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The March of Standards

A process that began untold centuries ago, standardization lately has gathered impetus as North America converts to the metric system. Here, a look at the growth of standards and the need for them — including those we set for ourselves . . .

□ Every moment of every day, we live surrounded by standards. The roofs over our heads and the walls around us are supported by beams and joists of standard width and thickness; we wear clothing of standard sizes from our hats to our shoes. Standards govern the design and performance of the things we use — furniture, utilities, appliances, tools and vehicles. There are even standards to monitor the cleanliness of the air we breathe.

Standards figure in our activities as well as our environment. When we talk to someone, our words are understood only because they are standard in the sense that they mean the same to others as they do to us. We further communicate in standard symbols called numbers which are instantly and universally recognizable. We eat food that must meet certain standards before it may be sold. In our work, whatever it may be, we practise standard ways of doing things. We call these methods or routines.

If standards are important to our individual lives, they are absolutely vital to our society. Without the standard of value represented by money, a modern economy could not exist. Without standards of measurement, there would not only be no commerce, but no science and no industry. Without standards to guard our safety, the world would be a minefield of hazards. Without the standards of conduct found in moral codes such as the Ten Commandments, human relations would be condemned to chaos and savagery.

It might be said that society as we know it got its start with the setting of standards. Man was raised out of his primitive benightedness by the ability to communicate. A standard of sorts was forged when the people of some prehistoric tribe agreed that a sound denoting something out of sight meant the same to all of them. They then went on to make rules designed to keep the peace among themselves — standards of behaviour, in other words.

It was an epoch-making move into enlightenment when the cave people first decided on standards of correspondence. Their minds had to climb to a new, higher plane to conceive the abstract notion that, say, five fingers corresponded to five fish. By learning how to measure, they took another step along the road to civilization. The first measuring device was probably a hand or foot, but all hands or feet would not suffice because they are obviously not all of equal sizes. People therefore had to settle on a designated medium, such as the hand of the tribal chief.

Since the chief could not be available every time a measurement was required, it was only logical to scratch out the dimensions of his hand on a flat rock and keep it in a central place for ready reference. Before long, no doubt, someone laid a stick beside it and transferred the scratches to the wood so that he could measure something elsewhere.

That rock was quite literally a standard — a criterion to which other measures conform and are compared for accuracy. Records dating back almost 5,000 years show the pyramid builders of ancient Egypt checking their rulers against the Royal Cubit, a measure of the Pharaoh's arm from elbow to finger tips delineated on a piece of black marble.

By that time the practice had long been established of multiplying or subdividing the standard unit for larger or smaller measurements. The Royal Cubit was subdivided in a sophisticated way into the widths of fingers and palms of hands. Man had also long since developed standards for weight and volume: standard-sized stones for weight, and urns of standard circumference and depth to be filled with liquid, grain, etc. Like the linear standards, these were duplicated for portability and subdivided for refinement.

The spread of common measures followed the spread of trade

At the dawn of civilization, however, standards were strictly localized. A foot was not the same in one village as in the next because the length of each depended on the size of the chief's feet. The process we now know as standardization began with the advent of trade in the ancient world, when people from one region found that they had to understand the measurements used in another in order to do business. It soon dawned on them that it would be easier for everyone if they adopted measures that were understood and acknowledged wherever they regularly went to trade.

By 3500 B.C., the Hittites, Assyrians, Phoenicians and Hebrews had all, to some extent, taken up the system of measurement developed in Babylon. From the shores of the Mediterranean to the Indus Valley thousands of kilometres to the east, measures of Babylonian origin which had been adopted for trading purposes eventually found their way into common local use.

The next great wave of standardization came with the spread of the Roman Empire. Borrowing from Greek standards which in turn had been taken from Egypt and Babylon, the Romans came up with their own standard measures and implanted them in their colonies far and wide.

