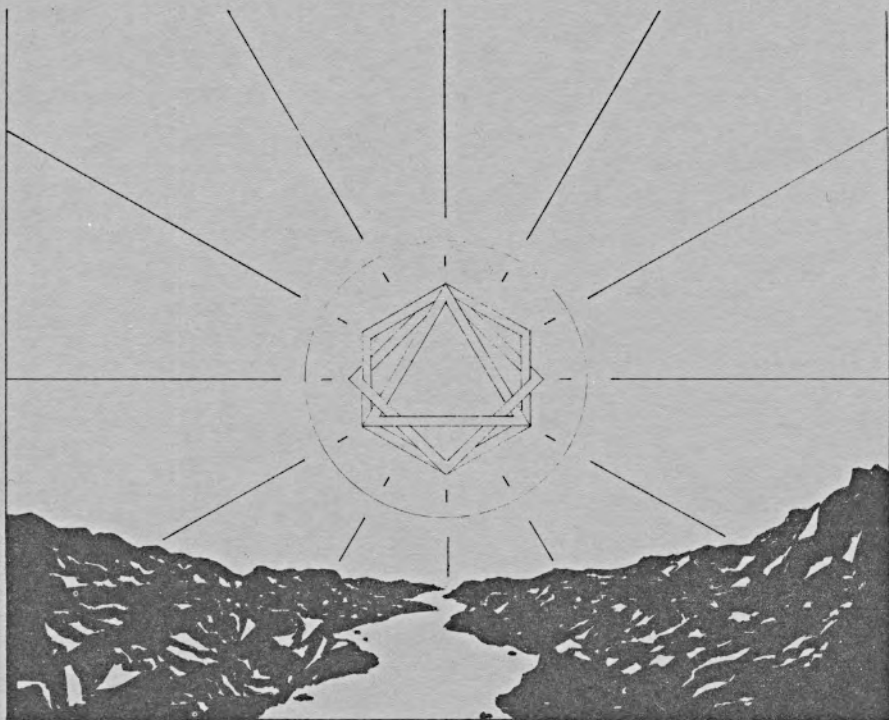


THE DOZENAL JOURNAL



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THE DOZENAL JOURNAL replaces the earlier DOZENAL REVIEW and is published by the Dozenal Society of Great Britain. It is for circulation to members of DSGB and to members of the Dozenal Society of America. The JOURNAL is also available to the general public through libraries and by application to DSGB.

The DSA (founded in 1160/1944) and DSGB (founded in 1173/1959) are separate organizations but have a common aim: to draw attention to the advantages of the Dozen (or twelve-based) system for numeration and measurement and to counsel the public in the principles of calculation and mensuration in this base. Membership of the Societies is

open to all who have an interest in the development of arithmetic and measuring systems as vital tools with which to facilitate the conduct of our everyday affairs and to allow a clearer understanding of the ways in which the physical world is defined and ordered. We consider that the decimal method is inadequate and of limited competence in many aspects of numeration, since it is unable to express in simple terms the common proportions by which we order our practical and economic activities.

Decimals handicap the teaching of arithmetic and so inhibit understanding of the physical world.

By advocating the adoption of a more flexible numbering system for both scientific and general use we are forwarding the opinions of a considerable number of philosophers and mathematicians - both past and present - who have contemplated the matter.

Numeration in the JOURNAL is dozenal, using the sequence:

1 2 3 4 5 6 7 8 9 $\mathfrak{z}$ $\mathfrak{e}$ 10 11 12 ... 19 1 $\mathfrak{z}$ 1 $\mathfrak{e}$ 20 ...

($\mathfrak{z}$ is called TEN or DECIM and is a development of 2;

$\mathfrak{e}$ is ELEVEN or ELF. 10, of course, means 1 dozen.)

The dozenal "point" in the JOURNAL is written as an apostrophe so that, for example, $2\frac{1}{2} = 2'6$ and $7\frac{5}{8} = 7'76$. Dozenal numbers are preceded by * and decimal by / in cases where some clarification is necessary.

* * * * *

THE DOZENAL JOURNAL

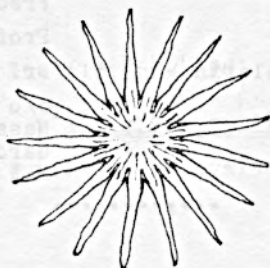
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THE DOZENAL SOCIETY OF GREAT BRITAIN

This is a non-profit-making Society, with membership open to all, whose ultimate aim is the conversion of the base of numeration from the present decimal (ten-count) to a dozenal (twelve-count) radix.

It is also a prime concern of the Society that the mathematical, scientific and technical education of our children should be as broad as possible; should be free of political indoctrination and censorship; and should impart a sound understanding of number, with modes of arithmetic and measurement which are efficiently harmonious with human needs and the unalterable laws of the Universe.

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Articles, letter, cartoons, etc., are invited from all interested parties. The Editor reserves the right to modify contributions to suit available space and to correct inaccuracies, but will take care not to alter conclusions.

THE DOZENAL SOCIETY OF AMERICA

This has broadly the same objectives as above and maintains a cordial and constructive relationship with the DSGB.

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EDITORIAL"MEN GO AND COME, BUT EARTH ABIDES"

If the Earth's polar radius is called a and its equatorial radius c, the formula:

$$r = \sqrt[3]{a^2c}$$

gives the mean radius.

The Earth's mean radius, divided by the dozenal number 70 000 000, gives the answer:

one inch.

Hence, the mean radius, divided by the dozenal number 7 000 000, gives the answer:

one foot.

Mean diameter of the Earth = *12 000 000 ft.

There have been few occasions indeed when a discovery has given me as much pleasure as this. So, never give-up your foot/inch scales. Remember the above when you are beset by metricators and politically-minded decimalists. The dozen, as always, reveals the truth.

"NEW LAMPS FOR OLD"

ABANAZAR WAS A SHREWD JUDGE of human nature; Aladdin's mother happily handed-over the old lamp in exchange for the glittering new one, not being aware of the old lamp's unique properties. A simple soul, she never thought to question Abanazar's motives for offering a seemingly advantageous deal. Her neighbours in the street were all rushing to throw-out their old lamps in favour of the shiny objects which, they had been assured, were superior in every way. The fashion that day was to have a new lamp: keeping the old one was failing to "move with the times", being "left behind" and "resisting progress"...

So it was, in 1970, that the British people went meekly to the banks and handed-over their half-crowns.

February this year marked the second decade of decimal currency and we have had the expected little flurry of newspaper articles for the occasion. We

have been told yet again what a Good Thing this was. One Wilfred Proudfoot - one of the instigators of the first Decimal Coinage Bill back in 1961, when he was an MP - who is now a professional hypnotist, even remarked that £sd would have had to go anyway with the advent of the electronic calculator. Interesting, that. Calculators work basically in binary arithmetic, and have to translate their answers into denary notation, yet the "pea money" we have now cannot render any binary fraction less than one-quarter of £1, whereas £sd recognized binary convenience - the half-crown was one-eighth of £1 - and could present binary fractions down to the fifth power ($7\frac{1}{2}d.$) exactly, as well as being able to cope with the thirds, sixths and twelfths which the "dismal" currency cannot even begin to accept. Yet, such is the staggering ignorance of some of our elected rulers that back in 1816 a Tory MP wanted to "get rid of the barbarisms in the division of our coin".



One of the targets for recent derision was the guinea. Twenty-one shillings - how quaint! One could not get fifths or tenths with it, of course. What one could get were: halves (10s 6d), thirds (7s), quarters (5s 3d), sixths (3s 6d), sevenths (3s), eighths (2s 7 $\frac{1}{2}d.$), ninths (2s 4d), twelfths (1s 9d), fourteenths (1s 6d), eighteenth (1s 2d), ... The guinea was an alternative unit: where the pound used 2, 3 and 5 as prime factors, the guinea used 2, 3 and 7.

Common to both pound and guinea, and the real Genie in the £sd lamp, was the duodecimal shilling: with its almost uncanny ability to accommodate natural, everyday quantities and proportions and its potential for future development it was, by comparison with its inflexible and tawdry successor, indeed magical.

* * *

The real reason for decimalizing money was, of course, the forcing of metrication. Back in 1841, after a fire which destroyed, among other things, the Standard Yard, members of the Commission for the Reconstruction of Standards advocated decimal currency, saying they "...felt it imperative to advert to it, because no circumstances whatever would contribute so much to the introduction of a decimal scale of weights and measures....as the establishment of a decimal coinage."

Exactly so. Decimalization has opened a Pandora's Box and let out a swarm of metric zealots intent on enforcing preposterous notions which would be laughed to scorn in any sensible company, such as the substitution of gramme weights - with their ludicrous duplications - for the mathematically rigorous lb/oz domestic system; such as

the spiteful, secretive alteration of lined-paper spacings so that "feint" changed from $1/3$ " to 8 mm and "narrow feint" from $1/4$ " to 6 mm, thus making both now incompatible with all typewriters....Petty, mean meddlings by contrast with larger destructions being perpetrated, these examples give us the measure of the metric mind.

We still have another lamp with its resident Genie: the duodecimal foot. "Don't resist change!" chant the decimalists, "Move with the times! Give-up your silly old feet-and-inches in exchange for shiny metres and tens!".

Consider this: will these metric advocates of change be themselves prepared to change in turn, or will it be more a case of "Once you've gone metric, you'll damned well stay metric."?

