George S. Hubbard, '28; April 1, 1993; San Diego, Calif.
James C. Coe, '29; May 1, 1993; Phoenix, Ariz.
James F. Hale, '29; April 10, 1993; Middlefield, Mass.
Malcolm M. Hubbard, '29; April 24, 1993; Gloucester, Mass.
Wayne F. Koppes, '29; January 29, 1992; Jamesburg, N.J.
George L. McKenna, '29, SM '30; April 27, 1993; Vero Beach, Fla.
Helen Walther, '29; October 4, 1991; Blairstown, N.J.
Frederick W. Holt, Jr., '30; December 11, 1992; Boca Raton, Fla.
Victor M. Gelin, '32; November 26, 1992; Winter Haven, Fla.
William L. Wells, '32, SM '36; November 1, 1992; Wilmington, N.C.
Robert A. Dobson, '33; May 21, 1993; Lincoln, Neb.
Gustav U. Liljegren, '33; January 24, 1992; Bellevue, Wash.
Calvin H. Mohr, '33; May 8, 1993; Columbus, Ohio
John Stuart Patterson, '33; May 21, 1993; Schenectady, N.Y.
William L. Sorensen, '33; May 28, 1993; Peoria, Ariz.
William C. Black, '34; March 10, 1993; Cedar Rapids, La.
Earl A. French, '34; September 27, 1988; Fort Worth, Tex.
Albert E. Heins, '34, SM '35, PhD '36; June 24, 1992; Ann Arbor, Mich.
Thomas A. La Cava, '34; April 30, 1993; Concord, N.H.
Herbert F.R. Plass, '34, SM '35; June 1, 1986; Minnetonka, Min.
Burton Williams, '34; October 16, 1992; Chesterton, Ind.
Stuart A. Challender, '35; December 14, 1992; Lakehurst, N.J.
Douglas Chalmers, '35, SB '36; December 18, 1990; Newport Beach, Calif.
Hugh L. McMath, '35, SM '36; November 15, 1992; New York, N.Y.
Thomas J. Chang, '36; 1993; Venice, Calif.
Alexander C. Veasey, '36; October 18, 1989; Los Gatos, Calif.
Robert F. Brown, '37; April 26, 1993; Cottage Grove, Ore.
John R. Maull, '37; March 18, 1993; Leonia, N.J.
Chester H. Bean, '38; February 2, 1987; Mount Vernon, Me.
Arthur H. Christgau, '38, SM '39; April 4, 1993; Pleasantville, N.Y.
James A. Prichard, '38; June 16, 1987; Silverdale, Wash.
Harry W. Tileston, Jr., '39; May 9, 1993; East Weymouth, Mass.
Robert W. Chase, '40; January 22, 1993; Oklahoma City, Okla.
Edward B. Cooper, '40; April 13, 1993; Newark, Del.
James I. Thomas-Stahle, '40; April 22, 1993; Richardson, Tex.
Delano Wight, '40; January 4, 1990; Green Valley, Ariz.
Mabra G. Abernathy, '42; June 5, 1980; Columbia, S.C.
Joseph Franklin, '42; May 5, 1993; Brookline, Mass.
David P. Heffernon, '42; February 27, 1991; Rockford, Ill.
John E. Guillotte, '43; April 12, 1993; Wilmington, Del.
Edward M. Jones, '44; January 26, 1993; Cincinnati, Ohio
Robert L. Meier, '44; June 15, 1993; Brewster, Mass.
