THE DOZENAL JOURNAL

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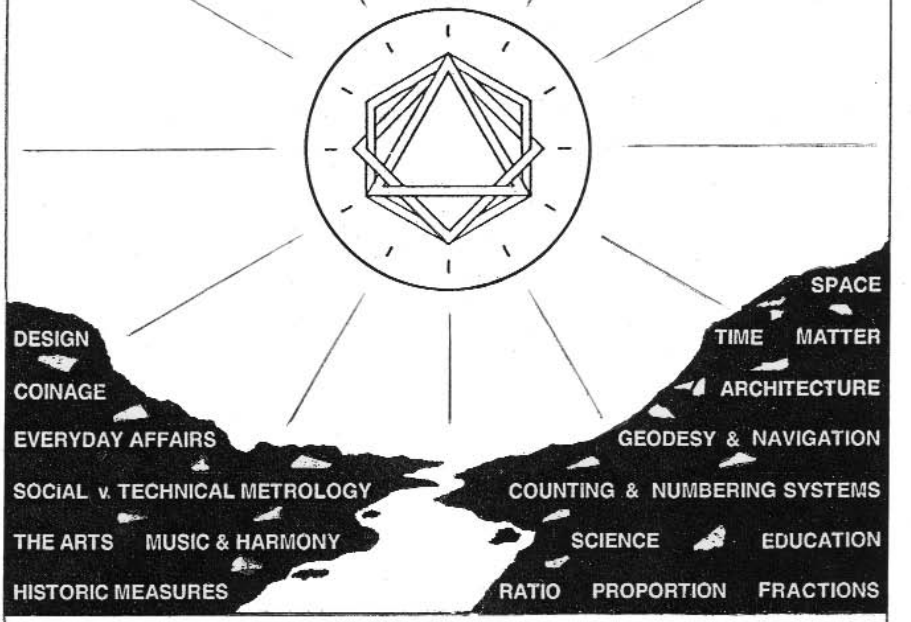

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STATEMENT OF PRINCIPLES

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 the Society and to members of The Dozenal Society of America. The Journal is also available to the general public through libraries and by application to the DSGB.

The DSA (founded in 1160; / 1944·) and DSGB (founded in 1173; /1959·) are separate organisations, but with common aims to draw attention to the advantages of the Dozen (i.e. twelve based) system for numeration and all forms of measurement. Also to counsel the public on the principles of calculation and natural measurement in a base of Twelve.

Membership of the Societies is open to all who have an interest in the development of arithmetical 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 ordered and can best be defined.

Advocation of base twelve for all purposes brings us into conflict with common arithmetical processes in base ten. This was established long before its mathematical deficiencies could have been recognised. We consider that decimalised methods are inadequate for many aspects of numeration, calculation and measuring, since they have limited ability to express in the simplest terms those common proportions whereby we conduct our practical, technical and economic activities. The decimal numbering scale also inhibits teaching of modern arithmetic, so, indirectly, an understanding of the processes upon which we are all dependent.

By advising the more divisible numbering system for both social and scientific purposes, we are endorsing the opinions expressed by mathematicians and philosophers ever since the introduction of place-value numeration some 400 years ago. The present conflict over measurement cannot be resolved until our means of calculation have acquired the benefits of divisibility found necessary for the former since early times.

Numeration in this Journal is with the Dozen scale adopted by Sir Isaac Pitman for use in his Phonetic Journal:-

1 2 3 4 5 6 7 8 9 ↊ ↋ 10 11 12 13 14 15 16 17 18 19 1↊ 1↋ 20...

The dozenal point is a semi-colon (;) but an apostrophe (‘) has sometimes been advocated, and a sloping top to ↊ used to distinguish this figure from 7. Dozenal numbers were once denoted by * unless they were specified in the text. Accepted usage now is to follow a dozenal number with the dozenal point, and a decimal number with the decimal point placed centrally, e.g. 100; 144·. There is a preference for a flat-topped three for inverting by rotation to el, but which is not always available.

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IN MEMORIAM

Donald Hammond

Members will be very sorry to learn that Donald Hammond, our hard-working Secretary/Editor, succumbed in June 1993 to emphysema compounded with asthma which had troubled him for many years. Our deepest sympathies are extended to Mrs Judith Hammond on her sad loss. At age 66 it was an untimely end for one interested in the world and its affairs, however exasperating, and although hampered by the illness, so active; he well deserved much longer.

Donald Hammond was the son of a forthright "steam" engineer, one of the breed who built this country up to the level of technical and moral standing it occupied when craftsmanship was understood and appreciated. The attitudes acquired in early life, combined with an ability to see through problems to their basic principles, remained throughout. As a practical idealist, a rare combination, he could undertake most jobs designing and building extensions to his house, servicing equipment, maintaining and handling a class sailing dinghy and repairing antique clocks. When not engaged in physical activities there were enquiries into neglected byways of mathematics. and geometry, from which our Society has reaped the benefit.

Donald joined the Royal Navy in 1942 as Apprentice Artificer, where there must be many opportunities to exercise a talent for heuristic solutions to unusual situations, and retired in 1957 as Chief Petty Officer. After a teacher training course he taught mathematics and physics in the Portsmouth area, studying for his BA degree at the same time. On one occasion, given a free hand with a group of innumerate girls, "not the most promising material", Don devised a set of symbols which enabled them to grasp the principles of arithmetic. He recalled meeting some of his pupils later, then married women, who remembered with evident pleasure "them signs what you drew for us". There is hope yet!

Don had been with us in spirit since the early 60s when he saw a televised discussion of the duodecimal system as it was then called, one of the reactions to the onset of decimalisation, with Sir Ian Montcrieffe of that Ilk, President, and Brian Bishop, founder Secretary. In the background was a continuous repetition of the Pitman Dozen Scale we still use. These seeds fell on fertile soil, but it was not until 1977, through correspondence in a science jounal, that he discovered there was an organisation actually using them and promptly signed on. With such interest we had an obvious choice for a successor to take charge of our affairs when the then incumbent was seeking relief from what is a demanding task. Under Don's guidance the *Dozenal Journal* rose to a new peak in both content and presentation which we will attempt to maintain.

Fred Newhall

Fred Newhall, President of the Dozenal Society of America, suffered a heart attack early in November 1993 and underwent a complicated operation to replace a faulty valve, from which, sadly, he was unable to recover. The DSA has thereby incurred a loss comparable to ours, since Fred was a "hands on" President, taking an active part in his Society's affairs and looking after their archives.

Another practical man with an engineering background, he gained an appreciation of twelve-based methods at college in the 30s, designing and building his house on Long Island to a twelve foot module, allowing economic use of standard size materials. His index of all known dozenal works, with cross references as to subjects, authors and publications is a magnum opus. Hopefully someone will find the time and energy to issue up-dates as Fred managed to do.

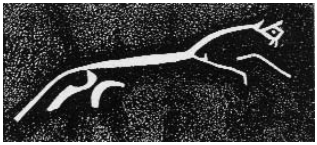
Prologue from the Past

From the York Cycle of Mystery Plays
Early XIVth Century

THE POTTER'S PLAY

PETER: *Brothers, take tent unto my steven;*
Then shall ye stably understand.
Our Master dear is hence in Heaven
To rest there on his Fathers right hand,
And we are left alive, eleven,
To learn his laws truly in hand.
Ere we begin, we must be even,
Else were our works not to warrant.
For perfect number it is none,
Eleven only to be here;
Twelve may be asunder ta'en
And severed into many a share.

Transcribed by J.S. Purvis 1962



Keep The White Horse Clean

On a hillside in the Berkshire Downs is the figure of a stylised Celtic Horse formed by trenches some two feet deep rammed in with chalk up to ground level. Such construction enabled it to resist weathering and the encroachment of vegetation, which would take over unless cleared off every seven years or so. The task had become a tradition for the village of Uffington nearby, accompanied by "all the fun of the fair"; described by Thomas Hughes in *The Scouring of the White Horse*. A horse was the emblem of the Dobunni Tribe, west of an area controlled by the Atrebates to whom they owed allegiance. The name "dobbin" for a general work-horse hints at a possible relationship between the two peoples

The hill figure is judged to be of late Bronze Age origin, some 3000 years old, and an unusual feature is it being hardly visible from ground level, the illustration above is from an aerial photograph. The best view is from the railway along the valley below, but in those days this would have been thick forest and marshland, quite impassable. The main cross country route between Stone Henge and the flint axe "factory" at Brandon in Suffolk lay along the sparsely covered chalk downs, furnished with hill forts at all vantage points providing shelter for friendly visitors. An opinion is that today our senses are numbed by high placed bill-boards exhorting us to buy this or do that. It was then sufficient to know your symbol was there, receiving your respects with dignity, and for pointing out to anyone questioning your rights.

Before the Gods that made the Gods,
Had seen their sunrise pass,
The White Horse of the White Horse Vale
Was cut out of the grass,

This was the first verse of an epic poem by G.K.Chesterton with the theme that a nation must keep its traditions and ideals unsullied to retain an identity. He relates, with much poetic licence with regard to history, how King Alfred toured the country gathering support for his struggles against the Danish invaders; a moral is even drawn from the cake-burning episode. Alfred foretold the eventual defeat of Guthrum and his followers because they knew only of destruction, whereas he and his people ... "guard even pagan things".

A Christless chivalry:
Who knew not of the arch or pen,
Great, beautiful, half-witted men,
From the sunrise and the sea.

There was a final battle with victory at Ashdown close by the Horse, which became associated with the event, and the Danes were driven from Wessex to the northeast of the country where they accepted Christianity. Alfred bade his people: ... "Keep the White Horse White, As the first plume of the snows."

And right to the red torches,
From the start of morning grey,
They stripped the White Horse of the grass,
As they strip it to this day.

Alfred realised that there would be a continuing struggle, not only with smothering ground weeds but with false ideas, sometimes advanced with the best intentions:

And though they scatter now and go
In some far century and slow,
They shall not come with warships,
They shall not waste with brands,
What though they come with scroll and pen,
And grave as a shaven clerk,
When there is talk of trend and tide,
And wisdom or destiny,
I have a vision and I know,
The heathen will return.
But paper be their eating,
And ink be on their hands.
By this sign you shall know them,
That they ruin and make dark.
Hail that undying heathen,
Who is ever thus to be.

The heathen have returned indeed, and not all from overseas, perhaps something that Alfred/Chesterton did not consider. In times of economic stress there is inevitable retraction, with centralisation of authority and resources. Those in control do not have the widest concerns, and operate with a detachment from anything not offering immediate advantage. Since it seems to be of greater importance to control rather than do things, there is more concern over cash balances than with unquantifiable attributes having no column on the account sheet, such as fitness for purpose, historical continuity, local loyalties and civic pride, environmental protection, adequate health care, or, especially, education. This last is particularly prone to neglect or interference, positive or negative, with those ideas finding favour that help to cheapen the process.

In the commercial field, long-term projects and research work not considered profitable in the near future are abandoned; this topic is mentioned later. Selling off the country's infrastructure, howbeit internally, but to those whose only concern is to extract as much as possible from it, for temporary advantage and to prop up the three Ps - Power, Privilege and Profit - is not enough. Essential assets, even parts of the country itself, are allowed to pass beyond our control, an inversion of Danegeld policy.

Edmund Burke's age of economists and calculators is reaching its culmination. Whilst it may be true that you cannot buck the market, history suggests that a nation's stability remains intact only for as long as it is capable of doing so. Even Adam Smith recognised it was a duty of government to curb the excesses of market forces. Unbridled money has been described as a corrosive fluid that penetrates and dissolves the fabric of society. The idea that there is no such thing as society becomes self-fulfilling under a regime operated by those who know the cost of everything but the value of nothing.

I agree that this little diatribe does not have much direct dozenal concern, as should be expected, and verges on political comment, which I assume should be avoided, so have been as restrained as possible, omitting quotation marks even for points on which I disagree. This issue has acquired a cultural outlook, so the Chesterton contention that words on paper written by people "meek as monkish clerks" can cause more permanent destruction than armed warriors, whose damage can at least be repaired, should appeal to those members who support us for our aim to preserve ergonomic human-oriented measures, particularly in their English form. Also those who do not accept there would be advantages in placing these into a more rational arithmetical framework, or are resigned to the considerable difficulties of so doing. This is fair enough, we are a broad church, I hope, and all are welcome. Nevertheless we must contend that criticism of whatever artificial system is in vogue should be founded on some standard of excellence to act as a foil against inadequacies and illogicality.

Metrology and Culture

C.H Evans

Readers of the Dozenal Journal will be already well versed in the computational deficiencies of the metric system. Less appreciated, however, are its cultural implications, the subject of this short article. It argues that the metrological language, used by a society to describe its surroundings in quantitative terms, is as integral a component of its cultural matrix as the everyday language. used qualitatively. Under these circumstances it is not to be surrendered lightly.. On the contrary, it should be defended with the same vigour as ancient monuments, rain forests and endangered species.

Such a position immediately flies in the face of those who would have us believe that measuring systems are culturally neutral tools of convenience, to be selected dispassionately on criteria of utility. Yet it is borne out both by scholarly research and everyday experience. In the book *Measures and Man* [1] , the author Witold Kula describes the imposition of uniform metric measures in various parts of Europe. As this analysis clearly shows, the difficulties in achieving this were not so much mathematical as cultural. In reviewing this book Osborne [2] writes:

Because systems of measurement express the social content of the cultures that create them, they tend to gain a cultural impetus that resists change until the culture changes . ... The right to determine measure was symbolic of sovereignty.

Volumes could be written on the implications of this passage. Here I shall limit myself to just two comments. Firstly, the link between measure and sovereignty is a real one; it seems to me that those opposed to the abandonment of imperial measure are more likely also to oppose Britain's membership of the EC although, as far as I know, this statistic has not been formally demonstrated. Secondly, the notion that cultural change is linked to systems of measurement has sinister overtones. It may have not escaped the Eurocracy that enforced changes in metrology can be used as weapons with which to enforce changes in culture.

