his expected score after another throw is $(x + 3k)$ with a probability of $(\frac{5}{6})^k$, and 0 with the remaining probability. Therefore his expected score is

$$v_x = (x + 3k)(\tfrac{5}{6})^k.$$

If v_x is less than the score x he already has, then it is better to stop. Therefore he should stop once his score has reached or passed x_k, given in the table:

k	1	2	3	4	5	6	7	8
x_k	16	14	13	12	11	10	9	8

For $k \geqslant 8$ this strategy is equivalent to stopping after one throw, because with k dice it is impossible to achieve a score of less than k.

Humphrey's strategy produces expected scores E_H given in the table below for different values of k. The expected scores E_S using the score stopping rule are more difficult to compute. The figures given in the table were calculated using a computer.

k	1	2	3	4	5	6	7	8
E_H	6·03	6·03	6·03	5·79	6·03	6·03	5·86	5·58
E_S	6·15	6·12	6·06	5·98	6·05	6·03	5·86	5·58

It can be seen that the score stopping rule produces the higher expected scores. It is interesting to note that whereas using Humphrey's strategy the expected score is the same whether 1, 2, 3, 5 or 6 dice are used, the score stopping rule performs best with only one die.

However, neither of these strategies is the best one for playing Pig. The objective of the game is to be the first player to reach a score of 100. This is not the same as trying to produce the highest score on each turn. For example, if your opponent has a score of 99 and you have a score of 80 and have scored 19 so far for this turn, then it is better for you to throw again, otherwise you are very likely to lose! The best strategy will take into account your current score, your opponents' scores and whether the sole objective is to win or there is also a second prize. This becomes impossibly complex and in most circumstances the score stopping rule will probably be close to optimal. In extreme circumstances common sense may perform better.

Yours sincerely,

C. A. GLASBEY

ARC Unit of Statistics, University of Edinburgh, Edinburgh EH9 3JZ

A fuller analysis of the game will appear in the December issue. V.W.B.

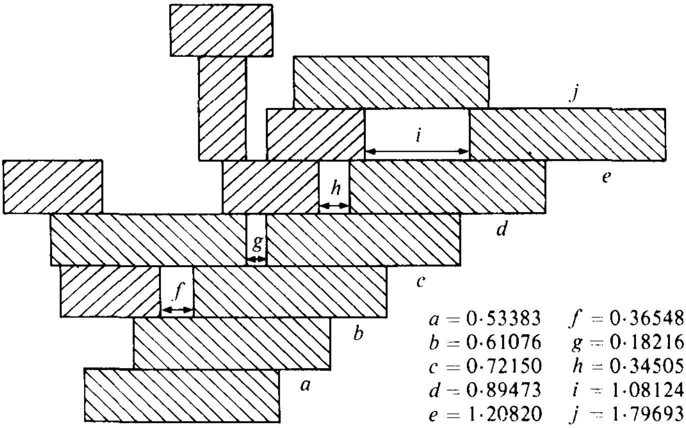
A giant leap

DEAR EDITOR,

I first saw a problem similar to that discussed by Mr Ainley (*Gazette* **63**, 272 (No. 426, December 1979)) set as a Braintwister in the *Observer* in 1962, but no doubt it has arisen on other occasions as well. Coincidentally, the problem is also mentioned in the October 1979 issue of the *Bulletin* of the IMA.

The problem set in the *Observer* asked how large a span could be obtained by building a bridge with a set of twenty-eight dominoes, each 2″ by 1″ by $\frac{1}{2}$″, the bridge to consist of two self-supporting half-spans. This is essentially a matter of extending Mr Ainley's treatment from four bricks to thirteen (since one domino on each side must be used as the base). The answer given in the newspaper the following week was the one based on the model of two self-supporting single-stepped piles, namely

$$2(1 + \tfrac{1}{2} + \tfrac{1}{3} + \ldots + \tfrac{1}{13}) = 6{\cdot}36027''.$$



Inevitably this initiated a flood of correspondence, from which it emerged that a span of 7·93804″ could be obtained. The diagram shows the appropriate arrangement for each half-span, but the configuration is not unique, and a substantial amount of computation is involved.

Mr D. St P. Barnard, the setter of the problem, presented the results as a chapter of his book *Adventures in mathematics* (see review, *Gazette* **49**, 453 (No. 370, December 1965)). In the course of this chapter he shows that if the restriction on self-supporting half-spans is removed a span of 8·70456″ can be achieved. In fact neither of the above results is the best possible. If the diagonal of a domino, rather than the length, is used as the basis of construction, they can be multiplied by $\frac{1}{2}\sqrt{5}$ to give 8·87499″ and 9·73199″ respectively. As far as I know, no one has yet shown a way to improve on these last results.

Yours sincerely,

R. E. SCRATON

School of Studies in Mathematical Sciences, University of Bradford, West Yorkshire BD7 1DP

Editorial note. It would be interesting to know when and where this problem originated. Ramsey's *Statics*, published in 1934, had a worked example (pp. 47–48) in which a stairway of blocks is supported at the outermost point of the top block; this is ascribed to the Mathematical Tripos, but the year is not given. Did this version precede the unsupported stairway? Can any reader help? D.A.Q.

Reviews

Mathematical plums, edited by Ross Honsberger. Pp ix, 182. $14. 1979. SBN 0 88385 304 3 (Mathematical Association of America)

This is number four in the series of *Dolciani Mathematical Expositions*. It is a splendid book, packed with nice mathematics. The ten chapters each deal with a different topic from combinatorics, the theory of infinite series, geometry, probability or number theory. Several chapters have exercises at the end. Much of the material was new to me, and although the bright A level student will be able to read the book, it contains a lot which will interest the more experienced mathematician. Here is a sample of the contents.