Charles C. Buik, III, '45; March 23, 1990; Hinesburg, Vt.
Robert L. Horowitz, '47; March 19, 1993; Newton, Mass.
John H. Keefe, '47, SM '48; February 23, 1992; Naples, Fla.
Rose A. Armstrong, '48; August 19, 1992; Racine, Wash.
Harry J. Beattie, Jr., '48; March 9, 1987; Fairport, N.Y.
Benjamin H. Danziger, '48; May 19, 1993; New York, N.Y.
Charles E. Fogg, '48; May 14, 1993; Sanbornville, N.H.
Ronald C. Gillis, '48; April 22, 1993; Downey, Calif.
Robert T. Andrew, '49; May 8, 1993; Manassas, Va.
Sigurd Hallager, Jr., '49; February 19, 1993; Lincoln, N.H.
Stephen J. Kovacs, '49; May 26, 1993; Dallastown, Pa.
Winfield W. Evans, SM '50; September 24, 1989; Oklahoma City, Okla.
Eugene R. French, '50; May 12, 1993; Leonia, N.J.
Alan C. McClure, '50; May 1, 1993; Houston, Tex.
Gordon G. Robeck, '50; February 21, 1993; Laguna Hills, Calif.
James S. Rowley, '50; June 6, 1993; West Yarmouth, Mass.
Allan W. Shaw, '50, SM '51; May 29, 1993; Arlington, Tex.
David M. Uline, '50; December 18, 1983; Rochester, N.Y.
Elbert F. Durfee, Jr., '51; May 12, 1993
Oscar R. Falconi, '51; April 18, 1979; Saratoga, Calif.
Charles H. Ehlers, '52; June 18, 1993; Concord, Mass.
Robert E. Kane, '53; April 2, 1993; Honolulu, Hawaii
Richard G. Locarni, '53; April 2, 1993; Carthage, Mo.
Laura E. Case, '54; October 17, 1987; Winchester, Mass.
Harrington T. Price, '55; February 19, 1993; Sun City, Ariz.
Robert S. Duncan, '58; November 1, 1990
Jack L. Kesten, '58; March 21, 1991; Chesterfield, Mo.
Victor L. Berman, '60; January 16, 1989; Beverly Hills, Calif.
Gerard R. Cugini, '60; April 25, 1993; Bellingham, Mass.
Kenneth I. Lichti, '61; January 27, 1993; Ventura, Calif.
Joseph J. Schiffer, '61; May 31, 1993; Dennis, Mass.
Charles L. Ruttenberg, '61; May 3, 1993; Silver Spring, Md.
Edward A. Zukowski, '63; May 2, 1993; Hopewell Jct., N.Y.
John W. Horton, '66; April 20, 1993; Bellville, Tex.
Kenneth B. Moore, '66; February 2, 1993; Mendocino, Calif.
Wayne P. Stevens, '66, SM '67; May 22, 1993; Fairfield, Conn.
Louis Castelli, '67; June 21, 1990; Dallas, Tex.
George E. Wyatt, '69; November 25, 1987; Buffalo, N.Y.
Wallace E. Morrow, '71; March 18, 1993; Kent, Ohio
Frank Tariello, Jr., '71; April 30, 1990; Schenectady, N.Y.
Phyllis A. Daly, '73; January 11, 1984; Davidson, N.C.
Kenneth W. Vaca, '74; January 4, 1993; Cicero, Ill.
Mark R. Koupal, '76; August 18, 1992; Prairie Village, Kan.

