $180 \times 60 = 10,800$ historical nautical miles. It can therefore be used for approximate measures on a meridian as change of latitude on a nautical chart. The originally intended definition of the metre as 10^{-7} of a half-meridian arc makes the mean historical nautical mile exactly $(2 \times 10^7) / 10,800 = 1851.851851\dots$ historical metres. Based on the current IUGG meridian of 20,003,931.4585 (standard) metres the mean historical nautical mile is 1852.216 m.

The historical definition differs from the length-based standard in that a minute of arc, and hence a nautical mile, is not a constant length at the surface of the Earth but gradually lengthens in the North-South direction with increasing distance from the equator, as a corollary of the Earth's oblateness, hence the need for "mean" in the last sentence of the previous paragraph. This length equals about 1,861 metres at the poles and 1843 metres at the Equator.

Other nations had different definitions of the nautical mile. This variety, in combination with the complexity of angular measure described above and the intrinsic uncertainty of geodetically derived units, mitigated against the extant definitions in favour of a simple unit of pure length. International agreement was achieved in 1929 when the IHB adopted a definition of one international nautical mile as being equal to 1852 metres exactly, in excellent agreement (for an integer) with both the above-mentioned values of 1851.851 historical metres and 1852.216 standard metres.

The use of an angle-based length was first suggested by Edmund Gunter (of Gunter's chain fame) [Waters, 1958]. During the 18th century, the relation of a mile of, 6000 (geometric) feet, or a minute

of arc on the earth surface, had been advanced as a universal measure for land and sea. The metric kilometre was selected to represent a centesimal minute of arc, on the same basis, with the circle divided into 400 degrees of 100 minutes.

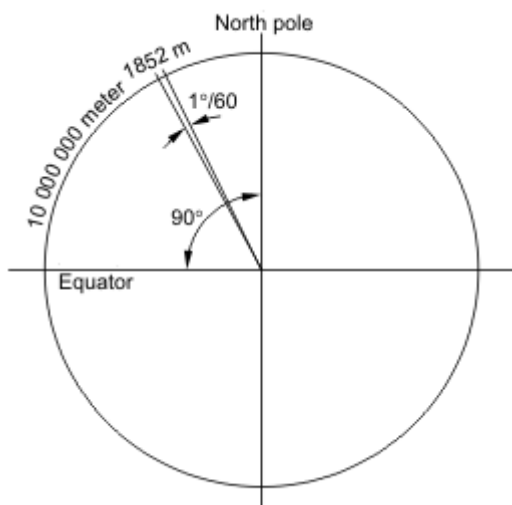


Fig.1. Historical definition - 1 nautical mile

4. HISTORICAL MILES

Mile, any of various units of distance, such as the statute mile of 5280 feet (1.609 km). It originated from the Roman *mille passus*, or “thousand paces,” which measured 5000 Roman feet.

About the year 1500 the “old London” mile was defined as eight furlongs. At that time the furlong, measured by a larger northern (German) foot, was 625 feet, and thus the mile equalled 5000 feet. During the reign of Queen Elizabeth I, the mile gained an additional 280 feet—to 5280—under a statute of 1593 that confirmed the use of a shorter foot that made the length of the furlong 660 feet. Elsewhere in the British Isles, longer miles were used, including the Irish mile of 6,720 feet (2.048 km) and the Scottish mile of 5952 English feet (1.814 km).

A nautical mile was originally defined as the length on the Earth’s surface of one minute ($1/60$ of a degree) of arc along a meridian (North-South line of longitude). Because of a slight flattening of the Earth in polar latitudes, however, the measurement of a nautical mile increases slightly toward the poles. For many years the British nautical mile, or admiralty mile, was set at 6080 feet (1.85318 km), while the U.S. nautical mile was set at 6080.20 feet (1.85324 km). In 1929 the nautical mile was redefined as exactly 1.852 km (about 6076.11549 feet or 1.1508 statute miles) at an international conference held in Monaco, although the United States did not change over to the new international nautical mile until 1954. The measure remains in universal use in both marine and air transportation. The knot is one nautical mile per hour.

