

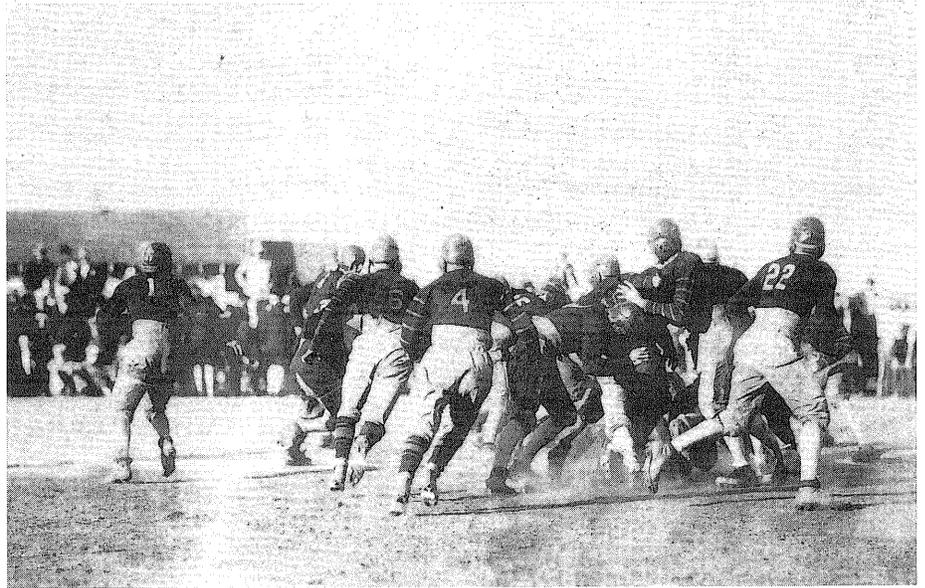
Army Beats Harvard

On a Saturday afternoon in the fall of 1932 on Soldier's Field in Cambridge, Massachusetts, Army's powerful football team trounced Harvard 46-0. This lopsided victory avenged a surprising 1-point win by Harvard the year before. During a luncheon following the game at the home of Harvard's President Abbott Lawrence Lowell, Mrs. Elizabeth Lowell Putnam suggested to General Connor, the Superintendent of the United States Military Academy (USMA), a contest between the two schools in mathematics. Her late husband, William Lowell Putnam, had previously suggested the development of intercollegiate academic competitions between teams of undergraduate students. He believed that the motive of winning laurels for their college in team competition would make students more interested in their studies.

After returning to West Point, General Connor wrote to President Lowell: "There is one matter that I have had in my mind ever since my visit and that is the mathematical contest your sister contemplated. I would very much like to test our method of teaching mathematics against that of your institution. I, frankly, think our method is superior to yours, and would like to try it out." Just two days later President Lowell responded: "Your challenge is a very interesting one which we will be glad to accept."

After agreeing to the contest, the leaders of the two schools turned over

DAVID C. ARNEY is the acting head of the Department of Mathematical Sciences at West Point and is researching this contest with George Rosenstein of Franklin and Marshall College.



On November 5, 1932, Army scored in every period to crush Harvard at Cambridge by a score of 46 to 0 before 40,000 fans. It was Harvard's worst defeat since 1884. This action shot is from the collection of H. W. Riley (USMA class of 1932).