The Romans made the intellectual leap from tangible standards to conceptual ones, such as when they declared that a thousand two-stride paces of five feet each equalled a *mille,* the forerunner of the present mile in name only. Like many men before them, they looked for immutable standards in the ways of the universe. In perhaps the most enduring act of standardization in history, Julius Caesar collaborated with the astronomer Sosigenes to devise a reliable calendar based on the earth's relation to the sun and the moon in the various seasons. Although it was later revised to eliminate anomalies by the Emperor Augustus and Pope Gregory XIII, Caesar's basic calendar is still used to determine dates worldwide today.

For standards, the Dark Ages were very dark times indeed

Besides instituting conceptual standards, the Romans extended the application of standards in new directions. They promulgated written standards for the ingredients of bread and the dimensions of water pipes. They built a stone tramway in Pompeii which required the width of the chariots to be standardized with the width of the road. The Roman legions had standard drills and equipment, which may have accounted for much of their military success.

Standardization suffered a grave set-back with the break-up of the Roman Empire, when Europe lapsed into parochialism. The feudal lords and kings got into the habit of decreeing standards in their domains according to whim. The lack of broad standards blighted trade, and the absence of contact among traders stalled the dissemination of knowledge and helped to prolong the Dark Ages. Measurements presented a shambles. Where the Romans had one standard foot of 12 inches throughout their empire, in continental Europe in the 8th century there were said to be as many as 280 variants of the foot.

In England the disorder was such that, when they came to draw up the Magna Carta in 1215, the Barons wrote in a clause demanding standard measures for ale, grain and cloth throughout the kingdom. A few years later a royal ordinance was issued defining an extensive range of standards and prescribing a standard unit of linear measurement, "the Iron Yard of Our Lord the King". These standards were to remain more or less intact for the next 600 years, with a few

revisions and numerous additions. In the meantime there was progress on another front which permitted standards to be applied more widely. The science of calibration, which grew out of the measurement of gun barrels, came to be based on the principle that "things which are equal to the same thing are equal to each other". This meant that if a measuring device was set accurately against a standard, other measuring devices could be set against it.

Still, the proliferation of English measures over the years proved a fountain-head of confusion. It gave rise to a welter of different measures for different things, which all too often had different numerical bases: furlongs, acres, rods, fathoms, gills, drams, grains, scruples, ounces (troy), ounces (liquid), pints (liquid), pints (dry), tons (short), tons (long), barrels (oil), barrels (beer). To add to the problem in North America, measures of the same name in Canada and the United States sometimes differed. For example, a U.S. gallon is smaller than a Canadian one because the Americans stuck to the old liquid measure of a Queen Anne gallon when the Imperial gallon was proclaimed in Great Britain in 1824.

The end of pounds and yards as standards came years ago

It was to overcome just such confusion across the Channel that Revolutionary France proclaimed the metre and the kilogram as the sole standard measures for all purposes in the late 1700s. They were multiplied and subdivided in units of 10, with decimal points replacing the awkward fractions employed for conversion in the English scheme. Although a simultaneous attempt to impose a 10-hour day and a standard 30-day month failed, the simplicity and adaptability of the metric system gradually won it recognition the world over. In 1875, the Treaty of the Metre was signed setting up the International Bureau of Weights and Measures at Sèvres, near Paris. Then new standards for the kilogram and the metre were made. One of these — a platinum-iridium cylinder kept at Sèvres — is still the world standard for the kilogram. The old metal standard for the metre has since been superseded by physics. A metre is now officially "1 650 763.73 wave lengths of the orange-red line of krypton 86".

In 1893 the United States scrapped its metal standards for the pound and the yard and redefined them in terms of the international kilogram and metre. In 1951 Canada did likewise, somewhat influenced by the fact that the Canadian model of the standard British pound in Ottawa had been found to deviate slightly from the original standard pound. Since then, our official pounds and yards have been defined as ultra-precise fractions of the kilogram and metre. Pounds and yards ceased to exist as standards entirely when the British government followed suit in 1959.