Mile - a traditional unit of distance. The word comes from the Latin word for 1000, mille, because originally a mile was the distance a Roman legion could march in 1000 paces (or 2000 steps, a pace being the distance between successive falls of the same foot). There is some uncertainty about the length of the Roman mile. Based on the Roman foot of 29.6 centimetres and assuming a standard pace of 5 Roman feet, the Roman mile would have been 1480 meters (4856 feet); however, the measured distance between surviving milestones of Roman roads is often closer to 1520 meters or 5000 feet. In any case, miles of similar lengths were used throughout Western Europe. In medieval Britain, several mile units were used, including a mile of 5000 feet (1524 meters), the modern mile defined as 8 furlongs (1609 meters), and a longer mile similar to the French mille (1949 meters), plus the Scottish mile (1814 meters) and the Irish mile (2048 meters). In 1592 the British Parliament settled the question by defining the statute mile to be 8 furlongs, 80 chains, 320 rods, 1760 yards or 5280 feet. The statute mile is exactly 1609.344 meters. In athletics, races of 1500 or 1600 meters are often called metric miles.

The modern English word *mile* derives from Middle English *myl* and Old English *mīl*, which was cognate with all other Germanic terms for "miles". These derived from apocopated forms of the Latin *mīlia* or *mīllia*, the plural of *mīle* or *mīlle*, literally "thousand" but used as a clipped form of *mīlle passus* or *passuum*, the Roman mile of one thousand paces.

4.1. Roman mile

The Roman mile (*mille passus*, lit. "thousand-pace"; abbr. m.p.; also *mille passuum* and *mille*) consisted of a thousand paces of two steps each. The ancient Romans, marching their armies through uncharted territory, would often push a carved stick in the ground after each 1000 paces. Well-fed and harshly driven Roman legionaries in good weather thus created longer miles. The distance was indirectly standardized by Agrippa's establishment of a 29.6 cm (11.7 in) foot in 29 BC. Surveyors and specialized equipment such as the decempeda and dioptra then spread its use. The Imperial Roman mile then denoted 5000 Roman feet, estimated to have been about 1,481 metres (4,851 feet or 1,617 yards) [Smith, 1975]. In Hellenic areas of the Empire, the Roman mile (Greek: μίλιον, *mīlion*) was used beside the native Greek units as equivalent to 8 stadia of 600 Greek feet. The *mīlion* continued to be used as a Byzantine unit and was also used as the name of the zero mile marker for the Byzantine Empire, located at the head of the Mese near Hagia Sophia.

The Roman mile also spread throughout Europe, with its local variations giving rise to the different units below.

4.2. Italian mile

The Italian mile (*miglio*, pl. *miglia*) was traditionally considered a direct continuation of the Roman mile, equal to 1000 paces, although its absolute value over time or between regions could vary greatly. It was often used in international contexts from the Middle Ages into the 17th century and is thus also known as the "geographical mile", although the geographical mile is now a separate standard unit [Zupko, 1981].

4.3. Arabic mile

The Arabic mile (*al-mīl*) was not the common Arabic unit of length; instead, Arabs and Persians traditionally used the longer parasang or "Arabic league". The Arabic mile was, however, used by medieval geographers and scientists and constituted a kind of precursor to the nautical or geographical mile. It extended the Roman mile to fit an astronomical approximation of 1 arcminute of latitude measured directly North-and-South along a meridian. Although the precise value of the approximation remains disputed, it was somewhere between 1.8 and 2.0 km.

4.4. English mile

The "old English mile" of the medieval and early modern periods seems to have measured about 1.3 statute miles (1.9 km). Arnold's c. 1500 *Customs of London* indicates this continued to be divided into 8 furlongs or 5000 feet [Klein, 1988], the same division used by the Romans. His mile, however, was shorter than previous ones, coming to 0.947 statute miles or 1.524 km. Robert Morden, a 17th-century cartographer, had multiple scales on his maps which included local values: his map of Hampshire, for example, bore two different miles with a ratio of 1 : 1.23 and his map of Dorset had three scales with a ratio of 1 : 1.23 : 1.41. In both cases, the traditional local units remained longer than the statute mile.