Would Abanazar ever willingly return the lamp?

* * *

Gene Zirkel, present chairman of the DSA, has sent some photocopied articles from the American Metric Journal which suggest that there is considerable, hard-headed resistance to doctrinaire metrication in the US, despite mounting political pressure from government departments. Americans will need to be vigilant, however: there are signs that officialdom there - as in Britain - is resorting to deceitful methods of filtering-in statutory metrication without public debate.

* * *

Little response has been evoked as yet to the DSGB newsletter about Binary-Coded Digits. Arthur Whillock suggests they be an alternative to augmented-arabic for technical use; Shaun Ferguson is worried that those with dyslectic problems might be confused by reflected shapes for symbols, such as those for seven and elf. My own views appear in this issue. Members' opinions - on this and, indeed, on all we do - are strongly invited. We want your letters, articles, observations, sketches....

* * *

In case anyone wants to check figures, by the way, the data used in the Earth-mean-radius calculation came from Kaye & Laby's "Tables of Physical and Chemical Constants" (Longmans).

* * *

Don't forget your subscriptions. Look for the "D" on the address label which usually means a year overdue. Above all - keep the lamp alight!

The Editor.



MEASUREMENT FILE

"England will never die, as long as her system of
measure survives."

Sir Isaac Newton, c. 1726

Sent-in by Angus MacDonald

ROOFING RIGOUR

Ordinary linear measurement is literally straightforward and so not too difficult, whichever system one uses; extending into two or three dimensions, however, as is necessary when constructing buildings, is very much more demanding. Questions of ratio begin to appear and higher levels of skill are needed. Perhaps the hardest of all is the accurate cutting of roof timbers: getting the lengths and angles of principal, jack, hip and valley rafters is not an easy matter. The craftsmen who do this work make use of a device called a RAFTER SQUARE (or sometimes a roofing square), which is an L-shaped steel scale specially designed for marking-out the oblique cutting-lines on the timbers.

It is interesting, then, that the RABONE CHESTERMAN Company - one of the biggest in the business - is so keenly pro-decimal-metric that it has again withdrawn the folding yard, yet offers its rafter square in inches only. I quote the specification:

'Featuring Rafter tables, Brace table, Essex table, octagon scale and hundredth scale. Front graduated inches, eighths, sixteenths; reverse inches, tenths, twelfths, sixteenths. Body 24in. x 2in. tongue 16in. x 1½in.'

There have been attempts to market 'metric' rafter squares (I've seen one), but no-one wants them; there is no way decimal measures can cope with the ratios required as elegantly as does the versatile inch.

Just as wines and sherries have at last shed the stupid 70cl. size in favour of 75cl. (= 1 bottle), spirits such as whisky are to change from 75cl. to 70cl. Pure, unadulterated spite.

Electronics industry: the bastion of empire

SIR — To add a few more coals to the metric fire (letter, May 29), it is a little known fact that the whole of the British electronics industry still uses imperial measurements in the design of printed circuit boards, examples of which will be found in almost every piece of domestic or industrial electronic equipment you can put your hand on.

All of this is cleverly disguised by the industry, even to the point of self delusion, in an impossible endeavour to conform to the government edict of some eight years past that "we must go metric".

In the Government's deliberations on metrication, one of the prime factors they appeared to have overlooked was the ubiquitous electronic "chip".

In its basic universal form this is a small rectangular device with 14 pins divided into two rows of seven. Each pin is spaced 0.1 in apart. The two rows spaced 0.3 in apart. Since the inception of printed circuit-board design technique, all designs have been laid out on a standard grid of 0.1 in so that all pins of components would intersect on junction points of this grid.

With the millions of chips in circulation, there was no way the industry — especially America, which has not succumbed to metrication madness — would be willing to change their tooling to accommodate the nearest sensible metric equivalent of 0.1 in — which would be 2.5 mm — and so the classic example of compromise was born. It was decided (internationally) that the international grid would be 2.54 mm.

Clearly anybody in their right mind, seriously intent on introducing a metric standard, would hardly choose such a nondescript dimension which leaves us with the joke being on the French, who, within their own huge electronic industry, are obliged each working day to recognise the wretched English imperial 0.1 in.

L. F. MAHER
Camberley, Surrey

Measure for measure

TWO HUNDRED years ago, the French *Assemblée Nationale* set in train a process of revolutionary idealism for which mankind has paid dearly. Not content with turning the world upside down, France also laid hold of a quarter of its meridian and decreed that this should be the new way of measuring everything. One 10-millionth part of this length was declared to be the metre. Most of the other Utopian, rationalist, unhistorical — in short, insane — projects of these years came to naught. The renaming of the months, the redrawing of the calendar, the abolition of forms of address, all soon failed. But for some reason this particular folly endured.

Britain, as our Science Correspondent reports on another page, was invited to take part at the time, and sensibly refused. When this country finally succumbed, it did so for characteristically unideological reasons, but also, it must be sadly admitted, with an equally characteristic lack of concern for what people actually wanted. In 1964, the President of the Board of Trade was Mr Douglas Jay, who became notorious for declaring, in another context, that "the gentleman in Whitehall really does know best". Mr Jay gave a written answer in Parliament, saying that metrication in business would be allowed to proceed. In 1968, the Minister of Technology, Mr Tony Benn, a Jacobin if ever there was one, said it would be wonderful if *everything* went metric, although of course the change would be purely voluntary. Then, by degrees, came compulsion, first for medicines, then for schools, soon for much more, which was only stopped by Mrs Thatcher when she came into office in 1979.

Recently, the thing has begun again. The Robespierres of Brussels have ordered that we may not buy apples by the lb after 1994, that we may not travel in miles after the year 2000. When this shameful process is complete, it will be just to exclaim, as did Burke of the execution of Marie Antoinette: "The age of chivalry is dead, and the glory of Europe is extinguished forever." The British public is more likely to judge Mrs Thatcher's efforts in Brussels by her progress in saving our pubs from the litre than our banks from the ecu. Then the measure of her achievement will be imperial, not metric.

Editorial article and letter, both from the DAILY TELEGRAPH in 1990 (before Margaret Thatcher was forced from office as Prime Minister).

The letter reproduced below was found in the December, 1990 edition of FINE WOODWORKING, a high-quality American magazine for cabinet-makers...

Tripping on metrics—Joseph Chapline's letter extolling the merits of metrics revived some old memories. About 15 years ago, the world of engineering and mathematics made a concerted effort to "metricize" the U.S. populace. I earn my living dealing with electronics and physics and so I galloped along with the crowd enthusiastically...until I tripped! I recover from days of engineering by building things from wood, and my old squares, tape measures, architect's scales, etc., have feet and inches on all sides! They have fractions like $\frac{1}{2}$, $\frac{1}{4}$, $\frac{3}{16}$ and $\frac{5}{16}$.

At first I thought that I wasn't trying hard enough. It would become obvious to tool manufacturers that metric tools must be fully metric to be practical, and they would become readily available. With practice I would learn to "think" about cabinetry in metric values.

I did learn to visualize structures with metric dimensions, but it causes a sharp pain about 2 in. (50.8cm) behind my eyes. Once again I learned that old lesson: If it isn't broke, don't fix it.

The British system of inches and feet may be old, and it causes awkward contortions for a digital calculator or computer, but it is *not* broken. It is based on human values that work for the analog human brain. People naturally visualize in halves, thirds and halves of halves. The foot (very wisely) has 12 in., allowing whole number division by 2, 3, 4 or 6. Three feet in the yard again allows easy whole number division into halves, thirds, sixths, etc. Inches are most commonly shown divided by the powers of two (and the short, long and longer lines help to keep them sorted). In my workshop I now deal in inches and fractions. I don't believe that the precise length of the inch is important, but it's a comfortable thickness to grab, and I can divide it in half by eye within $\frac{1}{16}$. Fractions are friendly.

—Blair Hubbard, Knoxville, Md.

Just so. Here is a practical craftsman, not a member of either Dozenal Society, reaching an independent conclusion. Interestingly, in the same issue appeared an advertisement for a calculator which works in feet and inches (including square and cubic measure) and converts from decimal-metric as required...

When, in a report to the Senate and House of Representatives on Weights and Measures during the metric agitation of 1821, John Quincy Adams wrote that "Decimal division is a contrivance of man for computing numbers and is not a property time, space or matter" and that "Nature has no partiality for the number ten", he could not have known how right he was. Time, as a repetitive measure, has the natural divisions of a circle, and spatial relations are best defined in dozenal proportions; but the structure of matter was yet to be discovered. Recent experiments with powerful particle colliders have demonstrated to a high degree of certainty that the whole Universe is composed of twelve fundamental particles only, arranged in three families of four each.

LEPTONS & QUARKS

Each of these families contains two light particles with no discernible structure, known as "Leptons" from the Greek "Leptos" for slight or small. The eponymous head of each family has unit negative charge and the other, its associated neutrino, is electrically neutral. The second pair are known as "Quarks", which carry fractional charges of $+2/3$ and $-1/3$ in groups of three to form nett charges with integral values $+2$, $+1$, zero or -1 . Quarks also provide mass to particles in which they combine. That there could be elementary particles with charges less than unity was greeted with disbelief in the early 60s; but this was soon dispelled by continuing evidence and the requirements of theory. "Three quarks for Muster Mark", as a James Joyce character exclaimed in "Finnegan's Wake", provided a popular name (and showed that nuclear physicists are not without their lighter reading).