If we are cheered by the repeated observation that popular public opinion tends to resist metrologic change, we should be sobered by the fact that governments tend to encourage them when they lead to uniform metrication. Unfortunately, this generalization holds whether the governments in question are dictatorial or democratic. In France, the perpetrator and chief proponent of metric measures, uniform implementation of this system could only succeed under the iron fist of Napoleon. And even he had to yield to popular resentment by permitting the existence of such hybrids as the "metric foot", which persisted for several decades until outlawed by legislation passed in 1837 [3].

Attempts to introduce the metric system by the US government in the 1970s were so strongly resisted by public opinion that the plan was shelved. One of its perceived deficiencies was to be "un-American". Unable to achieve metrication openly, Congress has surreptitiously placed an amendment to the Trade and Competitiveness Act of 1988 requiring federal agencies to use the metric system when procuring supplies. Yet, to the chagrin of the editor of Nature, [4] this requirement is being conveniently ignored by all concerned.

Public reaction to the attempted metrication of Britain has been to ignore it. Although we have been officially going metric for 26 years, no-one I know, young or old, uses its vocabulary in everyday life. Thus we have an odd dichotomy where official agencies pontificate metrically to a predominantly imperial public. This incongruity is most jarringly revealed at sites owned by English Heritage, where English measures are ignored in favour of metric ones. Perhaps the new Ministry for National Heritage can correct such hypocrisy. Officialdom tacitly acknowledges its metrologic isolation - "wanted" announcements for dangerous criminals always give the suspect's height in feet and inches. The language of the market place remains pounds and ounces, and it will take a legally binding directive from a foreign government in Brussels to destroy this [5].

This common affection for imperial measures surely gives the lie to the myth that it is excessively difficult, and therefore deserves a metric replacement. During the mid-1970s I worked briefly as a builder's labourer. As workmates I had carpenters, bricklayers, plumbers, electricians and roofers who, with scarcely an O-level between them, worked happily and easily with British weights and measures. As far as I know the houses we built were in no way inferior to those in Europe; nor did they take longer to build. And the use of traditional measures seems to have presented no impediment to the modem economic and technological growth of the USA.

Metrication is sometimes justified as introducing measures which are "more scientific". Why "more scientific" should be better than "less scientific" has always eluded me; does that make them "less artistic", and is this desirable? Furthermore, the comment makes no sense. Science is an experimentally based process used to discover the properties of matter and the laws which describe its behaviour. The units used for this purpose are irrelevant. The speed of light is not altered one iota by being expressed as 186,000 miles per sccoid, instead of 300,000 kilometres per second. The equations describing Newton's laws of motion can be expressed in any units one chooses, provided they are internally consistent- Newton used measures that we now know as Imperial.

To return to the earlier analogy of language, the object upon which I am sitting to write this article is unaltered whether I call it a "chair", a "stuhl", a "cadair" or by any other equivalent noun. As a practising scientist, I find no contradiction whatsoever in using metric measures in the laboratory and imperial measures outside of it. After a day of reference to sodium chloride and sucrose, I am happy to return to a kitchen table upon which are containers of salt and sugar. And the enjoyment of my cup of tea is in no way reduced by eschewing reference to Camellia Sinensis. Such cultural bilingualism is, I feel, the way forward. An increasingly interdependent world requires internationally agreed ways of conducting its affairs. In science, the English language and SI units of measurement increasingly provide this format. Yet, I see no more reason for me to use metric units domestically, than for an off-duty French scientist to speak English with his or her family.

Contact between cultures has often caused trouble. Attempts to solve these problems have ranged from culturicide to genocide. The sixties gave prominence to the "melting pot" solution, in which we would all be averaged to eliminate human differences. Metrifiers have borrowed some of this mentality in their ruthless attempts to impose a single metrological language for all humanity. Although vicariously justified on grounds of science, simplicity and logic, I strongly suspect the real motive to be the pursuit of uniformity. For we all live happily with an irrational annual calendar of 365 or 366 days, divided in the most irregular and non-metric of ways into months, weeks and days. No modern attempt has been made to re-design the way we keep time, despite its subdivision into sixtieths and twenty-fourths. And where are the objectors to the science of geometry which has inherited the sexagesimal system of the Babylonians? Clearly, the issue is not one of mathematics but a desire for uniformity. This is why all attempts to combat metrication with logic will fail.

On a more optimistic note, we can move beyond the sixties mentality to that of the present day, where we are increasingly encouraged to enjoy, rather than to eliminate, cultural differences. Ethnicity, at least in North America, is now fashionable. In this spirit of friendly diversity, our unique system of traditional weights and measures deserves to be nourished as part of our contribution to the world's cultural richness.

References

1. *Measures and Man*, W.Kula (Translated by R.Szreter) 386 pp. Princeton University Prcss,
2. Osborne, M.A., Book review, Isis 80, pp-504 -505, 1989. Princeton, NJ., 1986.
3. By the Système Usuel, French measures were adjusted to be compatible with metric units.
The Pied was one-third of a metre, the Livre half a kilogramme, and the Pinte a litre.
4. "Metrication and the falling yen" (Editorial) *Nature* 344, p.575.
5. This has now happened by imposition of E E C Directives 80/181 and 89/617. See p. 7 et seq.

Sic Transit Gloria Mundi *DTI & DSGB*

In February 1995, The Department of Trade and Industry sent us a copy of their Press Notice outlining the Statutary Instruments passed the previous November whereby an overall metrication of retail goods was to be imposed on October 1st next. This has been transcribed below into a format suitable for these pages.

A covering letter [x] stated that the legislation was debated both in the Commons and the Lords before being approved. That in the Commons was by a Standing Committee of MPs rather than the full House, so likely to have been a mere formality with no published records. "There was a full debate in the Lords", which, according to Hansard, lasted a good half an hour!

There was really little point in either discussion, because eventual implimentation of EEC Directives listed at the end of the press notice was accepted some twenty years ago as one of the conditions for entry into the Common Market as then termed.

For little more than commercial and administrative convenience an attempt has been made to dismiss a thousand years of socially determined metrology, with antecedents going back to the dawn of history. One consequence is further alienation from the objective world and the processes upon which we are all dependent.

It has been thought worthwhile including this material for its historical interest, and to show that we have not been completely inactive over the episode. It should serve also as a warning to members of The Dozenal Society of America, to whom this Journal is circulated, that decimal-metrication has a world-wide imperative and is being pursued by the same interests, using similar methods to which even the 'Land of the Free' is not immune. The price of liberty, for both thought and action, is still the same.

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[x] This letter did little more than repeat points in the Press Notice but finished with a comment that "the Imperial System is likely to continue for some time for cultural and sporting uses . . .."

According to the 'Updated Laws of Cricket', the game is now played on a pitch 20·12m long with stumps 71·1 cm high; such precision The bat is to be 6·5 cm (sic) in length, and ball of 155·9 - 163 grammes weight (mass?) etc, etc. Could technical toadyism be more ridiculous?

Even field sports have to be 'with it'. Hands for measuring heights of horses are officially down-graded from four inches to ten cm. Thus metric diminishes every thing it touches.

press notice

dti

P / 94 / 444 the department for Enterprise 19 July 1994

PINTS AND MILES TO CONTINUE AS GOVERNMENT ANNOUNCES LATEST METRICATION CHANGES

Pints of beer in the pub, doorstep pints of milk and road traffic signs in miles will be a continuing part of the British way of life under legislation published today by Comsumer Affairs Minister Lord Strathclyde, which will extend the use of metric units of measurement in the U. K.

In a written answer to a Parliamentary Question from the Lord Gainford, Lord Strathclyde said:-

I have today laid before Parliament the following instruments which implement the Units of Measurement Directive in relation to the authorisation of units of measurement and their use for weights and measures and price marking purposes:-

the Units of Measurement Regulations 1994;

the Weights and Measures Act 1985 (Metrication) (Amendment) Order 1994;

the Weights and Measures (Metrication) (Miscellaneous Goods) (Amendment) Order 1984;

the Weights and Measures (Packaged Goods and Quantity Marking and Abbreviation of Units) (Amendment) Regulations 1994;

the Weights and Measures (Metrication Amendments) Regulations 1994; and

the Price Marking(Amendment) Order 1994.

The first three S I s have been laid in draft for approval by resolution of each House of Parliament. The last three have been made before laying and are subject to a negative resolution.

The legislation provides that the doorstep pint of milk and the pint of draft beer or cider in the pub will be allowed with out time limit as well as the mile for road traffic signs, speedometers and odometers.

For many purposes the U K has already switched to the metric system. From 1 October 1995, almost all goods sold by quantity (including food pre-packed in variable weights such as cheese and meat) that are not already traded in metric will have to be so traded. The principle exception is in respect of goods sold loose from bulk by the pound or ounce - primarily foods such as meat, poultry, cheese, fish and fresh fruit and vegetables - which will not have to switch until January 1 2000.

Retailers who price food sold loose from bulk or pre-packed in variable weights in metric during the transitional periods will be required to display a price conversion chart or to dual price items. The British Retail Consortium has agreed to adopt a code under which retailers will supplement this with further charts at any place where consumers select such food which is metric priced The D T I is discussing with the trade other publicity measures.

NOTES FOR EDITORS The legislation will:-

(i) cease to authorise, from 1 October 1995, the use of imperial units for economic, public health, public safety and administrative purposes except for the imperial units used for the purposes set out in (ii) and (iii) below;

(ii) cease to authorise from 1 January 2000:

(a) the pound and ounce for goods sold loose from bulk

(b the pint and fluid ounce for beer, cider, water lemonade and fruit juice in returnable containers;

(c) the fathom for marine navigation; and

(d) the therm for gas supply

(iii) Authorise the continued use, without time limit of:

(a) the mile, yard, foot, and inch for road traffic signs and distance and speed measurement

(b) the pint for dispensing draught beer and cider and for milk in returnable containers;

(c) the troy ounce for transactions in precious metals

(d) the acre for land measurement.

The legislation implements the amendments made by Council Directive 89/617/EEC (OJ No L357, 7.12.89, p 28) to Council Directive 80/181/EEC (OJ No L39, 15.2.80, p 40). The 1980 Directive lays down the legal units of measurement to be used for expressing quantities for economic, public health, public safety and administrative purposes

The draft instruments amend the Units of Measurement Regulations 1986 (S I 1986/1082), the Weights and Measures Act 1985, legislation made under that act and legislation made under prices Prices Act 1974.

The Department sought interested parties' views in July 1992 and in June 1993 on the legislation.

Jonathon Evans M P
Parliamentry Under-Secretary
for Corporate and Consumer Affairs

Walnut Bank Underhill
Moulsford Oxford OX10 9JH

15th July 1995

Dear Mr. Evans,

I must thank you for your reply on June 3rd, and that from Lord Ferrers of Feb. 7th, to my questions regarding national measures sent on by Robert Jackson. Representing as I do a body of considered opinion which questions the wisdom and need to dismantle our human-adapted means of dealing with ordinary affairs, for, it seems, no more than commercial and administrative expediency, I feel obliged to offer some response.

There is wide-spread resentment, not only to the fact, but the apparently covert way the measurement scene has been altered by a series of poorly debated Statutary Instruments. Measures have been regarded as neutral symbols that may be selected on political and economic needs alone, without regard to their socially important role of utility with comprehension. A D T I spokesman claimed that people no longer made purchases by weight or size, but price. This is not surprising if the former are stated in three figure diminutive units, when one, and simple fractions, served before.

That we are permitted a limited use of historic measures is some consolation. Even if only cursorily mentioned in schools, with little indication of the principles on which they are founded and sometimes by way of invidious comparison with artificial methods for technical purposes, there will be a reminder of more appropriate ways of communicating with our material environment.

We must continue to explain that naturally evolved measures, with their binary and ternary divisions, are not so un-scientific as the public are led to believe, and more adept at defining mathematical and physical relationships as well as serving our needs in a pragmatic manner. Suspicion of science with its seeming arrogance, and the aversion to it in schools, may well be due to the subject not being dealt with in terms reflecting ordinary experiences. It has been noted that we are now completely dependant upon processes over which there is no control or even understanding. With these constrained to a narrow a-human framework, the situation is aggravated.

Our concern is for the cultural and social aspects of measurement which have not been considered in the drive for metrication. National methods could have been allowed their place, and calculators fitted to weighing machines would provide the link as they do now. Claims that America is well 'advanced' metrically are greatly exaggerated, their Metric Progamme Director has admitted: "we've gotten emotional comment in areas that I would call cultural". There will be greater resistance by citizens zealous for their rights, so we remain confident that measurement of the people, by the people, for the people will not vanish from the Earth.

Sincerely, A. F. Whilloch.

Our ref SM/108
Your ref
Date 14 August 1995

Dear Mr Whillock

METRICATION

Thank you for your letter of 15 July to Mr Evans concerning the metrication of measurement. I have been asked to reply. I apologise for the delay in replying.

I regret that there is little that I can add to Mr Evan's letter of 7 June. I would just repeat that the United Kingdom decided to adopt the metric system of weights and measures in 1965, in response to lobbying from British industry and before we joined the then European Economic Community. Since then the metric system had been introduced in stages and that this process has been achieved without confusion to either the business community or the general public.

The House of Lords debate on metrication took place on 1 November 1994. The relevant Hansard reference is column nos 775-784.

Yours sincerely
Halai.

Shanta Halai (Mrs)
Consumer Affairs Division

dti

The Min. no questions make of Ay or No.
According to Directives must it go.
But those who say we can or may not do,
They know about it all, or think they know.

Once more we face Administrative waste.
With less, perforce, the Well of Truth to taste.
The Foot is setting, and the Metric Band.
Moves to the Dawn of Nothing with such haste!

With no apologies to Omar Khayyam
who would surely have approved

TAMÁM SHUD

The British Weights and Measures Association was founded 1995 as a response to the events just described by which our measurement heritage is to be traded off for a litre of pottage; their initial statement is reproduced over. Meetings are held in London, and 'The Yardstick' is published twice a year to carry helpful material and act as a forum for members' opinions.