The English statute mile was established by a Weights and Measures Act of Parliament in 1593 during the reign of Queen Elizabeth I. The Composition of Yards and Perches—one of the statutes of uncertain date from c. 1300—had shortened the length of the foot and its associated measures, causing the two compositions of the mile by foot and furlong to diverge [Zupko, 1977]. Owing to the importance of the rod and furlong in deeds and surveying, Parliament opted to maintain the mile of 8 furlongs and to increase the number of feet from the old Roman value. The applicable passage of the statute reads: "A Mile shall contain eight Furlongs, every Furlong forty Poles, and every Pole shall contain sixteen Foot and an half". The statute mile therefore comprised 5280 feet or 1,760 yards.

4.5. Scots mile

The Scots mile was longer than the English mile, as mentioned by Robert Burns in the first verse of his poem "Tam o' Shanter". It comprised 8 (Scots) furlongs divided into 320 falls or faws (Scots rods). It varied from place to place but the most accepted equivalencies are 1,976 Imperial yards or 1.81 km. It was legally abolished three times: first by an 1685 act of the Scottish Parliament, again by the 1707 Treaty of Union with England, and finally by the Weights and Measures Act 1824. It had continued in use as a customary unit through the 18th century but had become obsolete by its final abolition. Edinburgh's "Royal Mile"—running from the castle to Holyrood Abbey—is roughly a Scots mile long.

4.6. Irish mile

The Irish mile (*míle* or *míle Gaelach*) was divided into 8 furlongs of 40 perches, a longer form of rod. During the Elizabethan era, 4 Irish miles were generally equated to 5 English ones although whether this described the old English miles or the shorter statute miles is unclear. In the 17th century, the perch was 21 feet against an English rod of 16½ feet, making an Irish mile 2.048 kilometres long (1.27 statute miles or 6,720 feet).

Under British rule, the Irish mile was not always used: from 1774 until the 1820s, the grand juries of 25 Irish counties commissioned maps at scales of one or two inches per Irish mile but the County Mayo maps (1809–1830) were surveyed and drawn by William Bald in English miles and just rescaled to Irish miles for printing. The Ordnance Survey of Ireland, from its establishment in 1824, used English miles. Thomas Telford's Howth–Dublin Post Office extension of the London–Holyhead turnpike had its mileposts in English miles. It was formally abolished by the 1824 Weights and Measures Act but the Irish Post Office continued to use the measure until 1856.

Prior to the publication of standardised traffic regulations by the Irish Free State in 1926, signage varied from county to county, prompting complaints from travellers such as Alfred Austin. In 1902, the *Royal Book of Ireland* explained that "Counties Dublin, Waterford, Cork, Antrim, Down, and Armagh use English, but Donegal Irish Miles; the other counties either have both, or only one or two roads have Irish". The 1906 *Oxford English Dictionary*'s definition of "mile" described the Irish mile as "still in rustic use".

The Irish Free State standardised its roads using English statute miles, leading to some nationalist complaints. In 1937, a man being prosecuted for driving outside the 15-mile limit of his licence offered the unsuccessful defence that, since Ireland was independent, the limit should be reckoned by Irish miles "just as no one would ever think of selling land other than as Irish acres". In 1965, two deputies proposed an amendment to the Road Transport Act to replace the English statute miles with Irish ones; it was rejected. Such complaints—and the traditional distance itself—are now considered obsolete following Irish metrication in the 1970s, but "an Irish mile" is still used colloquially to express a vague but long distance akin to "a country mile".

Various historic miles and leagues from an 1848 German textbook, given in feet, metres, and fractions of a meridian.

4.7. International mile

The English statute mile formed the basis for all subsequent miles in English-speaking countries, but different countries maintained separate physical standards for the yard; these were found to differ by small but measurable amounts which became noticeable at large scales [Bigg, 1964]. The U.S. redefined its yard in 1893, but this resulted in U.S. and Imperial measures of distance having very slightly different lengths. The difference was resolved in 1959 with the definition of the international yard in terms of the meter by Australia, Canada, New Zealand, South Africa, the UK and the U.S. [Barbrow, 1976]. The "international mile" of 1760 international yards is exactly 1609.344 meters.

The old Imperial value of the yard was used in converting measurements to metric values in India in a 1976 Act of the Indian Parliament. However, the current National Topographic Database of the Survey of India is based on the metric WGS-84 datum, which is also used by the Global Positioning System.

