March 1938

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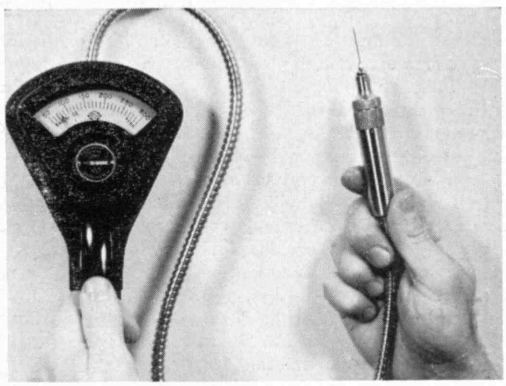
THE TABULAR VIEW

WRITING in The Review of last December, John E. Burchard, '23, said: "The work of Prescott and Underwood was outstanding in its comprehensiveness, in its accuracy, and in its fundamental nature. . . . There is no question but that the three classic papers of these two M.I.T. men in the years 1895 to 1898 marked the most important step [in the preservation of food] since Pasteur." The Prescott to whom Mr. Burchard referred is dean of science at the Institute, head of the Department of Biology and Public Health, and author of the article, "Putting Germs to Work," on page 215. Aside from his work as an educational administrator, Dean Samuel C. Prescott, '94, has devoted his life to the applications of biology to industry. During the War he was in charge of food research and the problems of storage in Army training camps. In 1918–1919 he was in charge of the division of dehydration of the Bureau of Chemistry in Washington. For three years he was director of the research laboratory of the United Fruit Company in Costa Rica, where he made notable studies in food preservation, and for 17 years he was director of the Boston Biochemical Laboratory. ℂ In addition to his teaching activities in the Department of English and History at the Institute, Frederick G. Fassett, Jr., (page 220) is one of The Review's most dependable and stimulating contributors and one of the editors of Research Reports, published at the Institute. Only once in recent years has The Review included poetry (March, 1936), and at that time, too, Professor Fassett was the poet. ℂ Arthur C. Watson (page 221) is secretary of, and technical adviser to, the committee on the Technology Museum. In this capacity he had charge of arranging the splendid Henry P. Kendall loan exhibition of whaling, now to be seen in Technology's Nautical Museum. Mr. Watson, sometime assistant curator of the New Bedford Whaling Museum, is an authority on the great whaling industry which once brought romance and wealth to New England ports.

A LETTER by Henry Bowen Brainerd of Wellesley, Mass., recently published in the *Harvard Alumni Bulletin*, seemed to us to be an unusually percipient statement of the objectives of The Review: "As I see it," wrote Mr. Brainerd, "the *Review* is primarily a good magazine in the modern style, edited for the type of men who graduate from M.I.T. and rather emphasizing news of the Institute. It is certainly a magazine which interests readers whether or not they are graduates of the Institute. In addition to news from Cambridgeport, it carries news of science and engineering from all parts of the world, generally with an alumni angle, but never with the alumni angle obscuring the news interest. Then it carries photographs, good photographs and lots of them, many by outstanding photographers, many that would win salon prizes. There must be an average of two photographs per page, and the technical nature of their subjects is not allowed to interfere with their quality as photographs. . . ."



MAIL RETURNS

LETTERS AND PICTURES FROM REVIEW READERS

Mercury Fountain

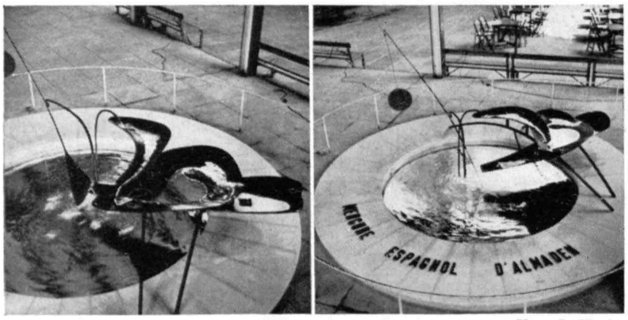
From William B. F. Drew:

. . . Under the heading of "Paris Exposition" [November issue] your reporter missed a scoop, or was it because you just do not advertise your competitors?