The Chairman, Vivian Linacre, and founding members have conducted correspondence with senior officials at The Department of Trade and Industry. Replies to questions were little more than 'off the shelf', ignoring the fact that previous governments had given us assurances there would be no compulsion, and denying that present regulations resulted from instructions by EEC Directives. These exchanges have now been collected into "The Questions that remain Unanswered" and "No, Minister". The booklets can be obtained from BWMA at the address given.

This move revives in name and spirit an organisation that formed effective opposition to the metric advocation early in the last century, which was supported by a wide spectrum of social interests ranging from small traders to engineers and scientists. Copies of the annual reports in our library show that points of differences over the two systems - abstract decimal-metric versus evolved human-orientated - have changed very little. Technology, with its specialised measures, has acquired political undertones, so the balance is tilted towards uniformity at all costs, and no concern for wider issues.

Nor has the division between interests changed. As realised from the begining, decimal metrication provides beaurocracy with a useful tool for accounting and control. An Admin officer was well pleased: "I like it. it makes things easy for me!" Retail trade, dominated now by large corporations will have further advantage over the small shop which can ill afford the cost of replacing equipment.

Those who have to *use* metric are well aware of its awkward sizes and poor divisibility. There were objections from some contributors to being confined solely to the decimal system, thus excluded from simpler methods when appropriate. Examples were given of the manner in which metric increases the number of figures required for many operations. At present, with steps of a thousand de rigueur in strict SI, three figures are made to grow where one served before.

In 1904 The House of Lords passed a Bill for a compulsory introduction of the metric system, with a fine of £2 for each offence of "using old weights and measures". This was rejected by The Commons. In France, during an initial flush of enthusiasm for the new thing, one was imprisoned for even dealing in dozens. There has always been compulsion backed by legal sanctions starting with Louis XVI, who was obliged to sign an authorisation for the metre survey whilst awaiting trial. In better times he had tried to unify French measures in their practical forms with binary and dozenal divisions.

Summary of the case against compulsory metrication

1 The regulations enforcing metrication, with effect from 1st January 1995 or from 1st October 1995 or from 1st January 2000, are being imposed on the British people solely in order to comply with EEC/EC directives rather than with any mandate from our own electorate who have been given no opportunity to express a view on an issue which affects every business and the daily lives of every citizen

2 Criminalization of imperial measures is being imposed only in. the UK - not in any other European country where they will continue to be widely used - which is a clear case of unfair discrimination and in breach of the EEC/EC/EU's own anti-discrimination rules under the relevant Articles in the Treaty of Rome

3 It is in any event intolerable that the system of imperial measures, which originated in the UK and has until this year been used throughout the UK for many centuries, should be arbitrarily abolished within the UK whilst every other people in the world remain free to use it

4 It is equally intolerable that, in this age of heritage and conservation, a so-called 'Conservative' government should abolish such a vital part of our national culture

5 No reason has ever been given for the enforcement of a metric monopoly at the expense of competition and a free market - no reason has ever been given why companies and their customers may not use either system in accordance with the nature of the product and demand - so much for this government's vaunted 'commitment to choice' and 'deregulation'!

6 The cost of metric conversion to commerce and industry is running into hundreds of millions of pounds (while the economy is still in recession and essential public services are starved of funds) while the cost of the bureaucracy required to enforce it will amount to tens of millions annually

7 In any case, a Junior Minister has admitted that prosecutions for "petty infringenents" are most unlikely; so why introduce regulations which are not to be strictly enforced? The traditional party of 'law and order' is deliberately bringing the law into contempt!

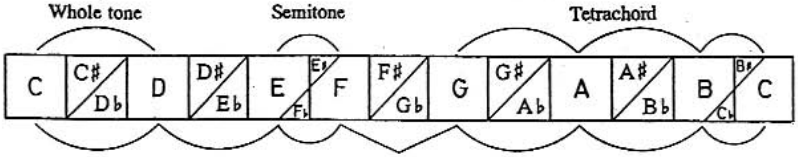
8 If the entire system of imperial measures were to be abolished at a stroke, there would at least be some logic in imposing penal sanctions; but given the many exemptions and anomalies there is clearly no principle at stake and no consistency or uniformity in metric enforcement, andtherefore penal sanctions are wholly inappropriate and inequitable.

9 In any event, the metric system itself lacks consistency and uniformity: e.g. there are several different 'metric units' for measuring screw threads in engineering, or pressure (in engineering and medicine), whilst in different contexts "m" can mean either 'metres' or 'millions', causing possibly disastrous confusion! Imperial is universal and safe -

The Circular Music Notation Strip

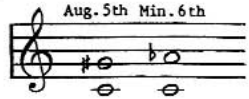
© Candida Tobin

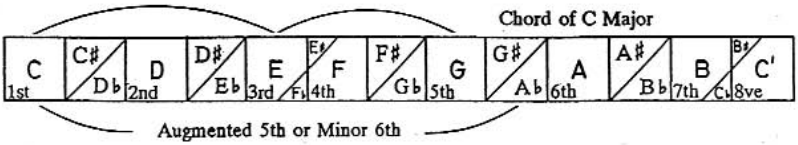
I always felt it was most unfair that music students had to think of the keyboard to work out their theory examination questions, especially if they were woodwind or string players with no plans to play a keyboard instrument. In 1967 I designed a ruler an called it a Notation Strip. It was invaluable. All questions of musical measurement could be worked out by using this device. Basic note designations and relationships are given by:



The major scale comprises two tetrachords joined by a bridging tone.

Many interesting observations can be made concerning intervals between notes. For instance, the augmented 5th and a minor 6th both contain eight semitones as shown below, and the construction of three note chords can be readily measured.



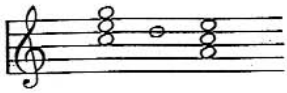


A major chord contains 4 semitones, then 3. A minor chord has 3 semitones then 4.
An augmented chord has 4 semitones then 4. A diminished chord has 3 semitones then 3.

The Notation Strip can be written in a circle. Most musical facts can be understood far more clearly if seen in the round, with notes displayed in the same positions as figures on the face of a clock. In its circular form, the Notation Strip becomes an unending succession of 12 semitones, any one of which can be selected as a start of an orthodox scale in which notes and chords will be related in accordance with the rules described here.

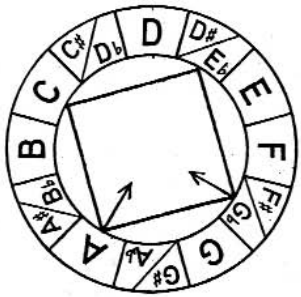
If you start on any note, say C for clarity, and move clockwise round the circle picking up perfect 5ths (seven semitones) you will have found a pentatonic scale C D E G A which makes a star-like pattern called a pentacle.

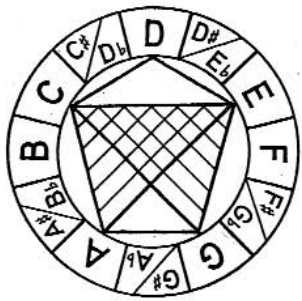
Join the points of the star and you get a pentagon. Within these five notes there are two chords, in this case the chord of C major and its relative A minor. The note D is like a pivot between the two. Fascinating?



But this is the interesting part of our project – what are the notes that do not belong to the scale? They are in fact the pentatonic scale: F♯ G♯ A♯ C♯ D♯.

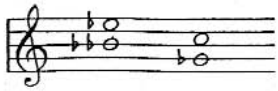
Does this mean that if we listen to a piece of music in any key, what we cannot hear (like the negative of a film) are the notes of the pentatonic scale? Wouldn't it be interesting if we could manage to hear the antithesis?

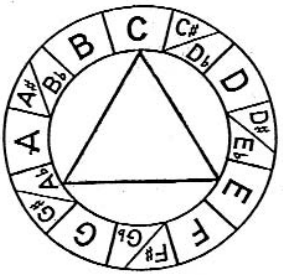




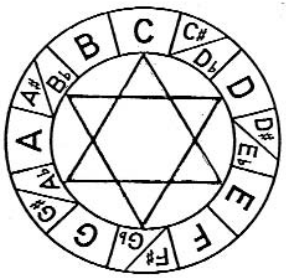
Now let us do this again, but starting on F (the subdominant of C) and pick up seven 5ths. The seventh will be B. What we have found is the scale of C: C D E F G A B C.

A diminished 7th divides the Notational Circle into quarters. Again, starting from any of its points will produce a diminished 7th. The square can be fitted to any notes in the notation strip.

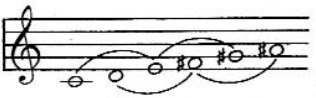




The augmented triad divides a Notation Circle into thirds. Starting on any point of the triangle produces the augmented triad, and the triangular chord can start on any note.



The whole-tone scale is made up of two augmented triads.



One can go on like this with every aspect of musical notation and sometimes one's conjectures become so erudite that it makes the mind boggle at the cunning interweaving of patterns that occur in music, and how they coincide with nature itself.

Candida Tobin, Hon FTCL, has a special interest in the teaching of music to children, using colour coding for notes and chords with action games to instill concepts of intervals, chord formation, rhythm and pitch. She was recently awarded the European Multi-Media Award (EMMA) for her Musicolor teaching programme. Information on this can be had from: The Old Malt House, Knight Street, Sawbridgeworth, Hertfordshire, CM21 9AX.

Nature is With Us

We certainly approve the final remark in Candida Tobin's illuminating dissertation, but must mention that it is, perhaps, more valid than she realises. As a twelve-based system, the construction of music exemplifies the inherent merits of such in many ways. Sir James Jeans wrote in his Science and Music that two tones will sound well together when the ratio of their frequencies can be expressed by the use of small numbers, and the smaller the numbers the better. Somewhat earlier, Plato had Socrates say: "Then beauty of style and harmony, and grace and good rhythm depend on simplicity".

To this end a diatonic or true tonal scale is built up in seven steps, each of higher frequency, leading to an eighth note, the Octave, of exactly twice the frequency or pitch of the first. When the First or Tonic is sounded together with its Octave, the aural impression is the smoothest possible between differing tones, having a ratio of 2:1. The next simplest relationship with the First is the Fifth, with a frequency ratio to it of 3:2 or 1;6 times (decimally 1·5), then the Fourth at 4:3 or l;4 times (1·333...).

On either side of these central notes, but with reducing consonance because of

increasing complexity, are the Third of ratio 5:4 = 1;3 (1·25) and Sixth of 5:3 = 1; 8 (1·666...) Near to the First is the Second at 9:8 1;16 (1·125) and adjacent to the Octave is the Seventh at 15: 8= 1;Ƹ6 (1·875). These latter intervals form a whole tone and a semitone respectively; the last is most discordant because beats between such close notes in the middle of the usual register, about 28; (32) per second, cannot be readily interpreted as a continuous sound. In the base range, beats are tolerable because they are slower, at the treble end faster and of low intensity. All values in dozenal numeration are indicated by the semicolons.

Any note has as background a series of 'harmonics' which are created by separate vibrations of aliquot parts of whatever resilient member - string, air-column, bar or membrane, is generating the First, or Fundamental, F. These reduce rapidly in intensity as they become more numerous and higher in pitch. Most prominent is the second harmonic caused by two halves of a length vibrating individually at 2F, i.e. the octave. The next is due to thirds of a length at 3F, which is a fifth from the octave. Quarter lengths provide a second octave above the first one, and fifths of the length a diatonic fourth above this.

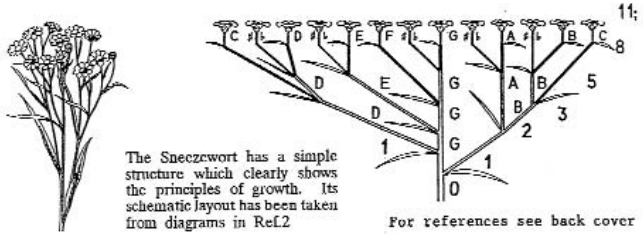
All diatonic divisions of an octave are created generically, if not in pitch, by a single vibrating element, but we have to go beyond the third octave, 8F, to find the last which is due to a vibration of 13; segments. Two most prominent overtones are those used in a major chord, and when these are sounded with the fundamental they also have harmonics of their own which are concordant with each and those of the others to produce one glorious combination of sound. The octave with its seven divisions is not an arbitrary system of sound as it appears at first sight, and is sometimes thought, but is constructed from the realities of physical vibrations which have always been available for acceptance. Part, no doubt, of Karl Popper's objective World 3 which contains facts and truths waiting to be brought into our subjective one.

It must be recognised that the diatonic or justly intoned series of notes within an octave does not produce a range that can be transferred by simple halving or doubling of frequencies to octaves below or above. No multiples of any note, singly or in combination with others between the First and its Octave can coincide with any number of octaves, which have to be in strict binary sequence. This incompatible relationship of a fifth to an octave has been compared to the incommensurable relation of the diameter of a circle to its circumference. The nearest fit is given by seven octaves, spanning a frequency range of 2^7 = Ƹ8 c/s to that of twelve Fifths over a little more due to $(3/2)^{10}$ =Ƹ9;8Ƹ9... The small ratio between these, 1;01627.., is called the comma of Pythagoras, who was the first to identify it and propose a solution.

Pythagoras the musician: better known, as our portrait (from the *Guardian* 3/vii/1969) illustrates, for his expertise with triangles.

Given a just intonation for each octave, notes in adjacent ones whose tetra-chords overlap, as shown by the circular notation strip, would not have the same pitch, although nominally the same. No less than 64; (decimal 76) divisions of an octave are required to allow justly intoned scales in all keys on instruments with fixed tones, but the mechanical complications have been found daunting. Helmholtz managed to use an octave with two dozen notes. An electronic keyboard with chips for each note that could work out instantly its true relationship with the preceding one is now a possibility.