The difference from the previous standards was 2 ppm, or about 3.2 millimetres ($\frac{1}{8}$ inch) per mile. The U.S. standard was slightly longer and the old Imperial standards had been slightly shorter than the international mile. When the international mile was introduced in English-speaking countries, the basic geodetic datum in America was the North American Datum of 1927 (NAD27). This had been constructed by triangulation based on the definition of the foot in the Mendenhall Order of 1893, with $1 \text{ foot} = \frac{1200}{3937}$ meters and the definition was retained for data derived from NAD27, but renamed the *U.S. survey foot* to distinguish it from the international foot [Astin, 1959].

The exact length of the land mile varied slightly among English-speaking countries until the international yard and pound agreement in 1959 established the yard as exactly 0.9144 meters, giving a mile exactly 1,609.344 meters. The U.S. adopted this international mile for most purposes, but retained the pre-1959 mile for some land-survey data, terming it the *U. S. survey mile*. In the United States, *statute mile* normally refers to the survey mile, about 3.2 mm ($\frac{1}{8}$ inch) longer than the international mile (the international mile is exactly 0.0002% less than the U.S. survey mile).

While most countries replaced the mile with the kilometre when switching to the International System of Units, the international mile continues to be used in some countries such as Liberia, Myanmar, the United Kingdom and the United States. It is furthermore used in a number of countries with vastly less than a million inhabitants, most of which are UK or US territories, or have close historical ties with the UK or US: Am. Samoa, Bahamas, Belize, British Virgin Islands, Cayman Islands, Dominica, Falkland Islands, Grenada, Guam, The N. Mariana Islands, Samoa, St. Lucia, St. Vincent & The Grenadines, St. Helena, St. Kitts & Nevis, the Turks & Caicos Islands, and the U.S. Virgin Islands. The mile is even encountered in Canada, though this is predominantly in rail transport and horse racing, as the roadways have been metricated since 1977.

4.8. Other historical miles

- a) The German mile (Meile) was 24,000 German feet. The standardised Austrian mile used in southern Germany and the Austrian Empire was 7.586 km; the Prussian mile used in northern Germany was 7.5325 km. Following its standardisation by Ole Rømer in the late 17th century, the Danish mile (mil) was precisely equal to the Prussian mile and likewise divided into 24,000 feet [Rowlett, 2005]. These were sometimes treated as equivalent to 7.5 km. Earlier values had varied: the Sjællandske miil, for instance, had been 11.13 km. The Germans also used a longer version of the geographical mile.
- b) The Hungarian mile (méröld or magyar méröld) varied from 8.3790 km to 8.9374 km before being standardised as 8.3536 km.
- c) The Scandinavian mile (mil) remains in common use in Norway and Sweden, where it has meant precisely 10 km since metrication occurred in 1889. It is used in informal situations and in measurements of fuel consumption, which are often given as litres per mil. In formal situations (such as official road signs) and where confusion may occur with international miles, it is avoided in favour of kilometres. The Swedish mile formerly varied by province from 6–14.485 km. It was standardised in 1649 as 36000 Swedish feet or 10.687 km. Prior to metrication, the Norwegian mile had been 11.298 km. (The traditional Finnish peninkulma was translated as mil in Swedish and also set equal to 10 km during metrication in 1887, but is much less commonly used.)
- d) The Portuguese mile (milha) used in Portugal and Brazil was 2.0873 km prior to metrication [Rowlett, 2005].
- e) The Russian mile (миля or русская миля, *ruskaya milya*) was 7.468 km, divided into 7 versts.
- f) The Croatian mile (hrvatska milja), first devised by the Jesuit Stjepan Glavač on a 1673 map, is the length of an arc of the equator subtended by $1/10^\circ$ or 11.13 km exactly. The previous Croatian mile, now known as the "ban mile" (*banska milja*), had been the Austrian mile given above.

5. HISTORY OF THE METRIC SYSTEM

The history of metric system is strictly connected with polar distance calculation. The metre (meter in American English), symbol m, is the fundamental unit of length in the International System of Units (SI). Originally intended to be one ten-millionth of the distance from the Earth's equator to the North Pole (at sea level), its definition has been periodically refined to reflect growing knowledge of metrology. Since 1983, it has been defined as "the length of the path travelled by light in vacuum during a time interval of $1/299,792,458$ of a second".