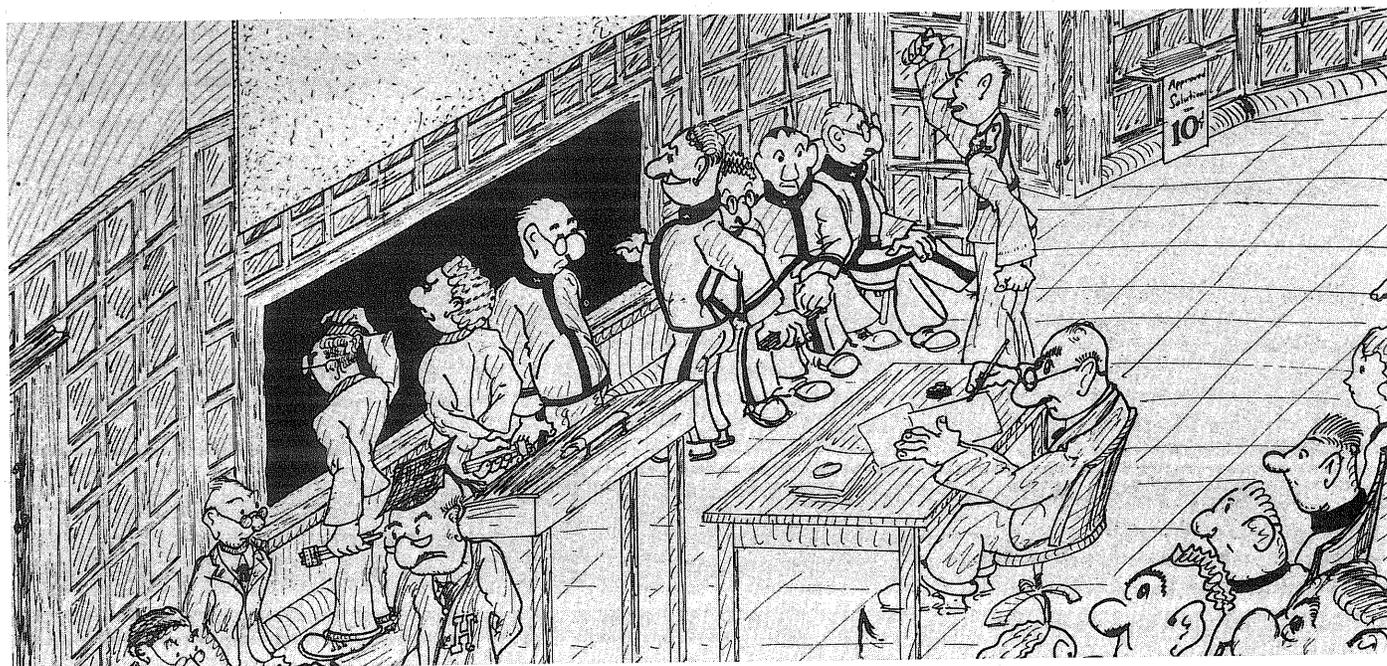
the responsibility for the details to the chairmen of their mathematics departments, Colonel Harris Jones and Professor William Graustein. While several important issues were resolved quickly (e.g., the competitors would be sophomores, the topics examined would be analytic geometry and calculus, and the test would be given in May 1933), some potential problems surfaced. Both teams wanted to be the home team and there was disagreement on the number of men on each team and the length of the test.

Apparently, USMA thought it had an advantage in depth of quality students, while Harvard believed its star performers could go on the road and win. Therefore, in his first letter to Graustein, Jones called for ten to twenty men on a side and stated that "it will probably not be practicable for cadets to leave West Point" for the contest.

Graustein replied that he did not have in mind teams as large as that. Jones responded that it was probable that the Army team could go to Harvard if the exam date was May 20. Graustein remained adamant that the number of men on each team should be restricted to ten, but offered to "play the role of the visiting team," since Army had been the visitors at the football game. On the issue of the number and length of the tests, Graustein offered the possibility of two tests of about three hours with the second examination "a real test of the men's capacity." It was finally decided that the team size would be ten and Harvard would travel to West Point to take two three-hour tests, one each on May 19 and 20, 1933. Mrs. Putnam agreed to pay for the travel expenses and prizes in the form of books, certificates, and medals for the winning team.

Graustein and Jones further agreed

in Football and Mathematics!



"The Team of Mathematics" was caricatured in The Pointer with the Army in dress-grey on the right and Harvard in suits on the left (honestly, they really did dress that way then). The event was famous enough to be remembered two years later in the cadet yearbook, The Howitzer: "On the nineteenth of May, back in '33, ten classmates, armed with slide rules, trigonometry tables, and a formula "poop sheet," sallied forth to meet the cream of Harvard's math majors. West Point out-logarithmed, out-differentiated, and out-integrated the Cambridge aggregation by a score of 98 to 112."

on a third party who could write and grade the examination. Graustein wrote: "The man I have in mind as the third member of the committee is the President of the Mathematical Association of America, the body which stands for collegiate mathematics in this country. A new President, Professor Arnold Dresden, was elected at the beginning of the year, and fortunately he is at Swarthmore. Dresden seems almost 'ordained' for the job." Jones wholeheartedly endorsed Professor Dresden as "obviously the man to make up the examinations and grade them." Dresden agreed and set the scoring rules similar to cross-country track. The exams would be ordered and ranked from best to worst, and the ranks of the ten team members would be summed.

The team with the lower sum would win.