The arrangement of a music scale in any temperament has a counterpart in nature by being analogous to growth that proceeds by adding new parts to those existing. In a plant, further stems originate at points where leaves appear on previous growth, after a sufficient separation length, and subject, of course, to the vagaries of light, nutrition or climatic conditions. Such development follows the Fibonacci numerical series in which each term is the arithmetical sum of the two preceding ones (beginning with 0, 1 or 1, 1). In dozenal notation this is 0, 1, 1, 2, 3, 5, 8, 11, 19, 2Ƶ, 47, 75, 100; ... Leaves, and their associated shoots, are usually arranged in a spiral form around their stems to receive light from all directions, so a schematic layout for the simple plant shown has to be distorted onto a two-dimensional surface to render the key stages clearly. The resulting flowers correspond to the 11; notes of a chromatic scale, but, as shown, the backbone of the scale in C is its Fifth, G, and the chord of G is in its second inversion. Perhaps music should be considered as á succession of Fifths rather than Octaves?



The Sneezewort has a simple structure which clearly shows the principles of growth. Its schematic layout has been taken from diagrams in Ref.2

For references see back cover

The Fibonacci is a special type of series, concerned only with real things that come in whole numbers, but its terms oscillate about a fixed ratio of 1;74Ɛ.., becoming asymptotic to this as the numbers get larger. This ratio is the Golden Mean of antiquity and art[5], which divides a spacing to best æsthetic effect. It is an irrational number, arithmetically $(1+\sqrt{5})/2$, with many important properties. The interest here is that it provides a link between discrete and continuous quantities.

The arithmetic framework of our musical scale is clear enough; there remains the question of how we appreciate it. Although the intervals between notes are now all slightly in error, an opinion is that we actually interpret them correctly since the brain is capable of adjusting its perception [1] to what it deems to be right; just as we try to make sense of optical illusions. The most un-musical of us, unless tone deaf, can find the intervals of a tonic sol-fa scale by instinct. If there is any substance in this it is aided by the similarity between sending and receiving equipment: A geometric series can be re-stated as one in which each term is formed by the addition of a quantity that has fixed proportion to the preceding one and, in general, can deal with fractional quantities or abstracts like the 2;8 children of a demographer's standard family.

The build-up of a musical scale proceeds along Fibonacci lines: two from First to Octave, three for a major chord, five the pentatonic scale, then eight in complete octave, with its one-zen one semitones. This arrangement is compatible with the mechanism whereby we gather air vibrations for processing. Lengths of hair-like receptors are arranged along the spiral cochlea in a geometric series, whose function is to resonate at the frequencies of incoming sound waves; these would readily respond to patterns of sound emitted from a similarly arranged source. It can be shown by many examples that if there is a physical, chemical, electrical or mechanical principle, and of course, mathematical, to be used, Nature has found it. We catch up, but slowly.

Symbols and Codes for 'Ten' and 'Eleven'

Robert Carnaghan

PART 1 - SYMBOLS

Among symbols used for the numbers ten and eleven are the asterisk (*) and the octothorpe or 'hash' (#), which are currently used by the Dozenal Society of America's Duodecimal Bulletin.

These symbols have the advantage of being available on most if not all computer keyboards, though the octothorpe is not, at least in Britain, available on most typewriter keyboards. This means that for computer users they are as easy to print as ordinary text and numerals. The disadvantages of * and # are firstly that they do not look like numerals, and secondly that elsewhere in everyday life they have other uses and meanings. Consequently their use as numerals is confusing and tends to deprive us of the other uses to which these symbols are put. On computers an asterisk is also widely used as the sign for multiplication, and the octothorpe is used in computing contexts either to mark a number as hexadecimal or, on its own, to represent a number.

Other symbols which have been used or suggested for ten and eleven include the letters T and E, representing the words in English; or the letters X, for a Roman ten, and E; or a and b; or Greek letters. All these suffer from disadvantages similar to those of * and # namely that they do not look like numerals, that they are confusing, and that they normally have other meanings. Hexadecimal notation uses the letters a-f or A-F to represent the numbers ten to fifteen, but it is used in a much narrower range of contexts (primarily certain aspects of computing) than those for which dozenal notation is intended, thereby much reducing the likelihood of confusion.

The symbols which Sir Isaac Pitman proposed for ten and eleven were a '2' and a '3' inverted by rotation. These have the advantage that they look like numerals, or at least that they do not appear to be letters or punctuation marks, and also that they apparently have no other meanings. In the days of letterpress printing using moveable type, these symbols could be printed by inverting the pieces of type for 2 and 3. On typewriters they are more difficult to reproduce, although typebar machines can be specially adapted for the purpose by sacrificing two other characters and replacing them with the inverted 2 and 3 soldered in their place.

On computers the situation is more varied, partly because there are various types of printer. The 'daisywheel' sort is now little used, having been superseded by types which are faster and/or quieter, and often more versatile, such as impact dot-matrix, ink-jet, laser or LED printers. The shared characteristic of all of these newer printers is that they form the shape of every character on the paper from dots of ink or 'toner'. The design for the matrix of dots needed to print each character (letter, numeral, etc.) is usually held in an electronic "chip" called a ROM which acts as a permanent memory within the printer. The smaller the dots, and thus the more of them defining each character of a given size, the better the quality of the print. Laser printers have until recently generally used dots spaced at three hundred to the linear inch. Now there are models which use a resolution of six hundred dots per inch, so producing print of higher quality.

However, another way of storing the matrix designs of characters is in the form of files held on a computer disc. These are known as 'soft' founts (or fonts). This method has become more widely used in the last few years, particularly in the form of Adobe Type Manager (ATM) founts and TrueType founts. Typefaces or founts (the two terms should be distinguished though they are often used interchangeably) in this 'soft' form have the advantage that they can be modified, and there are several programs which can be used for editing such files or even for designing a new set of numerals or a new typeface or alphabet which requires skill and much time. However, copying and inverting an existing character, such as '2' or '3', is simple enough and provides a good solution to our needs. Programs for editing 'soft' founts include Fontmonger, Type Designer and Fontographer, each apparently having its strengths and weaknesses - like most programs.

The resulting altered file can then be used with any word-processing, 'desk-top publishing' (DTP), or other program that can use fount files of the relevant sort. Suitable programs are most of the recent versions of Ami Pro, Microsoft Word, WordPerfect, and so on. Most programs will show the new symbols on the computer screen as well as printed on paper. If the typeface is "scalable", as are those mentioned, then text can be printed in a wide range of sizes. Incidentally, typefaces are traditionally and often still measured in "points" of which there are six dozen to the inch (or very nearly so).

By placing the new symbols in the typeface file in positions normally occupied by littleused characters, the new symbols can easily be typed by pressing the keys which are marked with, and which normally produce, those characters. More than one fount can be used within a single document so there is no need to sacrifice any characters: those that appear to have been lost can still be obtained by switching temporarily to the original, unaltered fount.

The outcome is that on the more recent models of, for example, IBM-compatible computers (older models do not have enough power to run most of the programs necessary for these new tricks), there is now a solution available for printing ↊ and ↋ on nearly all printers. People who have older computers can contribute articles on disc for publication, by using any two characters not otherwise required in their text as temporary substitutes for ↊ and ↋. These substitutes can readily be replaced before printing by anyone with equipment that can use an appropriate 'soft' typeface.

Given these new possibilities, dozenal publications could in future be printed using whatever symbols are considered the best, even if substitutes still have to be used in most private correspondence and the like. A typographical advantage of using the existing '2' and '3' inverted is that founts can readily be adapted for dozenal use without the difficulty of designing entirely new symbols slightly differently to match each typeface. At a later stage it will be possible to modify the shapes if required, but the first step is the easier one of simply inverting existing characters. We can now aim to use ↊ and ↋ for ten and eleven whenever needed for published material.

PART 2 - CODES

For sending information produced on one computer for use on another, there are essentially two ways. One is to copy a file onto something such as a floppy disc which has a magnetic surface on which information is recorded as binary numbers, and to take this storage device to the other computer. The other way is to connect the two computers with a cable and pass the information (again, in binary form) along the telephone lines which are normally used for human conversation. In this case each computer is plugged into a telephone socket via a device called a modem which adapts the signals to suit the telephone network, and changes them back again at the other end.

To move data using a disc or other storage device has several advantages but the two machines must be able to use and understand the same type of storage and configuration of data in the device. Using a cable or telephone network has among its advantages the fact that almost any type of computer can "talk" thereby to any other - at least so far as concerns text in English, including numerals. However, there are some reservations. To understand the situation we must remember that all text (including numbers and other signs and symbols) used by a computer is stored and basically used in the form of numbers.

In order for different sorts of computers to understand each other, and for screens and printers to understand computer processors, there has fortunately for some time been a standard code. which is referred to as ASCII (American Standard Code for Information Interchange). It is this standard which ensures that when a computer processor sends the binary number 1,100,001, equivalent to dozenal 81; to a screen the letter 'a' is displayed, and when it sends that number along another cable to a printer it results in the letter 'a' being printed. Similarly, the numeral '0' is represented by the number 110,000 (40;), '1' by 110,001 (41;), and so on.

At first the numbers used to represent characters were each made up of seven "bits" (binary digits) so the largest number was binary 1,111, 111 (dozenal ᘔ7;). However, the first 28; numbers (starting with 0) were used for instructions (such as "move paper up a bit so as to start a new line of print"), leaving only 80; for printed characters: capitals, lowercase letters, numerals, and a small selection of punctuation marks and other symbols (such as %, & and +). Being an American code, the octothorpe (#) was included, but the pound sign (£), and accented letters needed by many languages (such as ñ, é, î, ü, ç), were not provided for. In any case, not enough characters could be accommodated to cope with the needs of all languages. However, the original 7-bit ASCII is used by almost all computers and is thus a "lingua franca".

Later an extended or 8-bit ASCII, providing ᘔ8; more numbers, was brought into use, and this is widely but not universally used. It includes the pound sign and enough accented letters for most West European languages (though not for Portuguese), but Slav, Baltic and other languages continue to be ignored. The Windows system which is now widely used on newer IBM-compatible computers, and which is now the system most widely used in conjunction with the 'soft' founts described above, uses a variant, the ANSI code, which is also an 8-bit one with similar limitations. However, it has a rather different set of characters and even assigns some of the same characters, including the pound sign, different numbers! Fortunately the basic set of characters, including numerals and the Latin alphabet, are unchanged and therefore common to ANSI and ASCII.

The point of all this computer information is that neither ANSI nor extended ASCII provides 'slots' or places for the extra dozenal characters (however shaped) needed for ten and eleven. However, neither do they provide for many mathematical symbols and diacritical marks required by specialists, or for many languages. So a new code has been devised. Called Unicode, it is based on ASCII but uses 14; bits for each character, and can therefore encompass a vast number of characters. Unicode can apparently cope with all the world's alphabets and all commonly used Chinese, Japanese and Korean ideographs as well. The price to be paid is that ordinary text files are doubled in length and occupy twice the space in a computer's working memory and for storage on discs, since each character is represented by twice as many bits.

Unicode has yet to come into general use, and it remains to be seen how quickly it will be adopted, although the facility to use it is apparently being built into some new software. However, the question that needs to be addressed now, if it is not already too late, is this: have a couple of places (that is, numbers) been allocated to dozenal ten and eleven, and if not are there any unallocated places left and can they still be claimed for these numerals?

Irrespective of how the numerals for ten and eleven are written, unless they are given standard code numbers, it will not be possible to communicate dozenal numbers readily and unambiguously between computers. This is a matter of great importance for future use of the dozenal system of notation. Both commercial printing and small-scale publishing are increasingly dependent on computers, so dozenal notation needs to be provided for in computer codes. Perhaps the Dozenal Society of America is better placed to be able to do something about this.

For immediate use amongst users of the dozenal system, it would be sensible if ᘔ and ᘓ were given temporary agreed places within the 8-bit codes, albeit as private substitutes for existing characters (preferably the least useful of existing characters). Such a purely unofficial arrangement would be of some advantage when communicating files, even though it would not replace the need for proper recognition of and provision for dozenal numerals in computers. Any serious advocacy of dozenal numeration must include urgent consideration of the need for allocation of agreed computer codes representing ten and eleven as single characters.

EDITORIAL NOTES

Up to now, the situation with regard to printing is similar to that at the start. Whilst the production of books by movable type allowed a wide dissemination of knowledge. this thereby became confined within an inflexible framework. Authority everywhere has a natural fear of open information so, in the beginning, anyone caught producing seditious works, like New Testaments in the vernacular, was harshly treated. Safety lay in prudent silence.

As times became more humane, only books were burned. The running of an increasingly complex society required improved education, and there were advantages in having a standard means of communication so that words could be given fixed spellings and the current ideology circulated. Printing thus became officialised, and control was attempted by censorship.

We have long suffered from the difficulty of introducing additional symbols as a means of expressing new ideas, hence the latest means for printing texts that does not depend on immutable pieces of type is very welcome. It seems that far from being by-passed by technology, technology has just caught up with us. Any rigidity resides in the minds of ardent finger counters

Another genie has climbed out of the bottle, difficult to put back or control. People all over the world can communicate with one another through computer networks, particularly the global Internet, which also store a wide range of technical, educational and cultural material, and anyone can reciprocate with contributions of their own. The scope for displaying information on the Dozen Principle, and contacting those likely to be interested, is huge.

Items sent in to your editor suggest there are wide-ranging discussions occurring. These are mainly concerned with traditional means and methods, history and relationships, also comments on decimal metrication and a recognition of its defects which forms a foundation on which to build. A short list of Internet site 'addresses' (known as URLs) is given at the end.

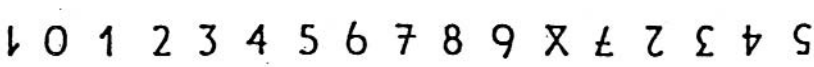
This opportunity makes desirable the establishment of suitable symbols that will be accepted as unique for their purpose by the public and agreed by the various proponents. It is not credible that there will never, ever, be any additions to the over-worked alpha-numeric set that we now use. Anything new might be eagerly seized on for other purposes. The fact that programs are available for creating something new, even if only for re-orientating existing forms, suggests that the need has been recognised.