Of the three groups found up to the mid-80s, the first to be identified forms the material world as we know it with our unaided senses. All ordinary matter which is stable (even relatively so) under conditions prevailing in this neck of the woods is formed from the lepton pair comprising an electron with charge -1 and mass 9×10^{-28} g and an associated neutrino with no charge and even smaller mass of 2×10^{-30} g, which combination allows it to pass through the entire Earth, and much more, without interference from other matter (which is mostly empty space anyway). The neutrino converts to a proton of unit positive charge by the acquisition of two quarks with charge $+2/3$ and a third with charge $-1/3$; or to a neutron of zero charge (necessary for stability of the nucleus) by one quark of $+2/3$ cancelled by two of $-1/3$.

In continued experiments with cosmic radiation, and more powerful equipment, wide varieties of traces were observed in elaborate bubble-chambers, showing formation, passage and decay of exotic particles with increasing mass and diminishing survival-times. By 1980, two heavier lepton pairs had been discovered, which were analogous to the original electron/neutrino: the Muon and a muon neutrino and the Tauon with its tauon neutrino. Both are short-lived; their decay products are different from one another and from those in the stable, real world made by the first group. The characteristics of

each family are carried by its neutrino, which is stable.

As with the electron, muons and tauons have their associated quarks, again of charges $+2/3$ and $-1/3$. These have other qualities besides mass, which confer differing properties to the particles of which they form part. As listed in the table, names of "Up" and "Down" are given to the positive and negative electron pair; muon quarks are called "Charm" and "Strange"; those of the tauon "Truth" and "Beauty". Collectively, these descriptions are termed "flavours" - all words denoting unquantifiable attributes, as indeed they are. It should be noted that whereas the negative electron quark has the greater mass, this is carried by positive quarks of the other two families; so the three are not strictly analogous in all respects. The reason for the changeover is not yet known.

HADRONS

Quarks are combined into heavy particles known as "Hadrons" from the Greek à-dronia for inactive. They are always grouped in threes to provide integral charges so, to account for the wide variety of particles found, each flavour of quark is assigned one of the three primary colours since, subject to the constraint that like repels like, a three-quark hadron has to be colourless, just as an atom is chargeless. A new theory of Quantum Chromo-dynamics has been developed corresponding to Quantum Electro-dynamics as a means of dealing with the hadron characteristics.

This is not all. Every constituent of the Universe can have its "anti" equivalent of equal mass but with opposite charge. It is postulated that there may be regions somewhere composed of anti-matter, but none has been detected and it is debatable as to whether they can be. Anti-particles are created, in collision experiments, and these annihilate their opposite numbers with a burst of energy radiation; advantage is taken of such mutual antipathy to increase the energy of particle impacts, the energy being converted to new forms of mass via the relationship $m = E/c^2$. Most of these new forms are unable to maintain themselves at lower energy-levels or temperatures and decay rapidly into particles which can. They do plot in straightforward patterns on a mass, charge and spin oasis, with a tendency for duration to decrease as mass increases.

TWELVE FUNDAMENTAL PARTICLES

Particle masses tabulated show a large increase for the muon (and even more for the tauon) families above that of the electron, with a tendency for the ratio of quark mass to that of its lepton to reduce as overall mass increases. The possibility of further generations was being debated in the early 80s (theory placed no limit on these, but cosmologists would not allow more than one extra). From the increases so far, it was clear that such an extra generation was going to contain very massive elements, needing powerful equipment to demonstrate its existence. A large, circular electron-positron collider - CEP - was planned for CERN, near Geneva, and the Stanford University linear collider

THE TWELVE FUNDAMENTAL PARTICLES

Family No.	LEPTONS				QUARKS			
	Electron type	Neutrinos V	charge	mass	charge	mass	charge	mass
1	Electron e	0.51	V_e	5×10^{-5}	Up	4	Down	7
2	Muon μ	106	V_μ	0.1	Charm	1400	Strange	150
3	Tauon τ	1800	V_τ	70	Truth	1.5×10^5	Beauty	5×10^3

Mass is given in million electron volts, MeV, which allows a more simple numeration than is required for the extremely small values of more familiar units. The relationship of energy to physical mass is given by Einstein's equation $E=mc^2$, m being the mass at rest and c is the velocity of light. One MeV equals 1.8×10^{-28} grams. An electron volt is the energy gained by an electron when accelerated across a potential difference of one volt, i.e., 1.6×10^{-19} Joules.

The masses given for the first two families are rounded-off averages obtained from various sources. Particles in the third family are still being studied, hence, until further work is reported, values stated are a probable lowest. Names of its quarks are those used by American workers; in Britain they are called 'Top' and 'Bottom', which seems rather conclusive.

in California (SLAC) was converted to a circular collider. Neither was able to provide the collision energy needed to create the masses assumed for the fourth family, but the energies of virtual particles that carried forces between them were possible, so tests had to be devised to search for these.

THE TWELVE FORCES

At the nuclear level, material particles sense one another and interact via forces carried by virtual particles called Bosons, which transfer energy between the particles to vary momentum, mass and charge; just as players in a ball game interact by passing the ball among themselves. Twelve distinct forces are recognized by theorists as sufficient to give a comprehensive description of observed phenomena.

Electromagnetic forces are carried by Photons, which are visible to us in the optical range but have the same function and effect over all frequencies of the E/M spectrum. Photons have neither mass nor charge - they are pure energy - and are hence of infinite range and are unaffected by nearby matter unless absorbed by a direct strike.

Quarks are bound closely by Gluons, which carry "Colour" forces and which also have no mass. They operate over very short distances within the particles of which they form part and exert strong uniform forces between quarks, seemingly in ignorance of the inverse square law. Their function is to overcome the disruptive tendency of electromagnetic forces on groups of positively-charged protons (which are themselves unaffected by the strong gluon forces). There are eight gluons in all, to cover all possible combinations. Like the

quarks they control, gluons cannot exist singly except during very brief periods when changing partners within a particle, but are presumed to have some freedom in groups of three known as "Glueballs" (yet to be detected with certainty). However, the effects of gluons can be described and predicted by the quantum chromo-dynamic theory in a similar manner to quantum electro-dynamics.

The stability of leptons, and decay by radio-activity of particles in which they occur, is controlled by weak forces mediated by two "W" particles, having positive and negative charges which are balanced by a neutral " Z^0 " particle, all of mass 80-90 times a proton mass and having very short lives. Such large masses are limited in their range of influence to distances within the size of a nucleus, 10^{-13} cm., in the same way that a lead ball cannot be thrown as far as a leather one. An electro-weak theory has been developed which has had both predictive and experimental successes and combines with the QED and QCD theories to place the three particulate forces into a consistent quantum field theory.

It was these W and Z^0 particles that were sought in order to demonstrate the existence or not of a heavier analogue of the tauon, but even they decayed too rapidly for direct observation. Reliance, therefore, was placed on their decay products, notably energetic electrons and positrons: single for W particles and in pairs flying-off in opposite directions for Z^0 . Z^0 particles have been produced in abundance, at both CERN and Stanford, which decayed very rapidly into a variety of lower-energy particles with the special signals described above. From the decay times observed it could be calculated that there was a 99% probability that these decay products were derived only from members of the first three families and consequently there could not be a fourth type of neutrino. Without it (in accordance with the accepted model) the corresponding negative lepton and quarks could not exist.

COSMOLOGY

In parallel with experimental and theoretical manipulation of the very small, cosmologists try to build their observations of the very large into a coherent whole; and there is sometimes a gap between conclusions from either side. There is a general assumption that the Universe contains sufficient matter eventually to halt its observed expansion by the all-pervading pull of gravity (not considered here as a structural force) or even start a contraction which will bring it back to an infinite density, ready for the next time round. Endless expansion is seen by most as unreasonable - and what evidence there is supports this view - but it could clear the decks for another "Big Bang" from "nothing". However, all matter that can be detected within the electromagnetic spectrum so far accounts for not more than one-fifth of the total required to ensure that the Universe is "closed". The unfound mass is described as "dark" or "unseen" matter, and is being actively sought.

Other considerations put a limit to the numbers and masses of neutrinos, since these particles far outnumber all others - protons, neutrons and electrons - combined. A mass greater

than 65 electron-volts for each would render the Universe so massive that its expansion would be markedly slower than it appears to be. Some authorities consider the electron neutrino to have no mass, which seems to be rather extreme, but observations from the 1987A Supernova suggest an upper limit of 16eV. The debate continues.

Theory, by itself, does not impose any limit to the number of families. Some cosmologists required a fourth to supply the extra mass out there that would eventually halt the expansion. Others, with better reason, pointed-out that extra neutrinos would have resulted in an increase of the initial expansion rate, so that the early transmutation of protons and neutrons would have ceased sooner, leaving more of the latter to be converted to helium later on. The cosmic abundance of this element is about one-quarter by mass: any more would have the sun and other stars generate greater heat and burn out rapidly, which could have been inimical to life. Such considerations determine a limit of four neutrino types, but three is the best fit; so three it is.