Alexander Calder, one of the best of the modern artists, whose mercury fountain is illustrated, was a splendid engineering student and graduated from Stevens, Class of '19. It is too bad there was not a description of the working of that fountain, because it is very interesting — especially the finely balanced movements that were developed. If you look at the picture, you will note that it is a series of fulcrums and levers.

New York, N. Y.

From Alexander Calder:



Hugo P. Herdeg

The [above] photographs give a pretty good idea of the fountain. A pump and a reservoir were placed under the stairs in the inclosed part of the building, and a large pipe to take the mercury from the basin to the pump and a small one to bring it back, under pressure, from the reservoir to the fountain, were laid under the paving. Due to the weight of the mercury, the extreme height permitted me from which to spill it was about a meter. Also, as the mercury splashes and wastes itself in very fine globules in all directions when permitted to fall for more than two or three inches on another surface of mercury, it was necessary to keep the whole thing very low.

So I used three plates, of irregular form, and permitted the mercury to flow across one after the other, spilling over a lip at the end of each plate. This gave the spectator the opportunity to look down upon the surface of the mercury as it flowed and also increased the effective surface of the mercury and varied its forms.

There were also limitations as to material — those I was given to work with being glass and polished steel. But the basin was made of concrete, lined with pitch; so I discovered that that, too, was permissible. This was very fortunate, as pitch has a flat black surface, which gives the strongest possible contrast to the mercury, whereas glass or polished steel is much closer to the mercury in color value. So I made the plates of steel, and once they were in position, had the working surfaces covered with pitch, and the supports and under surfaces painted black. First I had the plates made according to my design, and then took them to the fountain, supported them on a falsework, and then designed the supports.

As the design, thus far, was low, and the movement very gentle, I added a mobile element, which would increase the movement, add color, and also give the name of the mines from which the mercury came. This was composed of a rod, slung from a spot near its center and ending in a flat plate of irregular form, at the bottom, whose weight was sufficient to support a second, finer rod and maintain a steep slope. The upper rod had at its bottom end a circular disk, painted red, and at its upper extremity it flaunted, made of a single piece of brass wire, the name of the mines, Almaden. . . . Thus there were five colors in the composition: brass, red, flat black, the gray of the stones, and the mercury.

The movement was caused by the jet of mercury flowing from the third plate, which was a sort of chute, with dams, tapping against the heavy plate, causing a swaying of the red disk and of the name Almaden.

Curiously enough, there was no mercury available at the time of the conception and construction of the fountain. So I bought some ball bearings and permitted them to flow over the surfaces of the small, rough model which I had made. And thus we were able to speculate as to what would happen with the mercury, once we had it. The mercury arrived exactly in the middle of the afternoon of the press opening of the pavilion. There were 200 liters valued, I was given to understand, at half a million francs. One hundred and fifty liters were put into circulation, and the rest held in reserve to take care of losses due to splashing, seepage, and so on.

Roxbury, Conn.

Any Number of Answers

In December, Howard M. Edmunds, '05, submitted this problem: "There is one (and only one) set of five right triangles whose sides are all whole numbers and whose areas are all equal. What are they?" This brain teaser resulted in so much discussion that we requested Professor Philip Franklin of the Institute's Department of Mathematics to review it. Here is his response:

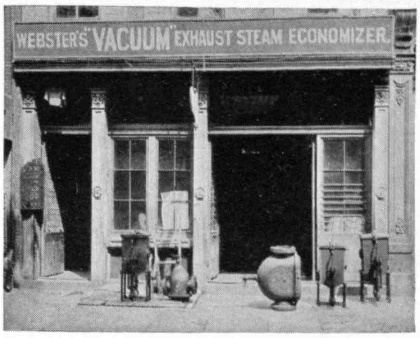
From Philip Franklin:

The statement of the problem, "Find a set of five right triangles (there is only one) having integral sides and the same area," is inexact. Not, as some readers suggested, because there is no answer, but because there are any number of answers. In fact, it was pointed out by the French mathematician, Fermat, in 1640 that if a, b, c are three integral sides of a right triangle, so that $a^2+b^2=c^2$, then $4abc^2$, $c^4-4a^2b^2=(a^2-b^2)^2$, $c^4+4a^2b^2$ are the sides of a second right triangle having the same area as the one with sides $2ac(a^2-b^2)$, $2bc(a^2-b^2)$, $2c^2(a^2-b^2)$, formed from the first by scaling up the sides. This process may be repeated, starting with the second triangle, and scaling up the sides of the pair just found to obtain three, and so on. Thus the problem has a solution even if the five be replaced by some greater number, and one triangle of the set may be taken similar to any particular right triangle with integral sides.