The DSA and DSGB publications have statements that the Societies do not endorse any particular symbols for 'dek' and 'el'. "It is the principle that counts", as Prof. Gene Zirkel said; and Prof. A.C. Aitken, founder member of DSGB, advised: "Duodecimalists should not dictate too much what is desirable ... once the principle is accepted, practical people may find an even better solution". However, these are opinions from some time ago, and events do not stand still, so an occasion for further advance may be upon us.

Both organisations are contacted by individuals who had been working in isolation, using their own particular sets of numerals to explore the new idea. It is embarrassing to admit that even long-standing players, for good reasons of their own, have yet to agree on such a fundamental topic. Any use of the facilities described above would be jeopardised by a lack of agreement among those who claim to be in the lead. Certainly, people responsible for allocating codes are not likely to be sympathetic to other than generally accepted usage.

The symbols ƻ and ɛ adopted by Pitman for use in his 'Phonetic Journal' stemmed from the use of inverted or reversed letters to denote each of the various sounds that they can convey in speech. It was a lost opportunity, besides unimaginative, meekly to accept A-F for hexadecimal (hexamal?) computer programming; there were objections at the time, and discussions in computer journals. The Pitman solution offers advantages which are now readily available to us.

Perhaps we should not be too parochial in the quest for numerical reform, since this might have to compass a range of uses from minus one to sixteen when we eventually re-align our thinking to comply with the real world, which was definitely not created with ten fingers! Bailantyne'in 1925 used an inverted 'one' for its negative value in his work on balanced ternary. A complete set of number symbols for all foreseeable needs could be as shown under.



In this context ↊ and ↋ are best suited to positions for 'twelve' and 'thirteen' to comply with the decimal connotations of those following. A Roman ten form seems to be an instinctive choice in many proposals, and is used for a base-eleven check in the ISBN book numbering system.

Telephone symbols are effectively a crossed X and 11 in accordance with the practice of distinguishing between similar figures and letters. In this case, a bar at the top converts X into an inverted upper-case phonetic symbol, X, for a voiced 'ex'. An inverted 7 speaks for itself, and the crossing is Continental style to avoid confusion with an exaggerated serifed 'one'. It was used for a 'ten' in Jean Essig's 'Douze, Notre Dix Futur', T and E having no significance in French numeration.

It should be stressed that the above proposal is not DSGB policy, which is to continue the use of ↊ and ↋ as additions to the western Indo-Arabic range until events dictate an agreed change. It is offered here by a minority of one for consideration as a solution to diversities that form a handicap to further advance. The proposed symbols do have sufficient features in common with those of a considerable body of literature that has been built up by both societies, which will allow this to continue in use - an important point - whilst complying with the usual evolutionary process in which existing forms are modified to become adapted to changed circumstances.

ARCHIVAL NOTE

For the record, and for the benefit of new members, it should be mentioned, that up to 1974 DSA used, for the new numerals, a Greek chi, Χ, and a straight-topped inverted 3, which are still shown on their circular logo. A change was made to Bell Telephone's * and # considered as a crossed Roman ten and an eleven, on the grounds that these were becoming familiar to the public on the telephone array of twelve buttons. See an article by Prof. Gene Zirkel in 'Duodecimal Bulletin', Vol. 27, Summer 1982. These symbols were used by E. E. Kramer for a chapter on base-twelve arithmetic in her book, 'Mainstream of Mathematics', published in 1955. This was about the time that Bell were developing their tone-dialling system.

SAMPLE LIST OF INTERNET SITES

The Dozenal Society of Great Britain. http;//www.dozenalsociety.org.uk

Dozenal Forum http://s.13.invisionfree/DozensOnline/index.php?

The Dozenal Society of America http:www.dozenal.org

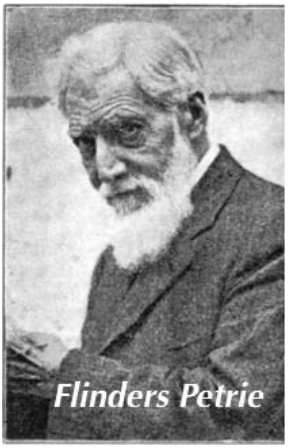
British Weights and Measures Assn. http://www.bwmaonline.com

Preservation of human-related measures for ordinary purposes.

John Douglas, http://www.users. zetnet.co.uk/estatopia/inch.htm

Many more are listed on the DSGB website

Whole Numbers



The propensity of designers and craftsmen to use whole numbers and simple fractions of a length unit for a project is a natural practice. It was once a two-way process, by which the establishment of a suitable length reflected the needs and uses to which it was put, but we now have an arbitrary measure imposed on us that pays no heed to such niceties. Two-way in time also. A study of ancient remains, on the assumption that whole numbers of the prevailing length unit were used for their layout, reveals the size of this in no uncertain manner. By such means, Flinders Petrie was able to determine the lengths of various 'feet' used throughout Europe and the Near East. One success was to discover what he termed the 'Northern Foot' from a study of buildings on the eastern side of Britain long before a specimen was found during excavations at Mohenjo-daro on the Indus plain. Known over there as the Belgic/Tungri foot, this was brought to Europe by Teutonic migrations and says something about the connection of these people with the pre-Indra Harappan civilisation.

LINCOLN CATHEDRAL

An article, 'St. Hugh's Church at Lincoln,' in Architectural History (vol. 34, 1991) refers to papers by F. Bond and W. Watkins in the RIBA Journals for Nov. and Dec. 1910, proposing that a building module of 21 feet 6 inches was used for its layout. Aisles on each side of the choir are of this dimension and the overall width of the nave is 86 feet. This idea was soon criticised, with an objection that 21' 6" was not fully substantiated.

The author mentions "a syndrome historians are prone to; that of dressing a subject up in their own clothes," but the use of English feet in this case does not cause any distortion as these have not varied significantly since first detected in tenth-century buildings. St. Hugh's was not started until the twelfth century; however, 21½ feet does seem an odd figure to adopt. If such a module was used, it is not unreasonable to conclude that as the master mason, Geoffrey de Noiers, was French he would have worked with his Pied-du-Roi, established in the eighth century by Charlemagne. It had twelve divisions, of course, but was 12·79 English inches long so twenty comes to 21' 4", the score being a common enough tally for measures and goods in those days,

Perhaps Bond and Watkins did a bit of rounding up of their own, not liking the look of 21½ feet; a half is an important enough quantity to be granted honorary whole-number status. Or, for major reconstruction after the tower collapsed in 1237, and later alterations, it may have been assumed that 21½ feet was intended. Lincoln Cathedral was built over a period during which a distinct English style was separating from the Continental, so has unusual features. Overall it has not unkindly been described as "geometrically sloppy," allowing scope for differing assessments.

Such magnificent buildings are essential constituents of the country's heritage, and must be preserved; so also should a knowledge of the dimensional units to which they were constructed. Let us hope that these will survive despite attempted interdiction of all our human-sized measures by Statutory Instruments, thus avoiding public debate. Dressing historic monuments up in metres and millimetres for a sycophantic acceptance of current commercial/political expediency could provide grounds for future debate, and if the decimal point is in the wrong place it does not matter, since all sense of scale and proportion will have been effectively suppressed.

PETERBOROUGH CATHEDRAL

When visiting this elegant structure, we were welcomed with a leaflet describing its main features and dimensions. These were stated as so many metres, with conversions to feet in brackets seemingly as an afterthought. I asked, politely, if there was any statutory requirement to give precedence to metric dimensions, since I understood that this applied only to retail goods at present, and should not the measures to which the Cathedral was built come first? I received an approving response, with surprise that anyone was concerned, and was advised to put the matter to the Chapter - a body of clerics in charge of the fabric. There was a friendly reply to my letter, that there was no legal obligation to the order used, and a promise that they would "go feet first" with the next printing.

However, it seems that I was rather hasty in declaring that the Cathedral was built to English feet. Construction was started in the twelfth century, but although the foot we know now had been in use since Saxon times, defiiied in documents as "duodecim uncia pollices" - twelve thumb inches, a legacy of the Roman occupation - it did not become official until the fourteenth under Edward I with an inch of three average barley corns. A booklet by Frederick Stallard and Paul Bush, 'The Geometric Skeleton of Peterborough Cathedral', describes its overall layout as based on 39-foot squares, ten in length and three in height to the pinnacles.

Thirty-nine does seem an awkward figure to adopt for design purposes, as it cannot even be halved and there are two windows in each square. A little thought concluded that the undoubted framework of squares must have been forty Roman feet, each foot (pes) with an implied length of 12 x 39/40 = 11·7 present-day inches. This length is a little above the range for samples of the pes found in the British Isles, 11·54 to 11·65, although up to 11·68 is allowed.

It is recognised that the Romans did not maintain their measures to any great accuracy, tending to adapt the practices of countries they occupied to facilitate trade (so what is new?). Their pes was obtained from the Greeks, whose original foot was sixteen Egyptian digits, 11·81 inches, which had shrunk to 11·7 by the time Rome was, interested. We should not be too concerned over exact measures from a single example. In the marking out and placing of stonework, with later measurement by different means, there is scope for variability.

If the above assumption is correct, Peterborough Cathedral embodies measures that go back to the dawn of history, which is as it should be. Understandable and agreed measures provide the foundation of organised living, and standards were traditionally deposited in temples for safekeeping along with other sacred objects. Ours were held in Winchester Cathedral until William the Conqueror had them moved to the Tower of London as an assertion of his authority; could this be a glimpse of the politicising of measurement? As Dr Evans suggested earlier, control of the means whereby people relate to their daily affairs is a step to control of people themselves.

RAILWAY GAUGES

A quite different topic is our railway gauge of 4 feet 8½ inches between the insides of the rail heads, and where did such a curious dimension come from? It has long been necessary to provide hard running surfaces over soft or uneven ground for wheeled vehicles. The Greeks had 'rutways,' trenches rammed with stones at the bottom. The Romans laid stone slabs which would acquire grooves from iron-rimmed wheels, obliging all users to have the same spacing. This is thought to have been five Roman feet of 11·65 inches as shown by the deep ruts worn in the streets of Pompeii, but I would like confirmation of this.

The first British waggon ways date back to the mid-1600s, and by 1800 there were hundreds of miles built on an ad hoc basis to serve collieries and mineral workings. Originally of timber, tree trunks halved or dressed flat, the more heavily used had iron plates for a more durable running surface. The term 'plate layer' still describes gangs of workmen engaged on track maintenance. The difficulty of keeping narrow wheels on the plates was avoided by

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Clogs to Clogs

- IN THREE GENERATIONS, is a north country adage describing how a profligate third generation fritters away the hard-won fortune of its forebears. Having sold the family silver, and Rembrandts off the walls, we are now thinking of chopping down trees in the park: Bushey Park, home of the National Physical Laboratory. In co-operation with the National Engineering Laboratory at Glasgow they are responsible for the National Measurement System, which the Department of Trade and Industry was seeking to privatise in the early 90s.

Companies who used services then available to calibrate their measuring equipment were strongly opposed to the move, and particularly concerned by the lower standard requited from bidders, perhaps to make it easier for them. One said they would take their work to national standards laboratories outside the. UK rather than rely on a commercial competitor. Another stressed that no private company could command the respect due to a Government laboratory, so it would be difficult to convince customers that the accuracy claimed was genuine - "it is very much a question of credibility". This could be a round trip, since I understand that some laboratories were set up during the first world war to provide a check on supplies from industry.

The Institute of Measurement and Control was justifiably annoyed by the transparent omission to consult them about the proposals. An article in their Journal for November 1993 defending the N.P.L. stated that an impartial centre of excellence needs to retain a critical mass for an integrated team to ensure a scientifically credible programme of research. "Without a strong national standards laboratory, the UK will have 'a diminishing voice in the international standards world." A letter we received from the DTI via an MP said: *"the holding and maintenance of standards are not the same as their improvement. The extent to which the latter is needed must be clearly established."* and goes on to mention *"these separate activities"*, leaving us in no doubt as to the intentions. (Our italics stress the sinister undertones).

Early in 1994 an "Efficiency Unit" was detailed to examine the working of all government research institutes with a view to selecting some thirty that could be sold off by the end of 1995. Concern was expressed, even by industry, that long-term and non-commercial research would be neglected, and the more exotic such as particle physics, however vital for future power nccds, would not find a market. In fact, the BoT is now withdrawing funds for research in favour of data networks giving better access to available technology for more immediate benefit. Reminiscent this of mediæval Scholasticism which was a closed circle, concerned only with disputations between scholars on known or assumed facts;. they never did decide how many angels could stand on the point of a pin! Technical development will be outside the circle,

Merging of institutions into five groups of kindred topics seemed to be the aim. Ostensibly to save money, but a letter from the unit blurts out the truth by saying it hopes to, create a clear boundary (barrier?) between purchasers of research and laboratories, with the controller of each group deciding who does what. Divide et impera is a good strategy if the value of imponderables such as world recognition, staff loyalty, continuity and flexibility are not considered. The ethos in a laboratory under no pressure to produce results on time at cut-price has to be experienced to be appreciated. It has been well said that if you want to find out how anything works, try and alter it. Possibly finishing up with nothing that works at. all.

If the objective is to create "efficient" non-redundant structures it should be realised that the ultimate is one in which the failure of a single part (to draw on a mechanical analogy) will cause an immediate collapse of the whole. There is evidence that this can happen in social and economic systems, which are biological in behaviour by requiring redundancies to ensure stability and continuity with unknown factors and in unforseen circumstances.

Despite all the effort, and expense both in doing the investigation and interrupting those concerned about it, the efficienc, unit, starting out with a pre-conceived notion that the.status quo was not an option, issued an interim report in April 1994 with quite a different opinion. It has failed to find any candidates for privatisation, nor much scope for rationalisation. "We are not sure as yet whether we have found over-capacity', and "found very few examples of actual duplication". A new (enlarged) agency would have "considerable difficulty in maintaining a sense of mission and strategic direction". Small is beautiful, and if a good job is required do not interfere with those dedicated to doing it. We can now be sure that if changes are made they will be for narrow doctrinaire reasons alone.