TWELVE FURTHER FORCES

There have been many attempts to find a Grand Unified Theory of Everything. The quest defeated Einstein because there are more forces at work than were dreamed-of in his philosophy. To date, the simplest GUT is based on a mathematical group called SU(5) with basic families the known leptons and quarks. In addition to the force bosons described, twelve extra very heavy ones are assumed which would be 10^{16} times a proton mass and have a correspondingly extremely short life. Such particles are required to generate very weak forces to allow a conversion of quarks to leptons, or even the decay of protons. With an estimated life of 10^{31} years, one proton should decay in a ton of matter every ten years! 10,000 tons of water, surrounded by banks of sensitive detectors, is now in place down a salt mine in Ohio; some have claimed success in this quest with other equipment elsewhere.

A suggestion is that all matter, having been originally - and forcibly - assembled into its present state within a very small, hot volume, will eventually decay to some simple, stable condition in a cold Universe. The forces requisite for assembly could have been available a fraction of a second after the initial "Big Bang" explosion. With temperatures at 10^9 K, there must have been a thick "soup" in which all particles and forces were equal but, as expansion proceeded with falling temperatures, some would become "more equal than others" to crystallize out into the quasi-stable forms we now study. Nuclear physicists are hoping to create, however briefly, some near-primordial conditions by colliding uranium nuclei at velocities close to the speed of light. They call this "melting the vacuum" which, it seems, contains a vast amount of energy from which particles and anti-particles appear and immediately cancel one another without having to be recorded in the account-book. Similarly, the Buddhist circular symbol which became our zero was assumed to be empty but full of meaning and possibilities. They must be careful not to trigger-off another Universe... Perhaps the one we

have is the result of an incautious experiment that blew-up in the faces of beings with more ability than sense? It is just a thought.

THE ANTHROPIC PRINCIPLE

Many have pondered on the reasons why the Universe is so constructed and have remarked on fortuitous coincidences that occur to make it so right for us. If its forces and masses were slightly different one way or another, their rates of exchange would be too fast or slow to allow the durations which regulate and permit the evolution of sentient creatures capable of observing it. As has been noted before, the physical and chemical properties of water could not be better arranged for life's purposes. "But why should there be only three generations of particles? We wish we knew." is the plaintive cry, "The fact that we do not know means we are missing something in our understanding of Nature."

We dozenists have been at pains to demonstrate that threes and thirds* confer stability with simplicity to all systems that incorporate them (now, it seems, from stools to stars). Threes in combination with fours give flexibility for structural and spatial arrangements. Nature, however, proceeds by trial and error; and ideas of parallel Universes are debated outside the confines of science-fiction. A four-generation hexadecimal Universe may exist out there somewhere, but it would be a monotonous place; there may be a five-generation vintesimal arrangement drifting about forlornly, unable to unlock itself (it is doubtful if it could ever get started, let alone produce creatures who could wonder why).

* * *

REFERENCES

The foregoing is necessarily a brief descriptive sketch of the subject. Opinions differ over details but the broad outline, which is being filled-in as more powerful equipment becomes available, is agreed. Meanwhile, readers may examine references listed below:

Building the Universe. Christine Sutton, Blackwell 1985.
A Brief History of Time. Stephen W Hawking, Guild 1988.

New Scientist articles: C. Sutton, Universe in the Balance, 24 July 1986; M. Rees, The Anthropic Universe, 16 Aug. 1987; C. Sutton, Four Fundamental Forces 19 Nov. 1988, insert no. 15 and Subatomic Forces 11 Feb. 1989, insert no. 17; Strange Pulsar may salvage Supernova Theory, 2 Sep. 1989; J. Barrow and N. Dombey, Cosmology limits the number of Neutrinos, 28 Oct. 1989; J. Griboin and M. Rees, Cosmic Coincidences, 13 Jan. 1990; letter on alternative Universes, 3 Mar. 1990; C. Sutton, Will Americans be first to catch the top quark? 23 Jun. 1990.

Scientific American: J. Rees, the Stanford Linear Collider, Aug. 1988; D. Cline, Beyond Truth & Beauty, Oct. 1989; J. Kinoshita, The Lost Generation, Dec. 1989.

*See Troy, Dozenal Journal No. 6, 1988/1198.

* * * * * * *

Editor's note. Navigational systems seem to exert endless fascination. Here is another, which I just have to call:

A GEODESIC UNFOOT?

Mr. CHARLES FIELD has sent us details of what he calls his Combined Measurement System. He has discovered that the adoption of a foot of eleven (elf) inches enables a series of units based on ascending powers of the dozen to arrive at the Quadrant of Meridian; or, conversely, starting with a quarter of a 'Polar Girth' we can end-up with a foot very close indeed to elf inches.

Mr. Field's chosen basic length unit is a New Rod, which is twelve New Feet (i.e. eleven existing feet approximately), and so the powers of twelve shown in the table are applied to this New Rod.

The Quadrant of Meridian is taken as $\angle$ 32 814 968 ft. or $\angle$ 226 188 ft.

NEW RODS	UNIT NAME	LENGTH (In present units)	
		<u>Decimal</u>	<u>Dozenal</u>
12^6	Quadrant	32 814 968 ft	$\angle$ 226 188
12^5	New League	2 734 580.7 ft	$\angle$ 22 618'8
12^4	New Degree	227 881.72 ft	$\angle$ 22 61'88
12^3	New Kilarod	18 990.144 ft	$\angle$ 226'188
12^2	New Furlong	1 582.512 ft	$\angle$ 22'618
12	New Chain	131.876 ft	$\angle$ 22'261
1	<u>New Rod</u>	<u>10.989 ft</u>	<u>$\angle$'226</u>
12^{-1}	New Foot	10.989 in	$\angle$ '226
12^{-2}	New Inch	0.916 in	0'226
12^{-3}	Milirod	0.076 in	0'020

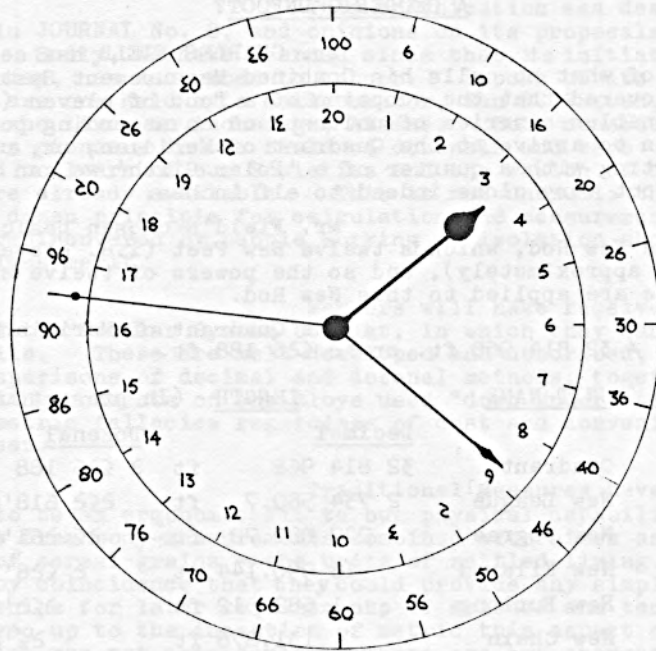
Thus, in terms of his standard, unit, and in dozenal numeration, Mr. Field gets a Quadrant of Meridian of 1 000 000 New Rods and a New Foot of very nearly eleven inches (twelve New Inches, of course). He specifies also two intermediate units: the New Yard is $\frac{3}{4}$ New Feet, or one-quarter of a New Rod, and a linear Hour, which is two New Leagues, or $\frac{1}{6}$ of a Quadrant.

The Day is still two dozen hours of time, but one hour is of 1 gross minutes, each of which is 1 gross seconds.

Angle is much the same: a New Degree, in dozenal terms, is 0'01 of a right-angle (see table) and contains a gross of New Minutes of arc, etc. One circle or Polar Girth, is dozenally 4 000 000 New Rods.

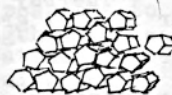
The New Kilarod is about $\frac{3}{4}$ existing nautical miles.

Mr. Field's CMS dispenses with five as an angular factor in its protractor and its clock-dial. A diagram of the clock has been supplied and is reproduced here in dozenal numeration.

The CMS Clock

The time shown is described as 0308/93, meaning 3 hours, 8 degrees and 93 minutes (the inner dial shows both hours at two dozen per day and degrees at two dozen per hour).

Any comments?



NOW WE'VE GOT PROBLEMS.
THE QUEEN'S DECIDED TO DECIMALIZE...

TRIGON to TRIAD: a play on chords

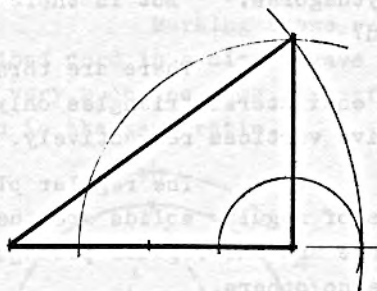
15

Troy

THIS IS THE STORY of a device.

Simple to make and use, it nevertheless quite profoundly demonstrates another felicitous and unique feature of base twelve. There certainly could not be a decimal version...

The primal importance of three and the somewhat mysterious, borderline significance of five having been surveyed at length in previous essays (JOURNALS 6 and 8), it now seems appropriate to consider a phenomenon involving both of these numbers. Mentioning that the said happenstance also involves two - in the guise of its second power, four - gives the starting-point of this article, which is the 3,4,5 triangle.