A single set of measures around a divergent world

In recent years, Great Britain, Canada and the United States have all decided to adopt the improved metric system known as "SI", for *Système International d'unités*. This is being done primarily to get into step in matters of trade and technology with virtually all the rest of the world. SI encompasses not only weights and linear measures, but time (for which the standard is a second), electric current (an ampere), temperature (a degree Kelvin), and luminous intensity (a candela). The standards for time, electric current, and luminous intensity have been in common use for many years in Canada, and Canadians are now learning to think in terms of Celsius degrees, kilometres, tonnes and litres. They are already familiar with the calculations involved in the metric system through the day-to-day use of decimalized currency. The metric system has long been the idiom of science in Canada. Canadians take for granted metric measures for such products as drugs, vitamins and films.

The North American and British conversion to SI is standardization on the grandest scale, comparable to the global application of Standard Time thanks to the great Canadian engineer Sir Sandford Fleming. (See *Monthly Letter,* August, 1978.) The establishment of a single set of measures throughout this whole divergent world must be counted as one of the most significant advances in history. Measurement is, however, only one of

many activities that draws its lifeblood from standards. In this complex modern world they are just as crucial in other fields.

In fact, if you asked most present-day Canadians what standards are, they would probably think first not of standards of measurement, but of safety standards. Many of these are imposed by law — food and drug regulations, fire and building codes, pollution controls, etc. But many more standards are set voluntarily by the industrial and professional representatives who belong to the more than 600 standards-writing committees of the Canadian Standards Association. Meeting constantly to hammer out stringent standards for a vast range of products, they are the people behind the familiar label, "CSA".

That monogram might be found on anything from a mobile home to an electric toothbrush. Wherever it is, it means that the product has measured up to standards that have taken experts an average of six months to formulate and write. Every CSA-approved product has been subject to rigorous testing. The association's laboratories put them through such paces as crashing a steel ball down on the centre of a bathtub to check for cracking, and twisting an electrical cord up to 10,000 times.

The CSA is the largest of several Canadian organizations which are continually at work developing new and improved standards. Most prominent among the others are *Bureau de normalisation du Québec,* the Canadian Gas Association, Canadian Government Specifications Board, and Underwriters' Laboratories of Canada. Their activities are promoted and co-ordinated by the Standards Council of Canada. This autonomous federal government corporation is also responsible for Canada's participation in international standards bodies and for encouraging standardization in Canadian industry.

A simple illustration of how industrial standardization works can be found in the case of an electronics manufacturer which once used several different types of transistors in its products. By settling on one type, it was able to order greater quantities at a considerable savings and speed up its production run.

Standardization such as this, says the SCC, leads companies to higher productivity, broader markets (especially internationally), more time to devote to innovation, and less expensive products for the consumer. It should be an important national objective. "Canada can ill afford the costs which are associated with the waste of materials and manpower resources which are associated with lack of appropriate standardization," an SCC booklet declares.

But standardization is not without its critics in Canada or elsewhere. To many it implies a degree of uniformity that clashes with the natural tendency to assert one's individuality. There is always a danger that, when it extends beyond the nuts and bolts stage, it may restrict the consumer's range of choice and inhibit the development of improved or more attractive products. Henry Ford was one of the great men of technical standardization, whose invention of the assembly line brought a new age of rationalization to industry. But he overreached himself when he declared (or so it is said) that you could have any colour of Ford you wanted as long as it was black.

In its proper place, however, standardization leads to convenience and economy without uniformity. Shoes make a good case in point: they come in standard sizes, yet they are available in innumerable styles and shades. Beer in Canada has no less variety in taste for being sold, whatever the brand, in the same interchangeable shape, size and colour of bottle. It can only help to hold down costs to consumers to ship goods in containers of standard sizes that will fit on ships, trains, aircraft or trucks.

So standardization is desirable as long as it is recognized that people themselves can't be standardized. They can be persuaded to accept certain standards, but they will persist in thinking and acting in their own individual way. Standards have a prominent role to play in human affairs as criteria to live up to — standards of decency, standards of excellence, and so forth. But, like standards in industry, these are most effective if they are agreed upon voluntarily and acknowledged as necessary by the people most concerned.

ALSO AVAILABLE IN FRENCH AND IN BRAILLE