Since writing the above, about seven government-regulated laboratories have been sold off. It was thought suitable to include this material because similar problems, whether real or imagined, tend to invoke similar solutions, which disregard the same principles.

We are not alone. New Scientist has regularly chronicled all stages of the sell-off with obvious disapproval. Their article "An exercise in inefficiency" by Andy Cohlan (26.11.94) discussed the Efficiency Unit's report on an examination of fifty-three laboratories for their privatisation potential, or ways of increasing the value-for-money they produced.

The report was heavily criticised by a Select Committee of MPs, who said that the conduct of the investigation may have been "profoundly and unnecessarily damaging" to the morale of researchers. The Unit could not produce definite examples of over-capacity, arid was "unable to quantify any savings from reorganisation". One member considered the scrutiny was "treasury led", and used "to find ways of reducing spending on research".

Like the Bourbons, they learned nothing and forgot nothing. An editorial for 1st June 96, "Beware the Juggernaut, my son", described how it was still rolling and crushing everything in its path. Despite condemnations from many prominent scientists, it had been announced [2] that a further six public institutes were to be privatised "for full independence from the public sector, with the greater freedom this will provide". All were in agricultural and biological fields but, with regard to the BSE crisis, it was considered that more long-term research was required, not less, to provide high-quality independent advice.

RAILWAY GAUGES

Continued from page 20

the use of rollers to span them, but such expensive material had to be. used sparingly so it was laid on the better routes no wider than the outside dimension of waggon wheels - 5 feet - which were confined to this by upturned flanges to the insides of the plates. The first instance of flanges transferred to the wheels, thereby causing a separation between road and rail use, was in 1789 for a feeder line to the Loughborough canal. The tracks were of vertical I section for greater stiffness, with a running surface 1¾ inches wide, and the distance between them became the critical dimension. So there we have it: five feet less twice 1¾ inches is 4' 8½", which it has remained for all rail heads, now 2¾ inches wide here.

When we were once 'the workshop of the world,' British equipment, with its measures, was sent everywhere, including our rail gauge, but there were exceptions. After his stint in the Deptford shipyards, Peter the Great took the English foot back with him to replace his less convenient 'Archine' of 28 inches (an arm-length unit), and they settled for five of our feet for the Russian railway gauge. It was recognised here that a gauge wider than that derived from farm carts or Roman chariot wheels would be required for the obviously increasing loads and speeds, but short-term economics prevailed as usual[3]. Brunei was far in advance of his time when he adopted seven feet, plus ¼ inch working clearance, for the broad-gauge system.

A Modified System of Imperial Measures *Donald Hammond*

The metrication of weights and measures presents problems of divisibility, which tend to confuse people who try to use the ten-based units for ordinary purposes. The Imperial system permits simple divisions, and frequently needed proportions, so is superior for practical work. However, in the present political climate, the Government is implacably intent upon metrication.

The system outlined here is what seems to me a logical continuation of the thinking which has prompted the building trades to use the metric foot' of 300mm, which, with its twelve metric inches of 25mm, preserves the valuable divisibility provided by true feet and inches. The French, I understand, use what amounts to a 'metric ell' of 1200mm for the same reason.

I now suggest that retail and wholesale trades should adopt a 'metric pound' of 480g. This is a manageable figure, and closer to the metricated value for an Imperial pound of 454g than the 500g (a French livre) used as a reference weight to supplant it. Such a unit would lead to very little, if any, changes to package sizes.

THE SYSTEM

LENGTH

	I metric inch,	inm	= 25 mm
12 metric inches	I metric foot,	ftm	= 300 mm
3 metric feet	I metric yard,	ydm	= 900 mm
4 metric feet	I metric ell.	elm	= 1200 mm

WEIGHT or **MASS**

	I metric ounce. ozm	= 30 g
16 metric ounces	I metric pound, lbm	= 480 g

This metric 'ounce' of 30g exactly is closer to the Imperial ounce than the inflationary 25 g at present being pushed. Note also that the ibm of 480g is actually more versatile than the Imperial pound. Whilst retaining binary divisions down to the ozm, appropriate for weights and volumes, it can also be divided into thirds, fifths and tenths.

VOLUME

The metric gallon (galm) can still be a volume of water that weighs ten pounds (metric lbm) and containing its traditional 8 pints, but metric ptm of 600cl each. This is divisible by 20 for fluid ounces of 30cl. The exact conversion is 1 galm = 4·8 litres

Alternatively, 1 galm could be equated to 43½ litres, as assumed for rapid conversion to proper gallons, giving a neat 6 galms per cubic ftm. With water the galm would then weigh 9 lbm ℰ ozm.

With the above, we thus achieve overall compatibilities of Lengths, Weights and Volumes:

10 metric ells = 12 metres. 25 metric pounds = 12 kilogrammes.

10 metric gallons = 48 litres. A cubic metric foot (ftm^3) would contain 27 litres and weigh 27 kg if of water.

Not perfect, but a start. D. Hammond 12.12.77 Continued over.

Metric measures are supposed to be de rigueur everywhere now, but are regularly being adapted to conform with the objective world, and so provide essential features of identifiable sizes with simple divisions Even the humble brick has to retain its wonted proportions of 6 : 3 : 2 for proper bonding, which are provided by the metric foot with great precision - 225 x 112·5 x 75 millimetres! "A spiteful little change" as Hammond described it in Journal No. ƻ.

The 25 mm 'inch' is used for timber thicknesses, bolt sizes, tape widths, etc. In Belgium 24 mm is thought more useful. A 12 cm building unit is common in Denmark, which fits in well with the architecture design module mentioned, 120 cm, widely used for flexibility of layout besides ensuring whole numbers for important divisions.

Dress-makers' tapes throughout Europe have 2 cm spacings, known by the local name for thumbs - tums, pouces, pollices, pulgadas, - whatever. A sample from Portugal was marked 'Made in Japan', where they are not slow to sense a need. British Standard pipe-work fittings are also to be had from there. A Russian scale used by tailors has centimetres divided into quarters, quite sufficient for soft flexible material.

Weights and volumes have had similar treatment. The livre, pfund libra, are traditional names given to half a kilogram, the full weight of which is far too heavy for common use. The decimal division, 100g has the generic names for this class of measure - once, unzen, onza even if somewhat bigger than the previous tweith or binary part of its parent weight

For precious stones, we have a metric 'grain' of 50 mg, with four to the metric 'carat'. Volumes are still allowed to be described by the Pint, much clearer than 568 ml in whatever size lettering is used. Non critical dispensing has its 'drop' with 20 to the ml, and a fluid ounce was once measured out at 30 ml.

Continentals are quite casual as to which regulation they decide to accept, but we are handicapped by a tendency to honour our "scrap of paper". Then there is a branch of snoopers, already in place, to ensure that anyone awkward enough to sell knicker elastic by the yard, or list Christmas trees by the foot, was apprehended for prescribed treatment. It may even be a crime not to use met-speak when describing quantities otherwise correctly composed of lifeless metric units, and thus denied escape routes being taken 'over there'.

The proposal by Don Hammond for small adjustments to our measures that would make them compatible with metric yet retain their divisible nature was amongst his papers and merits publication. It could provide our way back to a world of named quantities and simple proportions for everyday affairs, leaving those who chose to preside over their rows of figures, and "those damned dots". Within reason, it is not the exact sizes of measures that are important, but the way in which they can be presented and divided up.

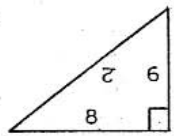
A Pythagorian Pinnacle

Donald Hammond

Readers may recall the method, described in JOURNAL 9, whereby Pythagorean Triples (P-triples) giving integral values for the sides of right-angled trigons, can be generated from any pair of natural numbers p and q, with $p > q$, by taking $a = p^2 - q^2$, $b = 2pq$ and $c = p^2 + q^2$. It was noted that:

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

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



E.g. $p = 3$, $q = 1$ gives $a = 8$, $b = 6$, $c = 10$

and $8^2 + 6^2 = 10^2$, so 8, 6, 10 is right-angled.

It is well-known, of course, that Pythagoras works in <u>three</u> dimensions as well as in two; a right-angled skew tetrahedron carries the relationship:

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

when edges a, b and c are projected in sequence and are mutually perpendicular and d is the hypotenuse edge of the tetrahedron so generated (Fig.1).

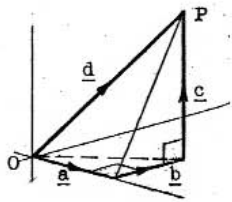


Fig.1

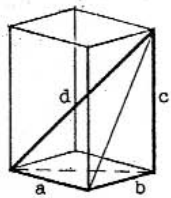


Fig.2

Such a tetrahedron also forms one-sixth of a cuboid $\underline{a} \times \underline{b} \times \underline{c}$, with $\underline{d}$ giving the solid diagonal of the cuboid (Fig.2).

Now, the journey from the origin, O, to the pinnacle, P, may be via the Cartesian route $\underline{a} + \underline{b} + \underline{c}$ or by their vector sum, $\underline{d}$; and if $\underline{a}$, $\underline{b}$, $\underline{c}$ and $\underline{d}$ are all whole numbers, we have a <u>Pythagorean Quadruple</u>. It seemed to me that it should be possible to find an algorithm to generate P-quadruples by developing the P-triple method.

Pythagorean Quadruples (Dozenal numeration)

At least one of these was easy to find: fortuitously, the well-known P-triples 3, 4, 5 and 5, 10;, 11; have a common side when drawn as triangles so that a 3, 4, 5 trigon can have a 5, 10;, 11; hinged to it along the 5-unit side and erected to delineate a skew tetrahedron (a cardboard model can be made for classroom demonstration) as in Fig.3.

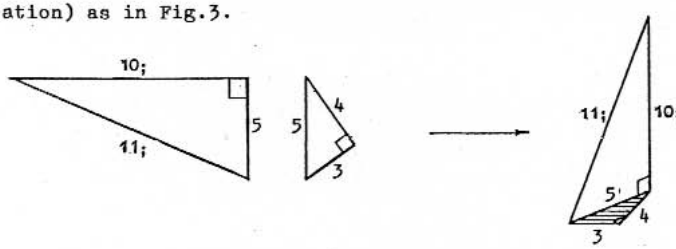


Fig.3. (3, 4, 10;, 11;) is a P-quadruple.

It was realized that a suitable algorithm would involve three 'starting' integers. A certain amount of work resulted in the following statement (readers may like to practise their algebra to verify the equation..).

To generate a Pythagorean Quadruple

Take three natural numbers p, q, r, such that $p > q > r$. Let:

$\underline{a} = p^2 - (q^2 - r^2)$; $\underline{b} = 2pq$; $\underline{c} = 2qr$; $\underline{d} = p^2 + q^2 + r^2$.

It can be shewn that:

$$\left[p^2 - (q^2 - r^2)\right]^2 + \left[2pq\right]^2 + \left[2qr\right]^2 = \left[p^2 + q^2 + r^2\right]^2$$

so $\underline{a}^2 + \underline{b}^2 + \underline{c}^2 = \underline{d}^2$

Example: take $p = 3$; $q = 2$; $r = 1$;

then $\underline{a} = 3^2 - (2^2 - 1^2) = 6$ $\underline{b} = 2.3.2 = 10;$

$\underline{c} = 2.2.1 = 4$ $\underline{d} = 3^2 + 2^2 + 1^2 = 12;$

and $6^2 + 10;^2 + 4^2 = 12;^2$

Just as with the P-triple, the P-quadruple can be divided through by a common factor (if there is one) to render it in lowest terms:

$(6, 10;, 4, 12;)/2 = (3, 6, 2, 7)$ and $3^2 + 6^2 + 2^2 = 7^2$

There is more..

Having worked-out a few of these just for the satisfaction of doing so, I noticed another relationship in some of the quadruples which is revealed when the numbers are re-written in ascending order, e.g.:

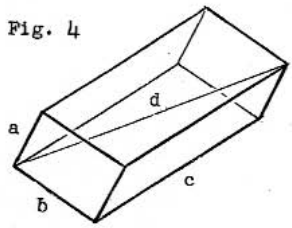
(3, 6, 2, 7)	becomes	(2, 3, 6, 7)
(5, 18; 4, 19;)	becomes	(4, 5, 18;, 19;)

So, in these, the second number is one more than the first, the third is the product of the first and second and the fourth is one more than the third... And it is, indeed, generally so: starting with any n, we find:

$$n^2 + (n + 1)^2 + \left[n(n + 1)\right]^2 = \left(\left[n(n + 1)\right] + 1\right)^2$$

hence, we can get an infinite subset of P-quadruples from a natural number n by putting:

Fig. 4



$\underline{a} = n$, $\underline{b} = n + 1$, $\underline{c} = n(n + 1)$ and $\underline{d} = n(n + 1) + 1$

The relationship is illustrated by figure 4, which is drawn with co-ordinate proportions of 2, 3 & 6..

It must be said that the personal satisfaction gained from independently developing the general p,q,r equation, then discovering the n-subset for Pythagorean quadruples, was considerable, despite the modest level of mathematics involved. These things, surely, must be known already; yet I have never seen them in any text book.

Pythagorus applies to four-dimensional Einstein / Minkowski space-time co-ordinates also, see New Scientist, 17th May 1997. Would someone care to determine the P-quintuples for this case?

A Fractious Inheritance

G.P.Jelliss

A correspondent recently raised the problem of the Sheik who wanted to divide 15; camels between three sons: half to the eldest, one-third to the middle and one ninth to the youngest. How could this be done, when 15; is not divisible by 2, 3 or 9? The clever lawyer consulted by the brothers resolved the impasse by bringing along his own camel to make 16, which is divisible by these factors, and after the share-out one camel is left for the lawyer to reclaim.

This amusing problem is almost certainly mediæval (and possibly ancient Egyptian). It is quoted, for instance (in terms of horses instead of camels), as An Unmanageable Legacy' p. 147, in *Puzzles Old and New* (1893) by Professor Hoffmann, where it is given among other mediæval problems, but without mention of its source.