Since this is the first issue of a new academic year, I once more review the ground rules under which this department is conducted.

In each issue I present three regular problems (the first of which is chess, bridge, go, or computer-related) and one "speed" problem. Readers are invited to submit solutions to the regular problems, and three issues later, one submitted solution is printed for each problem; I also list other readers who responded. For example, solutions to the problems you see below will appear in the February/March issue and this issue contains solutions to the problems posed in May/June. Since I must submit the February/March column in November, you should send your solutions to me during the next few weeks. Late solutions, as well as comments on published solutions, are acknowledged in subsequent issues in the "Other Respondents" section. Major corrections or additions to published solutions are sometimes printed in the "Better Late Than Never" section as are solutions to previously unsolved problems.

For speed problems the procedure is quite different. Often whimsical, these problems should not be taken too seriously. If the proposer submits a solution with the problem, that solution appears at the end of the same column in which the problem is published. For example, the solution to this issue's speed problem is given below. Only rarely are comments on speed problems published.

There is also an annual problem, published in the January issue of each year; and sometimes I go back into history to republish problems that remained unsolved after their first appearance.

Finally, I must confess to being somewhat in shock so forgive any errors you find. My colleague and friend, David Gelernter from Yale, the originator of the Linda programming language, has

SEND PROBLEMS, SOLUTIONS, AND COMMENTS TO ALLAN J. GOTTLIEB, '67, THE COURANT INSTITUTE, NEW YORK UNIVERSITY, 251 MERCER ST., NEW YORK, N.Y. 10012, OR TO: GOTTLIEB@NYU.EDU

ALLAN J. GOTTLIEB, '67

Indulging in a Little Tetrahedronism

just been seriously injured by a letter bomb and is now in the hospital. I am sure I join all his friends in wishing David and his family strength and good fortune in the difficult recovery period to come. I dedicate this column to him.

Problems

OCT 1. Unfortunately, I inadvertently omitted part of the M/J 1 question that Tom Harriman calls "Superweiner." The correct Superweiner is as follows (now renumbered OCT 1).

The opening lead is the three of clubs by West. How does South make the contract of seven spades?

North
♠ 10 9 8 7 6
♥
♦ A K
♣ A 10 9 8 7 6

West
♠
♥ 9 8 7 6 5 4
♦ 6 5 4 3 2
♣ 3 2

East
♠ 5 4 3 2
♥ K Q J 10
♦
♣ K Q J 5 4

South
♠ A K Q J
♥ A 3 2
♦ Q J 10 9 8 7
♣

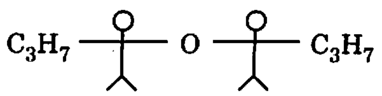
OCT 2. Thomas MacDiarmid asks you to cut a triangle out of paper—an equilateral is best to start with. Then fold each of the corners upward so that the vertices meet; the result is a tetrahedron. This does not work for all triangles. MacDiarmid wants you to determine which triangles can be folded into a tetrahedron with just three folds, one for each vertex.

OCT 3. Nob Yoshigahara wants you to replace each letter by a unique digit (excluding zero).

$$\frac{AB}{CDE} + \frac{FG}{HI} = 7$$

Speed Department

Speedy Jim Landau wonders what is the name of this "chemical."



Solutions

M/J 1. This problem was mis-stated in the May/June issue and the corrected version appears as problem OCT 1 above.

M/J 2. Richard Kluger asks the "surname problem." A hypothetical planet contains n males with n distinct surnames married to n females. In this and all future generations, all females marry, assume their husbands' surnames, and bear 2 children who mature, marry, etc. A child has a 50 percent chance of being female. How many distinct surnames exist after k generations? Couples with identical surnames, including siblings, can marry but transgenerational marriages are not possible.

This probably is a "standard" problem in population theory. It does get complicated to give a full solution, since that would be a probability distribution. Matthew Fountain gives us the following approximation to the mean number of distinct surnames. As noted by several readers, one must decide what to do if in a generation there are not the same number of males and females.

When n is large the following table is a reasonable guide to the number of surnames existing in the k-th generation per 1,000 males in the starting generation.

k	surnames	k	surnames	k	surnames
0	1000	10	252	50	66
1	752	15	194	60	58
2	595	20	148	80	43
3	512	25	126	100	38
4	451	30	108	200	24
5	396	40	81		

When n is small it is necessary to consider the fluctuation in population size. The equal probability for a boy or girl at each birth does not mean exactly half the births will be girls. For small n this fluctuation complicates matters to an unwieldy degree. But what populated planet would have a small population?? By restricting myself to large n I could assume with but small error that when there are N males named Smith in one generation there are 2*N births, each with a probability of INT(2*RND) of producing a male named Smith in the next generation.