The original "Sacred Cubit" was a unit of measure equal to 25 British inches, and also equal to one 10-millionth part of the distance between the North Pole and the centre of the Earth. In 1790 Charles Talleyrand was sent to the Paris Academy of Sciences in order to help establish a new worldwide system of weights and measures meant to replace the English system of weights and measures that was in use all over the world at the time. This new French measuring system would be based upon a new unit of measure known as the "meter." The meter (from the Greek word "metron") was designed to be a counterfeit cubit, equal to one 10-millionth part of the distance between the North Pole and the Equator:

Cubit = $1/10,000,000$ th part of distance from N. Pole to Earth's Centre;

Meter = $1/10,000,000$ th part of distance from N. Pole to Earth's Equator.

The original Sacred Cubit was a length equal to 25 English inches, or 7 "hands." The "hand" measure is still used today by people who raise horses, it is a length of just under 4 inches (3.58 inches to be exact), and is equal to the width of a man's hand, not including the thumb.

A decimal-based unit of length, the *universal measure* or *standard* was proposed in an essay of 1668 by the English cleric and philosopher John Wilkins. In 1675, the Italian scientist Tito Livio Burattini, in his work *Misura Universale*, used the phrase *metro cattolico* (lit. "catholic [i.e. universal] measure"), derived from the Greek *métron katholikón*, to denote the standard unit of length derived from a pendulum. In the wake of the French Revolution, a commission organised by the French Academy of Sciences and charged with determining a single scale for all measures, advised the adoption of a decimal system (27 October, 1790) and suggested a basic unit of length equal to one ten-millionth of the distance between the North Pole and the Equator, to be called 'measure' (*mètre*) (19th March 1791). The National Convention adopted the proposal in 1793. The first occurrence of *metre* in this sense in English dates to 1797.

CONCLUSIONS

Nautical mile a unit of distance used chiefly in navigation, equal to 6080.20 feet (1853.25 meters) in the U.S., or 6080 feet (1853,18) in the UK, now replaced by the international nautical mile (1852 m). Also called geographical mile, sea mile, what frankly speaking less oriented in the subject can lead to confusion. A Nautical Mile is $1/60$ th of a degree or one minute of latitude. Be sure you know what distance measurement is being used on the charts you are working with. There are four common measures of distance used on charts:

- Nautical miles are used on ocean and coastal waters;
- Statute miles are used for inland areas such as the Intracoastal Waterway and the Great Lakes;
- Yards are often used to define distances of a mile or less;
- Meters are being seen increasingly on U.S. charts and are used almost exclusively on Canadian and other charts of the world (Meters are commonly used on International charts for depth).

Abstract

The concept of a mile, a unit of length, comes from the time of the Roman Empire. Then it was introduced to use as land measurement unit called milia passum. Since the days of the Roman Empire the name mile permanently entered into almost all languages within the European civilization and it was moved to use in navigation at sea. In times of universal unification, uniform system of weights and measures and international agreements on existing standards, maritime distance unit, which is a mile, is seen as an anachronism. But International Nautical Mile (INM) still does not offend people connected with the sea and is used by almost everyone. This article briefly presents the fascinating story of a mile, this very remarkable unit of length

commonly used in shipping.

Historia mili morskiej

Streszczenie

Koncepcja mil jako jednostki długości, pochodzi z czasów Imperium Rzymskiego. Następnie została wprowadzona do użytku jako lądowa jednostka miary zwana „milia passum”. Od czasów Imperium Rzymskiego nazwa mila weszła na trwałe do niemal wszystkich języków europejskiej cywilizacji i zaczęła być wykorzystania w nawigacji na morzu. W czasach unifikacji i ujednoczonego systemu miar i wag oraz międzynarodowych norm, jednostka odległości morskiej, którą jest mila, jest postrzegana jako anachronizm. Aczkolwiek mila morska (Mm) jest nadal używana przez prawie wszystkich ludzi związanych z morzem. W artykule przedstawiono pokrótce fascynującą historię mili, bardzo niezwyklej jednostki długości, powszechnie używanej w żegludze.

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