The explanation of the difficulty is quite simple: namely that the three fractions do not add to unity, 1/2 + 1/3 + 1/9 = 15;/16;. [This is independent of the method of expressing the numbers, e.g. Roman numerals would do.] The actual fractions of the inheritance obtained by the three sons are 9/15;, 6/15; and 2/15; so that each in fact receives a little more than the specified fraction, a reasonably satisfactory outcome.

Similar puzzles can be constructed by starting from any fraction *m/n* and expressing it as a sum of fractions with unit numerator. This method of expressing fractions was used by the ancient Egyptians (c. 1800 BC). An algorithm for converting fractions systematically into this form was given by Fibonacci (1202 AD): The first fraction in the expression is $1/q$ where q is the next whole number greater than or equal to n/m (note the inversion). To find the next unit fraction apply the same rule to $m/n - 1/q$. And so on. [My source for this information is *Concrete Mathematics* (1989) by. R.L. Graham, D.E. Knuth & O. Patashnik, p. 95]. In the case of fractions of the type $(n-1)/n$, if n is large, the first unit fractions in the sum, determined by the Fibonacci method, follow the sequence 1/2 + 1/3 + 1/7 + 1/37; + ..., where each denominator is one more than the product of the preceding denominators (e.g. 37; = 2x3x7 + 1 and 1/2 + 1/3 + 1/7 + 1/37; = 1065;/1066;).

The following is a listing of all ways of expressing $(n\text{-}1)/n$ as a sum of distinct unit fractions, for values of n up to 36;. Solutions are only possible when the denominator has a sufficient number of distinct divisors. [All numbers henceforth in dozenal.]

Two terms: 3/4 = 1/2 + 1/4, 5/6 = 1/2 + 1/3.

Three terms: 7/8 = 1/2 + 1/4 + 1/8, Ɛ/10 = 1/2 + 1/3 + 1/10 = 1/2 + 1/4 + 1/6, 15/16 = 1/2 + 1/3 + 1/9, 17/18 = 1/2 + 1/4 + 1/5, 1Ɛ/20 = 1/2 + 1/3 + 1/8, 35/36 = 1/2 + 1/3 + 1/7

Four terms: 13/14 = 1/2 + 1/4 + 1/8 + 1/14, 1Ɛ/20 = 1/2 + 1/3 + 1/10 + 1/20 = 1/2 + 1/4 + 1/6 + 1/20 = 1/2+1/4+1/8+1/10,. 25/26 = 1/2+ 1/3+1/Ƭ + 1/26 = 1/2+1/5+1/6+ 1/Ƭ, 2Ɛ/30 = 1/2 + 1/3 + 1/9 + 1/30 = 1/2 + 1/3 +1/10 + 1/16 = 1/2 + 1/4 + 1/6 + 1/16, 33/34 = 1/2 + 1/4 + 1/5 + 1/18.

Five terms: 1Ɛ/20 = 1/3 + 1/4 + 1/6 + 1/8 + 1/10, 25/26 = 1/2 + 1/5 + 1/6 + 1/13 + 1/26, 27/28 = l/2 + 1/4 + 1/8 + 1/14 + l/28, 2Ɛ/30 = 1/2 + 1/4 + 1/9 +1/10 +1/30, 33/34 = 1/2 + 1/4 + 1/8 + 1/Ƭ + 1/34 = 1/2 + 1/5 + 1/8 + 1/Ƭ+ 1/18, 35/36 = 1/2 + 1/3 +1/12 + 1/19 + 1/36.

Six terms: 2Ɛ/30 = l/3 + l/4 + 1/6 + 1/9 + 1/10 + 1/30.

On the other hand, if the fractions were, say, 1/2, 1/3 and 1/4 which add to 11/10 or 1/2 +1/3 + 1/5 = 27/26 the lawyer would have to remove one camel while the first two brothers took their shares, and return it to complete the third brother's share. In this inverted version of the puzzle the flaw in the transaction is more obvious. The shares received by the three

When the fractions add properly to unity there is of course no need to call in the arbitrator, so long as the number of camels is a multiple of all the denominators. Sets of distinct unit fractions adding to unity are, for three, four, five and six fractions to a set:

Three: 1/2 + 1/3 + 1/6.

Four: 1/2 + 1/4 + 1/6 + 1/10 = 1/2 + 1/3 + 1/9 + 1/16 = 1/2 + 1/4 + 1/5 + 1/18 = 1/2 + 1/3 + 1/8+ 1/20 = 1/2 + 1/3 + 1/7 + 1/36.

Five: 1/2 + 1/4 + 1/8 + 1/10 + 1/20 = 1/2 + 1/5 + 1/6 +1/ᘔ + 1/26 = 1/2 + 1/3 + 1/10 + 1/16 + 1/30 = 1/2 + 1/4 + 1/6 + 1/16 + 1/30 = 1/2 + 1/4 + 1/5 + 1/18 + 1/34.

Six: 1/3 + 1/4 + 1/6 + 1/8 + l/10 + 1/20 = 1/2 + 1/5 + 1/8 + 1/ᘔ + 1/18 + 1/34.

These series are not unrelated to the problem of weights discussed by Troy in the last issue of the *Dozenal Journal* (pp.ᘔ -11).

Whilst the problem has been couched in a more familiar and simple form, to allow for a clear explanation, it was put to us by J.D.I. Morley as of Roman origin and seemingly more complicated. The story was that a Roman mathematician bequeathed his fortune to four of his best pupils: half to the ablest, a third to the second, with a fifth and a sixth to those next. In the event, the sum available was reduced to 57 000 denarii, which made the distribution awkward. By borrowing 3 000 denarii, to make it up to 60 000 d, integral divisions could be obtained that added up to the sum available. The extra money could then be returned.

The thousands of denarii look formidable, but these can be crossed out by reference to them as just that - 57 'thousand-denarii'. In this example, a divisible denominator is three more than the numerator. There must be many more problems that can be posed than by the addition of one only. Readers must be left to track these down for themselves.

There was a sting in the tail of the original enquiry: - would the solution work in dozenal notation? If not, why not? Yes, indeed - as mentioned by Jelliss - it is independent of the method of expressing numbers, Egyptian or Roman tally marks being no handicap. A heap of calculi that was prime would remain so in whatever uniform sizes of groupings into which it was divided up. There will always be a remainder, but of differing amounts.

Prior to place-value numeration, an aggregation of unit fractions was the only way to define values less than unity. The problem/paradox must have been stumbled upon whilst dealing with these at an early stage.

Multiples of 2, 3, 5 and 7 less than 1000; Continued from p 2ᘔ

The prime 15; (17) may occur as a rough approximation to 50/3 or 100/6. I know of no measures that use the factor 1Ɛ; (23), and the prime 25; (29) occurs only as the integral number month or phase cycle. Further examples of high prime factors are to be found in old capacity measures such as: Last of wool, 33; (39·) cwt. Last of feathers or flax, 15;x84; (17·x100·) cwt. Fother of lead, 17; (19·) cwt. Chest of tea, Ɛ; (11·) lb. Chest of opium, 15; (l7) lb. 'Gallon' of ale, 6x3Ɛ; (6x47·) cubic inches. There must be others, and we would like to hear about them.

No doubt, such bulk measures were adaptations of local practices or overseas trading - arrangements to fit in with our national standards. What, or wherever, these and other bulk[4] quantities would have been subject to the limitations of human and animal power, their abilities to handle or haul them and now relegated to the conveyor belt and fork-lift truck. However, one does wonder about the recurrence of factors like 15; and 17;. (-Ed)

Multiples of 2, 3, 5 and 7 less than 1000;

G.P.Jelliss

In defining systems of units the multiplying factors used are mainly multiples of the first four prime numbers, 2, 3, 5, 7, the first three occurring much more frequently than the 7. The chart below shows all numbers less than 1000; (1728·) that have only these divisors, and which therefore often occur as conversion factors in changes of units. Dozenal notation allows considerably more data to fit in a given space than would be required by decimal notation. The dozenal indicator (;) is omitted in the table.

1	3	9	23	69	183	509	7	19	53	139	3Ɛ3	Ɛ99	41	103	309	923	247	719
2	6	16	46	136	346	Z16	12	36	Z6	276	726		82	206	616		492	
4	10	30	90	230	690		24	70	190	530			144	410			964	
8	20	60	160	460			48	120	360	Z60			288	820				
14	40	100	300	900			94	240	700				554					
28	80	200	600				168	480					728					
54	140	400					314	940										
78	280	800					628											
194	540																	
368	Z80																	
714																		
5	13	39	Ɛ3	299	853		2Ɛ	89	223	669			185	513			Ɛ2Ɛ	
Z	26	76	126	576			5Z	156	446				342	Z26				
18	50	130	390	Ɛ30			Ɛ8	2Ɛ0	890				698					
34	Z0	260	760				1Ɛ4	5Z0										
68	180	500					328	Ɛ20										
114	340	Z00					794											
228	680																	
454																		
828																		
21	63	169	483				127	379	Z3Ɛ				861					
42	106	316	946				252	736										
84	210	630					474											
148	420						988											
294	840																	
568																		
Ɛ14																		
Z5	273	799					60Ɛ											
18Z	526																	
358	Z50																	
6Ɛ4																		
441																		
882																		

A down step multiplies by 2.
A right step multiplies by 3.
A down leap multiplies by 5.
A right leap multiplies by 7.

Other lines multiply by *m*
where *m* is the first number
on the parallel line from **1**.
E.G. diagonal steps multiply by 6.

The higher primes occur as factors only rarely. For example, Ɛ; (11·) appears in some UK length measures: a Chain = 2×Ɛ yards, a Furlong = 2^2×5×Ɛ yd, the Mile = 2^5×5×Ɛ yd. I suspect this factor was deliberately introduced to enable circles to be constructed accurately in whole units, using the approximation $\pi = 2\times Ɛ/7$. Thus a circular chain has a diameter of 7 yd. The next prime factor, 11; (13·) is the integral number of sidereal months in a year, and is the 'Baker's Dozen', one loaf being added to avoid giving short measure, for which there were draconian penalties. (Similarly, the Irish shilling once had thirteen pennies, so that people could be sure they were not

Continued over. ←—

being short-changed! — Ed.)

Fractions or Nonsense

Gwenda Turner

Canadian mathematicians are congratulating themselves on finding another 'off-the-page' decimal for Pi. The square root of two also receives this treatment as if it progressed our knowledge somehow. It might be funny if it were not so frightening. To those of us brought up before the days of calculators, these appear to be other examples of how common-sense is being scrambled by the current method of teaching mathematics.

The square-root of two for most practical purposes is 17/12 (which neatly becomes 1;5 in dozenal). If a draughtsman needs to be more accurate than this, the point he wants lies between 16·970/12 and 16·969/12. After this he would have to consider the thickness of his pen, as well as assess his skill, before deciding whether or not it would be possible to draw a line between two points given by 1/2545843/36000000, and 1/25455844/36000000, a difference of one part in thirty-six million.

The first fraction squared comes to 1·99999998, and the second 2·0000001, which even the machinist would not be able to distinguish between. There is also an ancient theory which might persuade both that to try and reach a point by division is futile; you cannot find the zero of a diameter by dividing it up. This does not mean that such a point does not exist. It is, after all, the point through which the tangent passes.

Mrs Turner is right to protest against the veneer of useless accuracy mentioned on page 33 by D. Lewis. However, the efforts of digit hunters for Pi have a theoretical value which might provide an insight to mathematical structures besides finding a pattern or repetition amongst the rows of figures. The Chudnovsky brothers (New York) reached eight billion figures in 1996, followed by fifty one billion by Kanada and Takahasi (Tokyo) in 1997.

This work, and all other leading up to it from the earliest times, is described in 'The Joy of Pi' by David Blatner, Penguin Press, 1997, which extends information given in 'The History of Pi' by Petr Beckmann, St Martin's Press, 1971. The conclusions are that the digital expression of Pi is probably quite random, and that there can be no exact resolution between circularity and linearity. Pi also turns up in other considerations involving chance events. David C. well said that "exploring Pi is like exploring the Universe".

Perhaps 'random' is not quite the word in a strict mathematical sense, but Gregory C. called Pi "a damned good fake of a random number". Algorithms are now used for its evaluation to the extent described, needing considerable computer power, so there might be some rationale behind it all not yet uncovered. One of the simplest is by Euler: $\pi^2/6 = (1/1^2 + 1/2^2 + 1/3^2 + \ldots)$, and the Chudnovskys were able to work out each digit in turn with:-

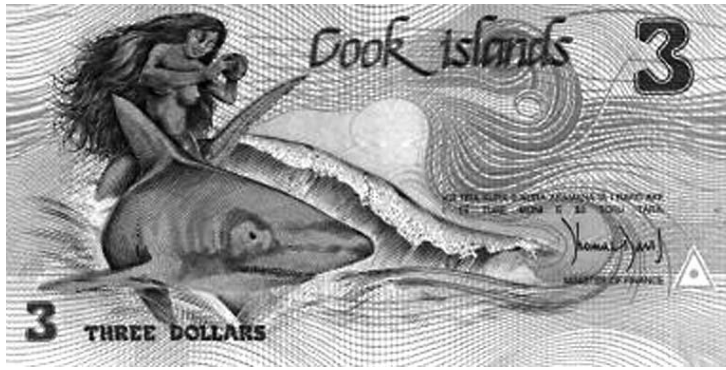
$$(5) \qquad \frac{1}{\pi} = 12 \times \sum_{n=0}^{\infty} (-1) \times \frac{(6n)!}{(n!)^3 (3n)!} \times \frac{13501409 + 5451140134n}{640320^{3n + 3/2}}$$

CORRESPONDENCE

FROM THE SOUTH SEAS *Bruce Moon, NEW ZEALAND*

My reason for writing is to inform Paul Rapoport (Journal No. ↊ p. 19), and you, that there is nothing phoney about a three dollar bill. It is a banknote of the Cook Islands, where I picked one up a couple of years ago. A winsome maiden riding on the back of a shark features on the face; an outrigger canoe, and a wooden god (clearly male) is on the back.