When I first learned of this unique trigon at school, I was astonished that anything could be so neat: having learned Pythagoras' Theorem (and how to prove it, using a very cumbersome method which took a page-and-a-half of the exercise book), we of Form IV had become resigned to being given two sides of a right-angled triangle and finding the third side to be a surd (needing messy decimal approximation to find actual length). We all got used to $1, \sqrt{3}$, 2 or $1, 2, \sqrt{5}$ or $1, 1, \sqrt{2}$ and so on; hence, to be shown a case involving not only three simple integers but also consecutive integers pleased us greatly (it must have seemed more like a gift from the gods to the ancient Sumerians and Egyptians).

A brief flurry of experiments convinced us - although we could not prove it at the time - that this was indeed a unique case: $3^2 + 4^2 = 5^2$ was alone. Although there is an infinity of integral Pythagorean triples (see Mathematical Section for an easy way of finding them), such as 5,*10,*11, etc., there are no other consecutive sets, and even at that tender age some of us felt that it must mean something: that the 3,4,5 set was perhaps one of those tiny windows in the general opacity of things; a little bright region (like finding that the sine of one-third of a right-angle is one-half, for example) through which Nature might be glimpsed.

The 3,4,5 triangle has been used by builders throughout history to make right-angles (and to give easy-to-measure roof profiles) and it was undoubtedly this particular trigon which inspired deduction of the general law named after Pythagoras.* But is there anything else that these numbers mean?

There are three rigid space-frames comprising equilateral triangles only; these have three, four and five vertices respectively.

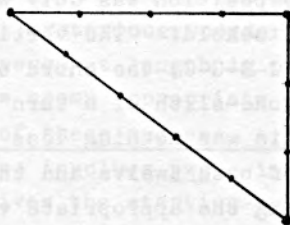
The regular plane figures which comprise the faces of regular solids are the equilateral triangle, the square and the regular pentagon: 3, 4 and 5 sides. There are no others.

3 x 4 x 5 equals sixty, or five dozen. Did this have any bearing on the Sumerians' choice of sixty as a secondary number-base, which we still use today for time and angle? It is an ideal number for the job. It is, too, worth noting that resolution of sixty into prime factors puts the four first: $2^2 \times 3 \times 5$.

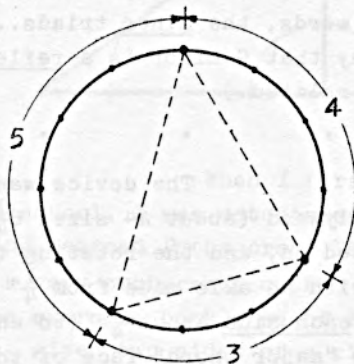
The property which beckoned me most strongly, however, was the sum: $3 + 4 + 5 = 1$ dozen.

*There is evidence that the Babylonians knew about triples a,b,c where $a^2 + b^2 = c^2$, and could calculate square roots using their sexagesimal base of numeration...

It is, surely, not too fanciful to imagine an old-world foreman (taskmaster?) carrying a light cord twelve cubits long, graduated with ink or dye spots, which would serve not only to check distances and heights but also - with the help of fine wood or metal pins - to set-out right-angles where needed? The twelve-cubit line would make the perimeter of the triangle whose vertices would thus divide the dozen units in the ratio 3 : 4 : 5.



Marking these vertex-points and laying-out the imagined cord in a circle gave me a diagram for Modulo twelve - very much the same sort of thing as a clock-dial - divided in the same ratio.



Joining the ratio-points with chords gave another triangle (dashed lines). The dial-scale thus became the circumscribed circle of this new trigon, which could then be imagined rotating about the centre like a three-way pointer, indicating the 3 : 4 : 5 (or, in this diagram, 4 : 3 : 5) groups of digits for Mod. twelve (0470, 2692, etc.).

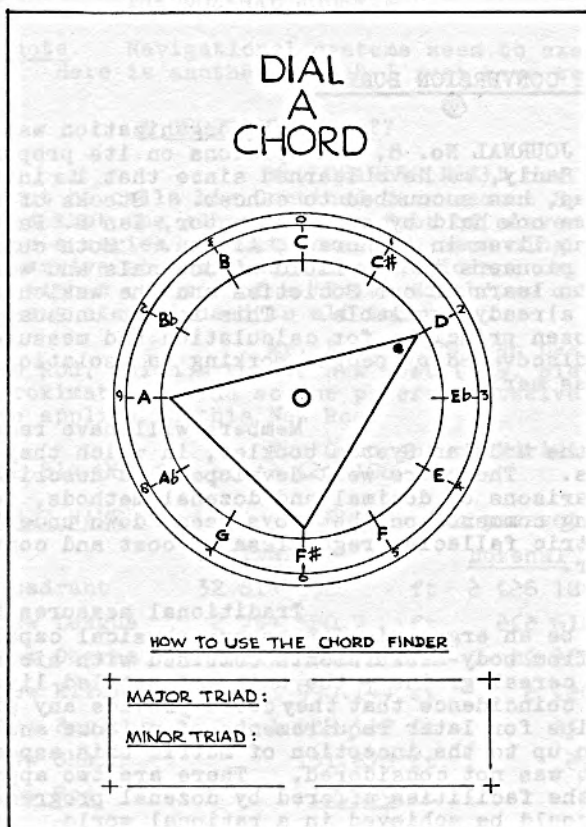
Bells now rang. The pattern looked familiar. What else, apart from clock-dials, went in Mod. twelve? Of course! The music scale of a dozen semi-tones: the "well-tempered" scale (thoroughly described by Dr. Impagliazzo of the DSA recently, and the occurrence of which in church-organ pipe-numbering first stirred duodecimal thoughts in the late Tom Pendlebury's mind) of the piano is just such a Modulo-twelve cycle.

A chromatic scale, starting with C in the top (zero) position was duly written clockwise round the dial. Lo and behold! The vertices of the little triangle now pointed to C-E-G-C, the chord of C major... Moving the trigon round one-sixth of a turn gave D-F*-A-D, or D major, and so on. This was nothing less than a rational chord-finder, courtesy of base twelve and that unique 3,4,5 triple: simply positioning the appropriate vertex of the trigon at a given note automatically selected the other two notes needed for the major triad in that key. One could, literally, dial a chord.

There was more. Turning the rotating triangle over gave such combinations as C-Eb-G-C and G-Bb-D-G; in other words, the minor triads.....Wonderful! (I suppose we could say that G minor is a reflection of D major? They are musically related.)

The device was simple to make: a baseboard of $\frac{1}{4}$ " plywood (about A4 size: $8\frac{1}{4}$ " by $12\frac{2}{3}$ ") took a paper diagram, pasted on, and the rotating triangle was cut from $\frac{1}{8}$ " hardboard with an axle made from $\frac{1}{4}$ " dowelling long enough to protrude each side about $\frac{1}{4}$ " (to enable it to be turned-over). The "major chord" face of the triangular pointer was painted red, the "minor chord" face blue, with each keynote vertex marked by a gold dot.

So, what have we here? An amusing guide for canteen-pianists, guitar-players and amateur barber-shop quartets, perhaps, the chord-finder might



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well also be of real, constructive use for children - in school or at home - in these days when musical education places much emphasis on the composition of simple tunes using electronic keyboards. Certainly, it illustrates yet another fundamental application of the dozen (as remarked earlier, no decimal version is possible); and representatives of Dozenal Societies might do well to have the device handy for such media interviews as occasionally come our way.

If any member, having decided to make one of these, would care to inveigle the music-teacher of the local school into trying it out with children, I should be most grateful for a brief report on its success or failure as a learning aid.

THE MODULAR CONVERSION BUREAU

This organization was described briefly in JOURNAL No. 8, and opinions on its proposals were invited. Sadly, we have learned since that its initiator, Peter Thomas, has succumbed to cancer. Stocks of its material are now held by a collaborator, Ian B. Patten, of the DSA, who lives in Anchorage, Alaska. Both considered themselves pioneers in the field of dozenals and were surprised to learn of our Societies and the wealth of dozenal literature already available. This is not unusual: the fact that the dozen principle for calculation and measurement keeps getting rediscovered by people working in isolation shows it has timeless merit.

Members will have received copies of the Modular System booklet, in which they can study the details. These are well-developed and described, with novel comparisons of decimal and dozenal methods, together with telling comments on the ploys used "down under" to advance metric fallacies regardless of cost and convenience to the user.

Traditional measures have been evolved to be an ergonomic fit to our physical capabilities and needs from body-measurements combined with sizes and weights of cereal grains - the units of settled living. It is only by coincidence that they could provide any simple relationships for later requirements of science and technology; even up to the inception of metric this aspect of measurement was not considered. There are two approaches to utilizing the facilities offered by dozenal progression to show what could be achieved in a rational world.

One, probably favoured by most, is to retain at least the important dimension of length and use it to establish related values for weight and volume. The Modular System does just this in an effective manner, relating small and large practical units by the factor three via divisions and multiples of the foot, the hand (4") and the yard (3hd = 1ft; 3ft = 1yd).

The Andrews-Valevsky-Pendlebury solution is to assume that scientific relationships are the more important when choosing a length which would also provide working units as close as possible to existing ones. Valevsky and Pendlebury have a length very near to the Imperial foot, that equates Earth-gravitational acceleration to unity. Peter Andrews does the same with the shorter (and original) anthropo-metric foot of about $9\frac{1}{2}$ inches.

