Conversion of Mean Solar Time to Mean Sidereal Time

OBSERVATORY practice in the past has always been to use separate clocks for indicating solar and sidereal time. In the case of quartz crystal clocks, this practice could be continued by using two separate crystals, one ground for a frequency of 100 kc./s. and the other for a frequency of 100·273 kc./s. It is, however, much more satisfactory to derive both solar and sidereal second pulses from one standard frequency oscillator. Hitherto, this has been accomplished by means of mechanical gearing, and many efforts have been made towards devising a gear train that would give a good approximation, and which would be mechanically practicable at the same time[1]. A different method is to use gears not for direct conversion, but to drive a continuous phase shifter, which has the effect of increasing one of the standard frequencies by 0·273 per cent[2].

This conversion might with advantage be done by means of electronic divider circuits instead of gears, and the following scheme offers a simple solution to this problem.

A standard frequency of 100 kc./sec. can be divided by numbers M and N which are chosen in such a way that $\left(\frac{100}{M} + \frac{100}{N}\right)$ or $\left(\frac{100}{M} - \frac{100}{N}\right)$ is a close approximation to the desired frequency. For maximum stability of the individual divider stages, it should be possible to break up both M and N into factors not higher than, say, 11.

Two such numbers are 1,155 and 2,744, which give a difference frequency of 50·136,937,892 cycles per second, about 8·5 parts in 10^7 larger than the correct 'sidereal' 50 cycles per second. More elaborate manipulation of such derived frequencies might give a closer approximation; but in practice it is simpler to correct for the error by continuously shifting the phase of one of the frequencies in the divider chain. When such a continuous phase shifter is driven by a synchronous clock motor through suitable gearing, a high order of accuracy may be obtained. For example, running a conventional clock motor, with a 1 r.p.m. shaft, off the 'sidereal' 50 c./s. supply (obtained from the same unit), and using a gear ratio of $\frac{7 \times 73}{27 \times 71}$ to connect it to a phase shifter at the 9,090·9 c./s. stage, a correction is applied resulting in an output frequency which corresponds to a ratio of 1·002,737,909,294,3. This is the correct ratio for 1,949 within 1 part in 10^{12}. It should be noted that gears only are used for correcting a small residual error. Backlash and tooth errors have a negligible effect on the accuracy of individual second pulses, so that high precision here is unnecessary. Equipment designed along these lines is at present being constructed at the Union Observatory.

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Variance of Triplets

TODD[1] has proposed a series of tests for examining whether the spread of disease in a rectangular plantation of m rows and n columns is random or not. For an observed set s of diseased plants, he compared the expected and observed numbers of doublets formed from these plants, using for the variance of doublets the binomial approximation based on the probability of a single doublet. Todd extended his results to triplets and quadruplets, again using the binomial approximation. Finney[2], however, showed that the binomial approximation over-estimates the variance for doublets, and under-estimates, rather considerably, the variance for triplets and for quadruplets. Krishna Iyer[3] gave the correct expression for the variance of doublets by a characteristically new approach[4]. This note gives the expression for the variance of triplets.

$$\begin{aligned}\mu_2 = {} & (20b - 28a + 36)\frac{s^{(3)}}{b^{(3)}} + (464b - 842a + 1464)\frac{s^{(4)}}{b^{(4)}} \\ & + (2612b - 5972a + 13128)\frac{s^{(5)}}{b^{(5)}} \\ & + (400b^2 + 784a^2 - 1120ab - 1656b + 4826a - 13332)\frac{s^{(6)}}{b^{(6)}} \\ & - \left[(20b - 28a + 36)\frac{s^{(3)}}{b^{(3)}}\right]^2.\end{aligned}$$

If p and $q = 1 - p$ are the probabilities of a plant being diseased and not diseased, the formula works out to be:

$$\begin{aligned}\mu_2 = {} & (20b - 28a + 36)p^3 + (464b - 842a + 1464)p^4 \\ & + (2612b - 5972a + 13128)p^5 \\ & - (3096b - 6842a + 14628)p^6,\end{aligned}$$

where $b = mn$ and $a = m + n$.

The details of this work are being published in the *Journal of the Indian Society of Agricultural Statistics*.

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[2] Finney, D. J., *J. Roy. Stat. Soc.*, Supp. 9, 99 (1947).
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Thumb of the Swartkrans Ape-Man

ONE of the most noteworthy differences between man and the higher anthropoids is that while man has a good opposable thumb, in the anthropoid the thumb is somewhat degenerate. It was mainly on this character that Osborn decided that man could not have evolved from an anthropoid.

Though we know the metacarpal of the first finger and a number of phalanges of the Kromdraai ape-man, and the os magnum or capitatum of the Sterkfontein ape-man, we have hitherto had no evidence of the thumb. The known metacarpal is slender and a little longer than in man, while the phalanges are a little shorter. The os magnum of the carpus is similar to that of man and much smaller than that of the higher anthropoids. It was thus manifest that the ape-man hand is essentially human, but remarkably delicate and far too feeble to have been used for walking on.