INT(2*RND) is a function that randomly returns either 0 or 1. I compiled the above table by running a computer program based on this assumption that combined the results obtained for 1,000 males, each separately tested for when or if his surname dies out. I re-ran the program several times more and was surprised to see how closely the figures between runs agreed. However, I noted that at k=100 the male population size varied widely. In six runs the population size and surnames existing at k=100 were 678 and 31, 681 and 32, 814 and 37, 902 and 38, 937 and 35, and 1188 and 39. This scatter of population is to be expected as at k=100 the number of males is dependent upon the outcome of approximately 200,000 births.

M/J 3. John Prussing needs help in stalking a drug runner.

A Coast Guard skipper named Pedro is stalking a drug runner named Biff. Both boats are at rest separated by a distance a. A fog rolls in and Biff flees in a *constant* but unknown direction at a speed b. Pedro knows the values of a and b and the fact that his boat is twice as fast as Biff's.

a) Determine a simple pursuit strategy which will guarantee that Pedro will intercept Biff in a finite time.

b) Determine the minimum and maximum possible intercept times (the intercept time will vary depending on the direction Biff flees).

The following solution is from Scott Brown. (Pete Davis believes this problem first appeared as a short story in *Collier's* magazine during World War II with the "players" a U.S. destroyer and a Japanese submarine.)

Biff flees on a constant but unknown course, at a known speed b. Pedro must design a track with speed $c=2b$, which is guaranteed to intercept Biff. Pedro also wants to determine the earliest and latest intercept times.

We solve the problem in a polar coordinate system centered on Biff's initial position, with Pedro's initial position at $(r=a, \theta=0)$. The earliest possible intercept occurs if Pedro and Biff head toward each other. Since Pedro and Biff can close the distance, a, between them at a rate of $b+c$, the earliest intercept occurs at time $t=a/(b+c)$. Pedro chooses the path which makes this possible, i.e., $r(t)=a-c\cdot t$ and $\theta(t)=0$ for $0 \leq t \leq a/(b+c)$.

Thereafter, Pedro knows that Biff's position always satisfies $r(t)=b\cdot t$ so Pedro maintains this range and chooses θ to satisfy his speed constraint, $(dr/dt)^2+r^2(d\theta/dt)^2=c^2$. Putting $r(t)=b\cdot t$ into this equation gives $d\theta/dt=\sqrt{(c^2-b^2)/b^2}\,t^{-1}$. An easy integration, and the initial condition $\theta(a/(b+c))=0$, give $\theta(t)=\sqrt{(c^2-b^2)/b^2}\ln(t\cdot b+c)/a)$. Pedro is guaranteed to have found Biff when $\theta(t)=2\pi$ i.e., $t=(a/(b+c))\exp(2\pi\sqrt{b^2/(c^2-b^2)})$. Finally, substituting $c=2b$, Pedro's path is $r(t)=a-2bt$ and $\theta(t)=0$ for $0 \leq t \leq \frac{a}{3b}$ = earliest intercept time; $r(t)=b\cdot t$ and $\theta(t)=\sqrt{3}\ln\left(\frac{3bt}{a}\right)$ for $\frac{a}{3b} \leq t \leq \frac{a}{3b}\exp(2\pi/\sqrt{3})$ = latest intercept time. (Note that this solution shows that Pedro can intercept Biff whenever $c>b$.)

Better Late Than Never

1992 OCT SD1. Speedy Jim Landau reports that this problem was actually told to him by Eric Weill.

1993 F/M 3. Harold Boas notes that our four-bug problem has been mentioned in both the November 1957 and July 1965 installments of Martin Gardner's column in *Scientific American*. The latter issue features a multicolor illustration of the problem on the cover!

Other Responders

Responses have also been received from G. Blondin, B. Cain, D. Church, R. Davis, M. Gennert, J. Grossman, J. Harmse, R. Hess, J. Landau, S. Portney, K. Rosato, M. Schwier, M. Seidel, S. Shapiro, A. Sherwood, and S. Weiss.

Proposer's Solution to Speed Problem

Diproply people ether.