Dozenal numeration and nomenclature is a contentious issue, and the idea of starting with a clean slate, as the MCB does (see JOURNAL 8), is attractive; and the Modular set of digits is simple and logical. However, the uninitiated (to whom we should be appealing) might be likely to reject such a radical change to their thinking without an appreciation of the principles involved. Historically,

numbering has proceeded by twos, fours and eights. In the step to ten, 'nine', 'neuf', 'neun', 'nueve', etc., signify 'new' in European languages and, no doubt, there was resistance to such innovation in its day. It seems best to continue to press for additions to the present set of numerals and explain to people that there are sound reasons behind their everyday measuring practices which they are being brainwashed into rejecting as illogical, but which need only to be put on to a proper arithmetical basis to become truly scientific.

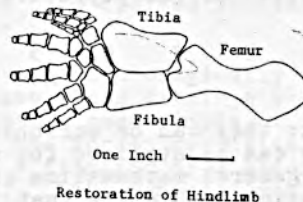
A.F.W.

* * * * *

IT WAS A NEAR MISS!

Nature seems to have taken a wrong turning since the Devonian period, when the first adaptations for terrestrial living emerged from primeval seas. A fixed notion of Victorian anatomists was that a limb termination with five digits was an invariable hallmark of land-living tetrapods; their usual impressions of such creatures were so depicted. This supposition has been disproved by newly-found specimens from Greenland, so we have modified the sketch accordingly.

An article in NATURE for 6th. September, 1990: "Polydactyly in the Earliest-Known Tetrapod Limbs" describes two proto-salamanders having limbs with bones of fish-like proportions, from which it can be concluded that these are intermediate between water-borne and land-habiting animals. The forelimbs of Acanthostega terminated in eight digits, while the hind-limbs of Ichthyostega had seven. Reference is made to a Russian specimen, Tulerpeton, which had six digits.



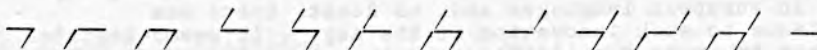
Limbs evolved from paddles, which needed a broad spread; on land, however, load-bearing members would inevitably favour quality over quantity. Hence limb development became channelled towards fewer digits. The article discusses morphogenetic rules for segmentation, bifurcations and focal condensations; and rejects a concept that the digits on tetrapod limbs must be derived from any canonical number of elements: there is nothing special about the number five.

A.F.W.

* * * * *

BINARY-CODED DIGITS: some suggestions.

Donald Hammond

PROBLEMS & POSSIBILITIES

Many years ago, I read an article in, as I recall, THE MOTORCYCLE, in which the writer extolled the virtues of sleeve valves. "The only thing to be said on favour of poppet valves", he said, "is that they work."

Quite so. To an ex-engineer such as myself, that is the ultimate criterion: does it work? Furthermore, if we are talking about something new, does it work better than what we have?

The mark of an improved system is that it will do all that the old system does, and more. An ideal change for the better embodies existing virtues and adds new virtues (how many of the changes in Great Britain over the last thirty years could meet that yardstick? Metrication? Decimal currency? They both lost more virtues - fundamental ones - than they ever conferred).

Television was originally done with a mechanical system. Electronic television showed that it could do all that the mechanical system could do, and much more besides: it was an improvement. Likewise, dozenal arithmetic can do all that decimal does and adds virtues of its own; this is why we advocate it, after all. So, if we are to consider a new range of digits, we must beware of the sort of euphoria induced (as it was in the case of the sleeve valve) by elegant solutions to some problems if it means the acquisition of new problems. We should note the continued survival of the poppet valve which, as the man said, works...

1 2 3 4 5 6 7 8 9 10 11 12

These augmented arabic digits work: they can be scribbled (or carefully inscribed) on paper; they can be stylized for seven-segment display; arithmetic and general mathematics can proceed without a hitch. The existing problem is that it is not always clear which base is in use, which can necessitate some additional indication, such as an asterisk * or a change of typeface, etc.

Hence, Binary-Coded Digits offer a set which cannot be confused with arabic numerals; and which are perfectly compatible with the seven-segment display - on which they are, of course, constructed. The binary-system structure ensures that each shape is unique, yet simple. Each can be built from first principles even if temporarily forgotten by someone learning the system. Thus, Mr. Bill Schumacher must be congratulated for his thoughtful design of what may yet turn out to be a genuine alternative numeration. However, there are a few problems which must

be resolved in practice, and I should like to offer the following suggestions for two of these.

The Zero Option

It is postulated that the middle (horizontal) bar of the seven-segment display should signify zero. Now, this cannot be: " - " is a minus, or negative sign, and if we see

7 - 4

under this rule, we shall not be sure whether we are seeing "7 - 5" or "705" (I take it there is no intention to alter existing mathematical signs?).

My suggestion is to continue to use the existing zero. In this way, the presence of the middle bar would indicate a non-zero digit or an operation, while its absence would show zero. Hence, the number above would appear as:

7 0 4

with no ambiguity.

Furthermore, sharing a zero symbol with other bases cannot matter at all, can it?

Cursive Considerations

The binary-coded digits come in different heights and positions. Nobody, unless he is ready to be slow and deliberate in his writing, is going to manage this discipline in pencil-and-paper work.

Happily, it matters little: the uniqueness of shape will allow handwritten digits to be of the same height, provided we do not worry too much about the height of that single horizontal bar - and with the dozenal base, there is only the one...

So, with equal heights, we get:

7 1 2 3 4 5 6 7 8 9 10 0

which, handwritten, might become:

7 1 2 3 4 5 6 7 8 9 10 0

or, with a pen:

1 2 3 4 5 6 7 8 9 10 0

1 2 3 4 5 6 7 8 9 10 0

THE ANTI-METRIC SOCIETYInformation Secretary

WE NOW HAVE A NEW ALLY in our continuing opposition to insidious metrication. The Anti-Metric Society has been formed under the aegis of Perfect Publications, who issue THE ROMANTIC and THE ENGLISH MAGAZINE, both dedicated to preserving (and using) the best features of our culture and traditions whilst questioning their displacement by "modern" concepts and commercially-inspired vicarious activities. Inflationary "Pea Money" and "Bongo Counties" of no legitimate status are among subjects that incur Perfect contempt.

Money and administrative areas have changed in the past and will do so again but, free from interference by those who do not understand them, measures are very stable; being authorized only by convenience and use. The spacing of about one foot has a perceptual quality and the pound is some five thousand years old, being descended from a Sumerian unit. Metrication, therefore, is seen as a greater threat to our inheritance: one of many deliberate attempts to sever us from our roots and coerce us into a world in which anything not forbidden will be compulsory, and only the latest diktat has any reality. Disparaging criticism has appeared in the ENGLISH MAGAZINE: the extract given below is a nice blend of derision and disdain, calculated to deflate an intolerant technocrat and give encouragement to those who object but are not sure why.

Detailed comments on metrication and the reasons for its social inadequacy are not appropriate for either magazine, so the AMS puts its views and information in a separate Journal. The technical arguments are familiar enough, and cultural points are presented in a positive manner. Metrication is described as one of those ugly world-changing reforms beloved by bureaucrats remoulding things in their own image - faceless and nameless as concrete tower-blocks.

They have a realistic outlook: the Metric cult, deprived of its supporting quango, was passing its peak in the mid-80s, when we began to slip back to our old traditional ways and media-persons no longer had to be 'with it' by relaying information in met-speak dogma; those that did seemed very self-conscious.

Metricists are pinning their hopes on indoctrination at school level.* There is, however, a natural resistance to alien, unergonomic measures which the AMS hopes to foster until disenchantment with supra-national projects now being sponsored by busy and interested parties sets in.

Regarding the introductory paragraphs of the AMS Journal, it would have been fairer to claim that they are the only body extant specifically

*Imperial measure is virtually eradicated
in State secondary schools. - Ed.

opposed to creeping metrication. We have been exposing its unrealistic nature for the last three dozen years (long before the Metrication Board and its opposite number were established), but mainly on a technical basis. We have had wide support for this aspect but rather less for our suggestions that traditional measures could be put into a numerical framework that would fit them for scientific as well as social use.

From THE ENGLISH MAGAZINE, Issue the Sixth:

Helpful Hints

Taming the Dragon

SINCE it is not possible to say words like *mètre* and *livre* in decent company, and since various of the native tradesmen have been browbeaten and bamboozled into using the things, it becomes desirable, when one has occasion to converse about the mundane matters of life, to have rough and ready translations into respectable English easily to hand. Here, for our readers' convenience and disembarassment, *The English Magazine* is happy to present a few such approximations:

A *mètre* is approximately a yard. It may be referred to as a yard under almost all circumstances. Where, for some reason, it is absolutely necessary to make it clear that you are not referring to an exact yard it may be called a *long* or a 'French yard.

A *livre* is approximately a quart. Actually, it is rather pleasant to return to dealing in old-fashioned quarts rather than pimminy pints. Again, where it is quite unavoidable, one may call it a *short* or a 'French quart.

A *kilogram* is a little over 2lb. One refers, therefore, to "a 2lb bag of sugar" etc.

It is perhaps a little disconcerting to apply such approximations to our august and ancient Imperial measures, although obviously it is better than using the ghastly foreignisms which seek to displace them. For those who find it distressing, we would offer the following solace: measures such as the pound (*librum*) are traditional to Western humanity not only in this country but, before the French Revolution, throughout Europe. They are based upon natural and human proportions rather than rationalistic concoction. They are still used in daily life by many European peasants after nearly two centuries of official 'metrication'. But their *standardisation* is a much more recent thing. In this country the exact length of a yard used to vary from district to district. The expression "a country mile" (as opposed to the standardised city mile) is a memory of this. It is not unlikely

that in some districts of England the local yard was a similar length to the modern French yard. It is, therefore, not without precedent that one might have to deal with more than one type of yard, quart or gallon (a French gallon is four French quarts).