The process just described leads to enormous numbers. If, for example, we start with 4, 3, 5 in place of a, b, c and form a set of five, the common area will be a number of more than 250 digits. We may obtain sets with a smaller common area by a modification of the process. We start with a set of three triangles of equal area, using a rule given by Diophantus of Alexandria (*circa* 300 A.D.). Diophantus observed that if x, y, z are three integers such that $x^2+xy+y^2=z^2$, then $2xz$, z^2-x^2, x^2+z^2; $2yz$, z^2-y^2, y^2+z^2; $2(x+y)z$, $(x+y)^2-z^2$, $(x+y)^2+z^2$ give integral sides of three right triangles, each of which has its area equal to $xyz(x+y)$. We note that all such sets x, y, z without common factors may be found by taking two whole numbers p (not divisible by 3) and q (having no factor in common with p) and putting $x=p(p+2q)$, $y=q(2p+3q)$, $z=p^2+3pq+3q^2$.

If we take $p=q=1$, and then use the process of Fermat on two of the three triangles, we find a set of five triangles with a common area $210(2\times29\times41\times23\times37\times47)^2$, approximately 1.9×10^{18}. If we write $A=29\times41$ and $B=23\times37\times47$, the area is $840A^2B^2$ and the sides are as follows: 21, 20, 29, each multiplied by $2AB$; 35, 12, 37, each multiplied by $2AB$; 112, 15, 113, each multiplied by AB; $2\times840\times841=2\times840\ (29)^2$, $(841)^2-(840)^2=41^2$, $(841)^2+(840)^2$, each multiplied by B; $2\times840\times1369=2\times840\ (37)^2$, $(1369)^2-(840)^2=(23\times47)^2$, $(1369)^2+(840)^2$, each multiplied by A.

E. G. Allen,'00, called my attention to the fact that the English puzzler, Dudeney, recently gave two sets of four triangles of the same area, with much smaller sides, by guessing a fourth triangle to go with certain triplets of Diophantus. For p, $q=1$, 3, the sides are 660, 259, 709, each doubled; 140, 1221, 1229, each (*Concluded on page 204*)



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FIFTY years ago, there wasn't a golf course in all America!

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WARREN WEBSTER & COMPANY, CAMDEN, N. J.

Illustration below shows Factory and Main Office today

H. F. MARSHALL '19

MAIL RETURNS

(Concluded from page 202)

doubled; 2960, 231, 2969; and the fourth, found by trial, is 6160, 111, 6161. For $p, q = 1, 5$, the sides are 4080, 1001, 4201, each doubled; 528, 7735, 7753, each doubled; 17472, 935, 17497; and the fourth, found by trial, is 1428, 715, 1597, each multiplied by 4. However, when we try to find a fifth triangle by Fermat's method to go with either set, the areas are, in the best case, about 2.3×10^{22} and 4.9×10^{25}, respectively, or somewhat larger than the area for the set given above.

But there are sets with smaller areas than that; for example, the set with area $2 \times 3 \times 11 \times 19\ (3 \times 4 \times 5 \times 7 \times 13)^2 = 37383746400$, approximately 3.7×10^{10}. The sides are:

$176 = 16 \times 11$, $57 = 3 \times 19$, 185, each multiplied by $(2 \times 3 \times 5 \times 7 \times 13)$
$304 = 16 \times 19$, $297 = 3 \times 9 \times 11$, 425, each multiplied by $(2 \times 5 \times 7 \times 13)$
$132 = 12 \times 11$, $475 = 25 \times 19$, 493, each multiplied by $(3 \times 4 \times 7 \times 13)$
$836 = 4 \times 11 \times 19$, $1323 = 27 \times 49$, 1565, each multiplied by $(4 \times 5 \times 13)$
$32448 = 64 \times 3 \times 169$, $256025 = 11 \times 19 \times 25 \times 49$, 258073, each multiplied by 3

I obtained the foregoing by a tentative method involving the construction of a table of the first few hundred possible areas of integral right triangles having no large prime factors.