Since the next note is ten dollars, whereas the 1, 2 and 3 denominations are coins (in which they preceeded New Zealand) its raison d'être must be to intrigue North American visitors so much that they take them home, as I have done, thereby forming a highly profitable export! I send a print of my sample which has some wear, indicating that it has been in circulation, and not just a piece of tourist tat.



The aspects in which the foot/pound system remains in current use here should be of interest to you. Noticeably, the authorities are doing their best to stamp it out, especially by keeping children in ignorance. Thus, school rulers no longer show feet and inches, not even on the back, although they are a foot long.

I note that vertical distances are often in feet, particularly peoples heights, aircraft altitudes, depths of snow (of which we have had a lot of late). People seem more comfortable with babies' weights in pounds and ounces. Petrol consumption is mostly given in miles per gallon. I can still buy a half-pint of beer, a 5, 7 or 12 ounce glass. Eggs and oysters (when you can get them) are still sold in dozens, and beer (again), typically in six-packs.

Officially, of course, the foot/pound system is heretical, so news reports (eg. from the USA) are sanitized by mindless conversions: "Gales at 177 kph pound the coast". . . - and so on.

Australians, too, have not lost contact with real measures, The heights of 'wanted' persons are required to be stated in metres and cm (ideal for a quick, accurate identification), but conversions to feet and inches are found necessary in police stations.

A replica of 'The Endeavour' in which Captain Cook surveyed the South Pacific, was built there for the bi-centennial of his landing in Botany Bay. This splendid piece of work has lately sailed to the British Isles, staying at several ports especially her home one of Whitby, to be inspected by thousands of enthusiastic visitors. The original plans are held by The Greenwich Maritime Museum, and, when the person in charge of construction was studying these,the curator remarked that this ship was a very popular one for modellers. "What scale are you going to use?" "Twelve inches to the foot", came the startling reply.

FROM ITALY

Another example of a three-unit bank note, with a 1·5 Euro coin, has recently been tried out in Italy at Fiesole near Florence. As this is clearly an un-metric amount, could there have been a gleam of light on the road to Federa?

The intention on this occasion must be a conditioning of people to a predecided arrangement, (at their own expense). Similar trials have been conducted in France and Germany, but all seem to have been a big yawn. Numismatists, into whose collections much of the various issues have disappeared, were the only ones

taking any interest, to provide a small easing of inflation.

The Euro is from a similar stable to that of the metric system, by b'Eurocracy out of Enforced Uniformity. Essentially, it attempts [6] to compress the facts of economic life into committee designed form for idealistic or material advantages. Just as decimal-metrication does for the physical world or the mathematics used to describe it.

FROM NEW MEMBERS

As detailed in the newsletter accompanying this issue of the Journal, an article about us by Stephen Jarvis appeared in The Sunday Telegraph for November 26th 1994. This resulted in a flood of enquiries from which it took a long time for your Editor / Information Secretary to recover. Many sent their subscriptions 'up front', without waiting to learn what we were about. Ex-pats were represented, from Canada, Australia, New Zealand and Kuwait. Not a few had some interesting or pertinent comments to make, especially on the imminent prospect of a blanket imposition of metric over all our daily affairs. These are repeated below, with acknowledgements, showing the range of interest 'out there' as represented by readers of just one newspaper.

October 1st 1995 (see p. 7) was the long-threatened 'M day', for which we had been softened up by a series of minor changes (p. ℰ). It was not without protests, but they were easily ignored. We are listed in several directories, so were contacted by the media, both printed and broadcasting, providing other opportunities to present the facts of metrological life to a bemused and resentful public. Journalists from Scandinavian countries and *The Tokyo Times* seemed very interested in our discomfiture, and, of course, more direct enquiries were passed on to us.

D LEWIS The decimal system has a veneer of useless accuracy .... As a science teacher, I see it having the same attraction as for the adolescent who can use a calculator to inform him of the answer to a footling sum to the *n*th place of decimals. Whereas the gifted pupil attempts to uncover, to link some facts, to investigate ratios and proportionality. The brash, bright, would-be-absolute figures of the calculator as compared with the simple yet deep relationships shown on the slide-rule. (It is now known as 'dumbing down')

P M FINDLAY. As an engineer I have had to suffer the change in our dimensional systems, introduced by innumerate, ignorant, polititions, and know which I prefer. The patterning mechanisms for all types of textile manufacturing equipment are designed on base twelve, usually 48, to give the fabric designers maximum flexibility in repeats, reflexes and sizes of patterns..

C.J COXAN. I work in the fashion business, and have long appreciated not only the mathematical attributes of the dozen but also the physical. The ability to sort sizes and colours over a dozen, and the way it fits into a box

C G W KNOWLES. I remember being convinced by a maths problem in my long-gone school days: The optimum number of objects with a definite shape to be put into a carton so as to use the least amourt of cardboard.

D C WINN. I have been a believer in the advantages of a duodecimal system for many years, having been introduced to the idea by my biology lecturer back in the 40s.. (The inch and line were used in biology long after other subjects had been metricated - nature for nature!)

R PARSONS. It makes me very angry.

Mrs A PARSONS. Very fiddley, having to use two weights for a simple operation.

D WARREN I am very pleased that there is a body of people who can articulate the argument for a better system, And, perhaps, turn back the tide.

F L A DAINTITH Why, in a scientific age, should we be reduced to whát is, in effect, counting on our fingers I do not know. Personally I gave this up when I was six.

D W A SUDWELL Although born and educated on the continent, I am a confirmed supporter of the Imperial system of weights and measures.

B E SYRATT The 'science' group is pushing for the metric system to be used universally because it makes their life simpler. The rest of us are dragging our feet because it doesn't ours.

R STEPHENSON There are so many of us who sense that there is far more to 'our' system than to artificial metric.

A DENNY As the full force of the metric system has gradually trundled into view, ... I wondered if I was the only person to devise real arguments against it, instead of just being reactionary.

B S GLYDE I have been in favour of duodecimalisation ever since my school days... at 14, I introduced the names umpt and dumpt for ten and eleven, and ten for twelve. I would then irritate my schoolmaster by using base twelve for sums.

J MOXLOW I always wear a black tie on February 15th each. year. (This was D for decimalisation day in 1971, when the most flexible and practical monetary system in the world was abandoned). I am extremely sympathetic towards, the Society's ideals. I have long since thought it daft that our unit of currency cannot be divided by three.

Mrs S W GARDINER BUT WE ARE RIGHT, AREN'T WE? (after explaining that her nearest and dearest would not agree)

My ears hear metres and kilogrammes, but my eyes see Feet and Inches, whilst my hands feel Pounds and Ounces.

(We regret not being able to give proper credit to the author of this little gem.

Will he or she please stand up for recognition, and agree that it has been correctly cited.)

(Editorial comments)

ACKNOWLEDGMENT

Especial thanks are due to George Jelliss and Robert Carnaghan, long time members, who processed major parts of this work. They endured inevitable changes of ideas and styles, alterations and corrections, with commendable patience.

Epilogue from the Future

'About nine months after John had learnt to speak, someone gave him a child's abacus. For the rest of that day there was no talking, no hilarity; and meals were dismissed with impatience. John had suddenly discovered the intricate delights of number. Hour after hour he performed all manner of operations on the new toy. Then suddenly he flung it away and lay back staring at the ceiling.

His mother thought he was tired. She spoke to him. He took no notice. She gently shook his arm. No response. "John!" she cried in some alarm, andshook more violently. "Shut up, Pax," he said, "I'm busy with numbers."

Then, after a pause, 'Pax, what do you call the numbers after twelve?" She counted up to twenty, then up to thirty. "You're as stupid as that toy, Pax." When she asked why, he found he had not words to explain himself; but after he had indicated various operations on the abacus, and she had told him the names of them, he said slowly and triumphantly, "You're stupid, Pax, dear, because you (and the toy there) 'count' in tens and not in twelves. And that's stupid because twelves have 'fourths' and 'threeths', I mean 'thirds', and tens have not." When she explained that all men counted in tens because when counting began, they used their five fingers, he looked fixedly at her, then laughed his crackling, crowing laugh. Presently he said, "Then all men are stupid."

Olaf Stapledon, ODD JOHN, 1935.

Collected by Donald Hammond. The best tradition of Sci Fi has been to use the genre as a means of commenting on the contemporary [7] scene, its faults and failures. Odd John was transplanted from the future in an attempt by our descendants to help us avoid mistakes that had lead to disasters.

Ungainly of appearance, and uncompromising in attitudes, John had difficulty in being accepted by 'normal' society. But this was not a handicap for discourses with mathematicians and philosophers to explain where they were wrong. He also became a highly successful operator on the Stock Exchange. If you can't join them, beat them!

Esprits d 'Escaller *The Editor*

Staircase Wit - the things one thinks of on the way out!

(1) Page 15. Recent neurological studies have indicated that we all live with a small time delay from actuality. Although fast, there is a finite speed of neural transmissions within the brain which could oblige it to take up to half a second to decide on a response to non-urgent or uncertain stimulii requiring extensive cross-checking to be done.. There is thus plenty of time available in which to decide what the correct note should be. See New Scientist for May 14th 1994 and June 15th 1996.

(2) Page 22. Public assets and services are still being traded off, and now (1998) the Post Office is under threat, with no assurances that it will be safe. Plus ça change, etc.,

(3) Page 22. For the eventual domination of Asia, and in continuance of the 'Drang Nach Osten' policy, the Third Reich was planning a three metre (ten foot) gauge railway. Imagine the loads and speeds that could achieve!

(4) Page 29. A 19p coin would help with the all-pervasive pricing practices to which we usually succumb.

(5) Page 2Ɛ. By a similar means Fabrice Ballard (1996) calculated the 400 billionth hexadecimal digit, but there is no mention of other departures from base ten. A change of base can be quite instructive, and twelve helps with prime numbers. Many formulæ used comprise infinite series, but there are dominant factors of 2, 3, 4, 6 and twelve which, as natural divisions of a circle, could allow some tidying up. Any use of a dozenal base, however, seems to be studiously. avoided, instinctively considered as untouchable or even dangerous!

(6) Page 31. The first minting of Euro coins had to be reworked because of a mistake in translation. If they cannot get such a simple thing right, what hope for the economics?

(7) Page 34. Alien visitors are assumed to be more advanced than us, if only for having got here. There was supposed to have been a crash of some Unidentified Flying Object near Roswell in New Mexico on July 5th 1947 from which several bodies were recovered, alleged to be "not of this world". Accusations of 'fake' and cover up by the military' were freely made by interested parties.

A dissection of one 'body' was widely shown on a television programme, 'The Roswell Incident' (1995). The crude manner in which this was conducted dispelled any illusions that it could be of a genuine extra-terrestrial.

The interest was that it had been endowed with six fingers on each hand, as others from 'out there' are often depicted. It seems to be accepted they have a superior mathematical ability also.

STATEMENT OF PRINCIPLES *Continued from inside front cover*

Terminology for a dozen system has been optional so far, and subject to discussion. Acceptable names applied to single symbols for numerical values now known as 'ten' and 'eleven' are 'dek' or 'dec', and 'el' or 'elv'. Higher numbers should be read out in sequence as for work in other bases, with no attempt at neologisms.

Neither Society fully endorses any particular solutions to the questions of symbols or nomenclature. An injunction by our Professor A.C.Aitken that "duodecimalists should not dictate too much what is desirable... ," will be heeded with respect until events determine agreed solutions. Meanwhile, DSGB will continue with the Pitman dozen scale, which is venerable enough to raise this subject above personal preferences.

Articles or comments are invited on any topic dealing with work in differing bases, but particularly relating to the Dozen principle. We would also wish to learn about numeration systems, past, present and future, together with their associated historical, technical or social metrologies. Our particular concern is to seek a convergence of these last two, and so try to resolve the existing disparity between incompatible patterns of thought.

We reserve the right to edit or shorten anything submitted to suit available space or layout, whilst preserving the ideas expressed. Unless otherwise requested, it will be assumed that these may be quoted and referred to in other work or correspondence, with full acknowledgement of course. Similarly we allow our published work to be used in any manner thought fit if its source is given. Material should be sent to the Editor at our address on the back cover.

A JUST MEASURE *for BWMA*

We have often been asked where scales graduated into inches and twelths can be obtained. School rulers once had such divisions, with 16ths and 10ths of an inch on the other edges, plus the 30cm metric foot. Engineers steel scales also carried them - Rabone 42F - but not any more.

The British Weights and Measures Association has now filled this deplorable vacancy by producing a plastic ruler having the above divisions of the foot to a recognised standard. A feature is of miles to a scale of 1 : 50,000 on the fourth edge.

For those seeking the elusive, inexpensive, but unique and useful gift, what better than one that is also a reminder of an inheritance handed down since the dawn of history.

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REFERENCES and READING LIST

Basic reference works, past and present, in order of appearance.

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12. T Pendlebury: TGM. A coherent dozenal metric system. 1985
13. Prof. R. D. Connor: THE WEIGHTS AND MEASURES OF ENGLAND HMSO 1987.
14. DSGB: DOZENAL REVIEW and DOZENAL JOURNAL

15. DSGB has produced papers describing the principles of numeration and measurement applicable to social and everyday needs. Technical usages often show more concern with size-order rather than size. We also hold reprints of articles from our Journals and DSA's Duodecimal Bulletins on important topics.

Nature is with Us REFERENCES

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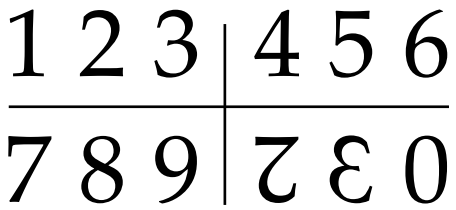
Such early writings often contain insights into basic principles that are now taken for granted or dismissed as trivial, also information on historical aspects.



THE PITMAN DOZEN SCALE

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