We, of course, will continue to use proper Imperial measures. However, while it may be galling (we intend no pun) that their exact proportions have been dictated by the crankish notions of foreign regicides, it is, from our point of view, not entirely without consolation that the old unstandardised vagaries should have returned.

We have heard it objected that a French quart is too much less than a quart to be so called. Nothing can be more easily disproved. The American quart is considerably less than the French quart. In fact the French quart stands about mid-way between the Imperial and American quarts: yet who has difficulty in accepting American pints, quarts and gallons when in America?

Every European nation used the foot before the introduction of regicide measurement, and my 1749 dictionary gives the different values for the foot for Amsterdam, Antwerp, Paris, Bremen, Rome, Copenhagen, Frankfurt and Cologne, Venice and Danzig, ranging from nearly 14 English inches at Venice to eleven and two-fifths at Frankfurt and Cologne.

We reiterate: this is in no sense an apology for regicide measures. We must continue to use true Imperial measures in all things; but where foreign variants are forced on our notice, quick methods of rough translation must be at hand that they shall fail in their intent of compelling us to the use of their alien and philosophically malevolent terms and concepts. Thus we protect our own lives from the poison without and draw the dragon's teeth.

**DON'T GIVE AN INCH
INSIST ON IMPERIAL**

Perfect Publications, B.M. Perfect, London WC1.

BREAKS WITH THE PAST

 Reactionary thoughts by Shaun Ferguson

HAD I EMIGRATED to a European country I would not complain about the funny money, peculiar measures and the weather forecast in Centigrade. But in my own country these are the very things that make me feel a stranger; in recent years everything has changed - not necessarily for the better.

Where is home? Certainly not here (Carlisle), nor even back in London. It's not so much a place as a time: home is thirty years away, and it's twenty years since the wall went up between those items which were essentially British and those which have never appealed to us.

If decimal pennies were really an improvement on what we had; if the metric system was a step forward and if the change to Centigrade afforded us some real advantages, then I know I'd still grumble, but I'd accept. As it is we have a currency fit only for Europeans and a weather forecast which always seems impossibly cold. If nothing else, it has frozen out our past, and the world that was seems all the more remote and unreal because of the fundamental changes brought in over the past years. It's not a question of the past being always better, or our wearing rose-coloured spectacles; it's a matter of being cut off from our roots by time as well as space. The Berlin Wall may have come down; I doubt our Decimal one will ever do so.

The Europeans, led by the Germans, would like a common currency - the Ecu; at present there are 1.6 of these to the pound. I would rather they chose a unit larger than the pound: there seems little point in having a coin - the cent - which will be of less value than the present 1p. In any case, the decimal structure remains alien to my way of thinking. There is the suggestion that the Ecu could be an international unit which we might use if we wish; in which case everything could be priced and all trade conducted in Ecus, yet each country could retain a national unit, which in turn could be subdivided in any fashion pleasing to the people. Let there be an Ecu; and let there also be a pound of twenty shillings and twenty dozen pence. When dozens finally replace decimals we can rethink the idea and have an international unit with dozenal divisions. Until then let people have the decimal Ecu and us keep the sterling pound.

The idea is very similar to that of the Latin Monetary Union the French devised, with the peseta, the franc, the lira and many other units all equal in size, shape and silver content. There was also, of course, the Esperanto Spesmilo, which was meant to be an international unit.

The pound is worth approximately one-twelfth of its purchasing power when I was in my teens; so if we want to restore £sd we need only replace the 5p by 1d and the 1p (1/5 of 5p) by a farthing (1/4 of 1d) should we need coins smaller than 1d. At present exchange rates this

would give 19.20 Ecu to the (restored) £1 - close to the 25 francs or so that there were to the sovereign before the Great War. The sovereign itself is worth some sixty pounds of present money, or five (restored) pounds; it was worth £5 when I was a teenager. (It might be worth making a pound equal in value to the sovereign, but if gold varies in value there would be little benefit: gold coins are not going back into circulation and though silver coins would be attractive it is unlikely that they will ever return.)

I admit to being reactionary; but I want to see a currency that is convenient, flexible and practical. I still believe the twenty shillings and twelve pence system we had to be the best compromise between decimal and dozenal that can be devised. Not "Give us back our eleven days" but "Give me back my half-crown"....

1 restored pound £(r) = 12 (*10) present pounds. Ecu @ 1.60

£(r)	Ecu	£(present)	£(present)	Ecu
1	19.20	12.00	1	1.60
10/-	9.60	6.00	50p	0.80
5/-	4.80	3.00	25p	0.40
2/6	2.40	1.50	20p	0.32
2/-	1.92	1.20	10p	0.16
1/-	0.96	0.60	5p	0.08
6d	0.48	0.30	1p	0.02
3d	0.24	0.15		
1d	0.08	0.05		

Ecu £(present) £(restored)

100	62.50	5 : 4 : 2
10	6.25	10 : 5
5	3.12	5 : 2½
1	0.62	1 : ½
50c	0.31	6d
25c	0.16	3d
20c	0.12	2½d
10c	0.06	1¼d
5c	0.03	½d
1c	0.01app.	⅛d

The franc was originally rated at 25 to the gold sovereign (like the Danzig Gulden) and the Mark at 20, or 1/- . A (restored) pound of £12, i.e. 19.20 (or 20) Ecu, revalued at 4.80 dollars also brings the dollar to a better level (4 dollars to a restored dollar).

£1 = \$4.80 = 20 Ecu

The workings of chance? German State Lottery tickets are sold at:

1 ticket DM 144 1/4 ticket DM 36
1/2 ticket DM 72 1/8 ticket DM 18

Bitte senden Sie mir folgende Lose:
Anzahl: Anzahl: Anzahl: Anzahl:
1/8 Los(e) 1/4 Los(e) 1/2 Los(e) 1/1 Los(e)
zu 18 DM zu 36 DM zu 72 DM zu 144 DM
je Klasse je Klasse je Klasse je Klasse
Ein GewinnSpiel umfaßt 6 Klassen

A LETTER TO THE BBC

BBC1 has been running a series of lectures entitled "A Way with Numbers", intended to overcome the many confusions about these, doubtless aggravated by the decimalization of everything. Following one which demonstrated the value of binary division, and how to achieve this in simple ways, there was a comparison of metric and Imperial measures, with their decimal and dozenal divisions, clearly to the favour of the latter.

We felt that a note of appreciation was called-for.

Dear Miss Vorderman,

We would like to express our appreciation of your lectures on the uses of numbers, and expect they will help to raise levels of understanding that have been the subject of so much concern lately.

As you explained, binary division is an important process, but is not helped when it proceeds in a decimalized form. General division is often introduced to children by assuming twelve articles to be shared among friends, but the hapless infants are soon led back to the more abstract ten. Your comparison of decimal with dozenal divisions, using cans of beer, was excellent: we could not have done better ourselves. An Iranian friend tells me that the dozen is still counted on the joints of the fingers in the north of his country, which was clearly on one of the Aryan (whoever they were) migration routes.

Subject as we are to directives from outside on the way we should manage our affairs, we must indeed look to the United States for a continuation of human-compatible measures; resistance to needless change is more effective over there. Unfortunately, since it is strongly represented in universities and colleges, the Dozenal Society of America tends to concentrate on the academic aspects of base twelve, to the neglect of the cultural.

We have sometimes reminded them that, outside the Ivory Tower, Gresham's Law applies to all things and there must be pressures towards more bureaucratic conditions for which metrication will provide the ideal regulatory instrument, as also at the start. Measurement of the people, by the people and for the people is not necessarily an inalienable right, even in the Land of the Free: unless defended with constant vigilance over the activities of intent and busy parties, it could vanish from the Earth.

We trust that these enclosures, written by our members and supporters, are not too great an imposition on your time, and that you will find something useful in them. There is more if you are interested.

The Information Secretary
DSGB

(Selected dozenal material has been sent. -Ed.)

JUST TO SAY...

Correspondence.

Debasing the Coinage

It gives me a trace of grim satisfaction to report that whereas the noble penny gave yeoman service to the English-speaking peoples for about twelve hundred years, the tawdry cent which replaced it in New Zealand lasted for less than two dozen. Introduced in 1967, the cent and two-cent coins were demonetized on 1 May 1990.

The sixpence, which remains legal tender, is now the smallest coin in circulation, though one rarely comes across it in change these days.

Bruce Moon
Diamond Harbour
NEW ZEALAND

(In Britain, the sixpence was killed-off on 30 June 1980, at the end of a ten-year period during which a public outcry would have restored £sd. - Ed.)

Progress...

Did you see the report that the abolition of the shilling (1990) was intended to save £1 million p.a. in minting costs, but cost the slot-machine industry £150 million to change-over to the tiny new '5p' coins?

Reading recently of the forthcoming demise of the gallon because of interference by the Common Market people in our affairs, I was struck once again by how many changes have taken place in our money, weights and measures without any consultation whatever and very little public opposition. I always found it convenient dividing a gallon into pints, half-pints, etc.