Cambridge, Mass.

Toward Better Automobiles

FROM ALFRED P. STEENSEN, '26:

While very much in sympathy with the goal of better automobiles, I find myself differing from the opinions in "Toward Better Automobiles" [December Review]. To begin with, I object to the use of the smear word, "gadget." This term appears to be indiscriminately applied to portions of the car not useful to the particular person. . . .

While yearly models introduce much waste, continuous improvement is desirable, and competition is inescapable. The 25-year car is unsound on at least three counts: The car of 25 years ago — 1913 — would not be popular today, even as a gift. The car of today, in 25 years, or 1963, will probably not represent the ultimate in transportation. The third point is that the extra cost of building for 25 years' service would bring the purchase price so much higher that the cars could not be generally sold. . . .

The criticisms of glaring headlights, difficult tire changing, and heavy corner posts appear to me to be justified. However, I question the danger in sloping, divided windshields. The middle barrier does not obstruct vision unduly, and the varying angle is little worse in the divided windshield. . . .

The criticism of the development of more comfortable automobiles is unfortunate. It is only recently that comfort has been considered in design, and while there have been unfortunate results, such as underestimation of speed, the present designs are far from the desirable limit. In all cars the rear seat, being virtually over the rear axle, is still less comfortable than the front seat near the middle of the wheel base.

I agree with Mr. Exley [February Review] that the modern car is unnecessarily heavy. As he says, eventually automobiles may advance with the technical sciences. Mr. Eaton ['17] appears to be very optimistic in hoping for control on ice comparable to control on dry pavement. However, improvement should be readily obtained, particularly by improved weight distribution. The overhanging rear end in the modern car appears to make rear-wheel skids more common, outweighing the advantages of four-wheel brakes. Mr. Miller ['02] appears to have described the Stout Scarab — without overhang of body over wheels, and engine in rear. Broadly, his suggestion appears reasonable — larger inside and smaller outside. At the present time the price limitation seems to rule it out. Mr. Whitmore ['38] seems to feel that now that the better automobile has been specified, some manufacturer should make it. This car must be free from gadgets, not too comfortable or powerfully engined, with bumpers on all four sides, internally operated jacks, and summer cooling devices. On the contrary, it appears that scientists and engineers are essentially no different from other car owners. They have their prejudices and pet peeves, and one engineer's meat is some scientist's poison.

Sharon, Mass.

SHE SAYS "Please" AND "Thank You"

THE alert, courteous voice of the telephone operator is known to all who use the telephone. To the little old lady in the shawl, the man in the big house on the hill, or a tiny tot of six, the words are the same, "*Number, please*" and "*Thank you.*"

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PREVIOUS RECORD: a belt-killing drive. Heavy load and high speed (7600 F. P. M.) caused excessive stretch, frequently ripping out fasteners. One belt lasted only a few days. Another broke in half and tore large hole in brick wall opposite, causing considerable damage. Workmen feared to go near mill in operation. Average belt life three months.
TREATMENT: thorough analysis of drive's characteristics made by the G.T.M. — Goodyear Technical Man. On his specification a Goodyear COMPASS "40" truly endless belt, 45' long x 20" wide, was applied on December 4, 1933.
RESULT: today, 51 months later — after more than 16 times longer service than previous belts averaged — the Goodyear COMPASS is still in service! During this entire period it has never required a single repair or caused a moment's shutdown and looks to be almost as good now as when first installed!
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GOODYEAR COMPASS "40" ENDLESS BELT
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40"
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THE GREATEST NAME IN RUBBER
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THE TECHNOLOGY REVIEW

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THE COVER

OIL

From a photograph by Robert Yarnall Richie, Courtesy Oil Well Supply Company

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