J.P.R. de la Mare
LONDON

(That seems to give a 150-year break-even forecast overall.... And what is half-educated Joe Public to do when all the pig-brains tell him that these changes are for the better? - Ed.)

Fashion?

The blind, overwhelming impetus toward metrication is part of the much larger drive to extirpate everything which gives us identity in terms of our traditional heritage. You can see it happening in every area of life, with different (and sometimes contradictory) justifications in each case; and no argument, however true, can prevail against it..... The metric question is part of a much larger question, which is ultimately one of mass-psychology (or élite-psychology) rather than of practicality....

Priscilla Langridge
LONDON

Tentative approval...

Thank you for sending all that fascinating literature on the dozenal notation. I've been reading it ever since.

I have been interested in and using the old measures like feet and inches for many years now. The foot is such a useful hunk of space to work with when gardening. However, until I wrote to your Society I had never thought of using a different number-base from ten for everyday calculations. I knew about the binary notation but only as a theoretical curiosity, not having much use in daily activities like gardening and building. I am now trying to break down the old conditioning which makes me say "ten" as soon as I see the symbols "10".

I am very interested in calligraphy and to me the primary criterion for a symbol is whether it fits in aesthetically with the other symbols. Whether the symbol is found on an ordinary typewriter or not seems irrelevant to me. The other important criterion is whether the new symbol is easily distinguished from the others. When I see "2" as a symbol for ten I immediately think of "2" rotated. I like your "2" and "3" with their araic shapes. As for "4", I write my three as "3", that is, with two semicircles and no straight bar at the top.

Thanks for all the work you have put in to keep the ideas about twelve alive.

Andrew Kozlowski
LONDON

From a journalist:

I was most impressed by your letter on the "irrationality" of the metric system - the profound mathematical point is one I cannot remember seeing made before. When I said that the metricators crave "rationality" this was only reflecting their own view of what they are up to - and of course such an obsession usually ends up collapsing into howling unreason. But you have put your finger on something very important - I am sure I will return to this theme, and hope sooner or later that I can convey your point about ratios.

Christopher Booker
BATH

A succinct comment:

The sooner international agreement is obtained on the "shapes" for numbers the better. They must be simple to be popular with the public...

C.G.A. Hall
CHRISTCHURCH

WHAT ARE THEY LEARNING?

In these enlightened times, when school pupils need to divide-up a circle, the official method is no longer to learn the construction (using compasses and straight-edge) for regular polygons, but instead to make use of a protractor. It is, however, not called a protractor, but an "angle-measurer". Classical construction and words like "protractor" are now considered too hard for most pupils to handle (yet I remember teaching constructional circle-division - successfully - to the 'C' stream in a Secondary Modern city school).

Pupils in Technology lessons are expected to make sense of electronic "counter modules" with a row of four LEDs which count in binary and display numbers in base sixteen - yet they have never been taught 'number-bases' nor binary itself (dropped from GCSE maths. syllabus).....

* * *

MORE TV ENLIGHTENMENT

In the programme "Mathematical Eye" it was clearly implied that measuring in feet was done by using actual human feet: no standardized unit was mentioned.

Another programme, on "Sensors & Robotics", mentioned that a computer-controlled sensor used to measure profiles of wineglasses takes 256 separate measures. 256? The square of sixteen? 2^8 ? An interesting number: the square of a square of a square. In dozenal terms, it is 194: three square digits. The sensor camera uses a matrix of 4512×4512 ($*368 \times *368$) photo-sensitive elements. That these distinctly non-decimal numbers are powers of two, made necessary by the binary logic of the computer was not, of course, explained; yet one might have thought it a valid educational point...

* * *

SULLIED SET SQUARES

Remember the days of impartial, academic innocence? Set-squares were simply triangular pieces of wood, then of celluloid, then of acrylic plastics

whose function was the construction of angles: one-half, one-third, two-thirds and the whole right-angle. One found the rather useless, tiny set-squares in so-called "Scholastic" sets bought in stationers' shops which had measurements along their edges; but they were not proper squares and were soon discarded in favour of decently-sized plain items for serious drawing. Now, all the set-squares purveyed by Education Authorities are contaminated by millimetres (never inches!) which ruin the transparency of the edge for the sake of relentless decimal-metric assertiveness. In fact, it is now very difficult to obtain plain set-squares. One firm which still makes them is Staedtler-Mars, but they can be found only in specialist draughting/graphics shops. Why not equip your children while there is still time? (No, I am not being paid by Staedtler-Mars.)

DEAR ME! SO SORRY....

A BBC Radio 4 Schools' programme featured a driving-lesson from an advanced-driving instructor. The presenter interrupted the lesson to apologize for the use of feet to refer to distances.... Later, in the same programme, the presenter noted that Dunlop's representative, at their test track, "unlike the driving-instructor, referred correctly to metres".

STARRY MATHEMATICS

NATURE SEEMS TO OBEY her own rules well enough. Gauss, in 1796, proved that it is possible to divide a circle - by construction - into an ODD number of equal arcs if, and only if, the number is a prime Fermat number of the form:

$$2^{2^n} + 1,$$

or any combination of such numbers. This gives a sequence of prime circle-divisions:

2, 3, 5, 17, 257, 65 537, ... in decims, or

2, 3, 5, 15, 195, 33 715, ... in dozens.

Noting that the common starfish has five limbs, or "points", it is surely interesting to observe that there is a starfish with seventeen points living in the Emerald Sea off the west coast of Canada...

 MATHEMATICAL SECTION

FINDING PYTHAGOREAN TRIPLES

Taking any two numbers, p and q , then writing expressions for the difference and sum of their squares, we get:

$$p^2 - q^2 \quad \text{and} \quad p^2 + q^2$$

Squaring these expressions and comparing, we have:

$$(p^2 - q^2)^2 \quad \text{and} \quad (p^2 + q^2)^2$$

Giving: $p^4 - 2p^2q^2 + q^4 \quad \text{and} \quad p^4 + 2p^2q^2 + q^4$

These can be equated by adding $4p^2q^2$ to the LHS, so that

$$(p^2 - q^2)^2 + 4p^2q^2 = (p^2 + q^2)^2$$

Noting that $4p^2q^2$ is a perfect square, we can write:

$$(p^2 - q^2)^2 + (2pq)^2 = (p^2 + q^2)^2,$$

which is precisely the Pythagorean relationship whereby the sum of two squares equals a third square, or:

$$a^2 + b^2 = c^2$$

where $a = p^2 - q^2$, $b = 2pq$ and $c = p^2 + q^2$.

Hence, Pythagorean triples can be found by taking any two positive integers p and q and calculating (a) difference of their squares, (b) twice their product and (c) the sum of their squares.

E.g. $p = 2, q = 1$.

$$a = 4 - 1 = 3; \quad b = 2(2) = 4; \quad c = 4 + 1 = 5; \quad \text{and}$$

$$\underline{3^2 + 4^2 = 5^2}$$

$p = 4, q = 1$.

$$a = 14 - 1 = 13; \quad b = 2(4) = 8; \quad c = 14 + 1 = 15;$$

$$\underline{13^2 + 8^2 = 15^2}$$

• • • • •

ITEMS

Shaun Ferguson

PRIME FORMULAE, ETC.

Davenport, in the Higher Arithmetic, says:

"It is conjectured that there are infinitely many primes of the form $x^2 + 1$, the first few being 2, 5, 17, 37, ..., but not the slightest progress has been made towards proving this, and the question seems hopelessly difficult."

But is it? Since, apart from 2, primes are odd numbers, then the formula can only produce odd numbers, including primes, when the x in the formula is an even number. So we can ignore odd values of x . Then, if x is even, we can put $2k$ for x and modify our formula from $x^2 + 1$ to $(2k)^2 + 1$, which is $4k^2 + 1$.

Now this latter expression is of form $4n + 1$, and in the same book Davenport states that it can be proved there are infinitely many primes of this form. Surely this then implies the same for $4k^2 + 1$, hence $x^2 + 1$?

Have I overlooked something?

Footnote: any number of the form $a^2 + 1$ has a prime factor of the form $4x + 1$, and is composed solely of such primes (and perhaps the number 2).

* * *

DIGITS & PRIMES

Using all the single digits once only (excluding 0), what's the minimum sum you can make when the numbers to be added are all prime?

For example, in base ten, $2 + 3 + 5 + 47 + 61 + 89 = 207$ is the minimum sum where all summands are prime for base ten.

In base five: $12 + 34 = 101$.

Results for other bases?

base four:	1, 2, 3:	$2 + 13 = 21$
base six:	1, 2, 3, 4, 5:	$3 + 21 + 45 = 113$
base seven:	1, 2, 3, 4, 5, 6:	$2 + 5 + 43 + 61 = 144$
base eight:		$2 + 3 + 65 + 417 = 511$

and more to discover..... What about the maximum sum?

* * *

REVERSALS

If we take a three-digit number, say 732, reverse it and subtract the reversal, then reverse the answer and add that to the result: $732 - 237 = 495$, then $495 + 594 = 1089$. In base ten we always get the answer 1089. In base twelve we always get 1022. The numbers 41089 and *1022, in reverse notation, are both 1111; so, we can predict that the same recipe will always produce 1056 in base seven, 1023 in base four, etc. Now look at multiples of 1089_x:

1089		9801	
2178		8712	
3267	5445	7623	
4356		6534	

This should work with other bases, too.

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