The mathematics curricula for the first two years at both schools were very similar. The order of topics, pace of coverage, and method of teaching differed slightly. All cadets at USMA were required to take four semesters of mathematics: algebra, solid geometry and trigonometry in their first semester; analytic geometry in the second semester; differential calculus in the third semester; and integral calculus in the fourth semester. USMA used the Thayer method of teaching, which required drill work at the blackboard, and recitation on the board work in every class. Since the entire curriculum of the Academy was required of all cadets, there were no mathematics

majors. The 10-man team was selected from the 300 sophomore cadets doing the best in their core mathematics courses. While all 500 freshmen at Harvard took a required common mathematics course, Harvard students began concentrating in special subjects at the beginning of their sophomore year, working under the guidance of tutors. The Harvard 10-man team was comprised of the best from the pool of 150 students taking sophomore-level mathematics, mostly from the 40 sophomores beginning their concentration in mathematics.

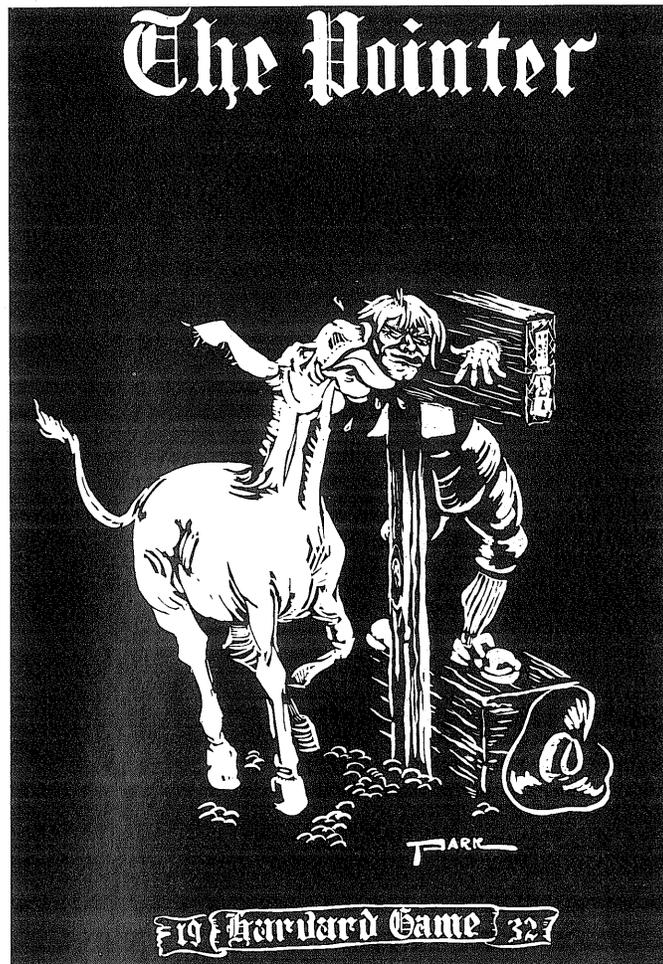
News of the contest reached the media. During the month of May, the Associated Press released several articles describing the

contest and its inception from the football game the previous fall. On May 18, John Kieran, sports columnist for the *New York Times*, reported the impending clash with football analogies and great metaphor in his "Sports of the Times" column entitled "The Coordinate Clash, or Block that Abscissa." Kieran reported that the Army coaches had cut their team on the basis that "some men were decidedly too light for heavy line duty in Analytics and others were not fast enough for back-field work in Differential and Integral Calculus." Kieran related some mathematical history to cite the similarities of this contest with a previous mathematics battle waged by Cardano and Tartaglia. But his most revealing coverage came in the form of an introductory poem entitled "A Logarithmic Lilt."

The Harvard horde is plotting,
 under the cover of dark,
 A fight to make the Crimson Chord
 subtend the Army arc.
 The coefficient Corps has drilled
 with sharpened pencil tips
 And plans to drive the enemy
 from the ellipse.
 The Harvard cry is "Break the square
 and take the cube away!"
 While at the Point "Abscissa!"
 is the watchword of the day.
 And high upon the turret top
 the sentry turns his head
 And hears the Cambridge legions
 come with logarithmic tread.
 "Advance and give the cosine!"
 rings the challenge through the air.
 The Crimson host advances —
 and we hope the fight is fair.

The Pointer, the West Point cadets' own magazine, presented their view of the contest, including the line-up, coaches, theme song, cheer, as well as the illustration on page 15. Anticipating an action packed, football-like contest, *The Pointer* parodied:

"The carrier of the ellipsoid is swinging wide on the arc of a cubical parabola, whose equation is: $4y = x^3$. Oh, that is too bad, someone has committed a numerical error. That now makes it



This cover of the West Point cadet magazine anticipates that Army, whose mascot is a mule, will lick Harvard, mockingly represented here by the pilgrim in the stocks.

last series with still two terms to go. The teams are lined up on the line $x - 2y = 3$, over near the y -axis. The defense finds itself completely unprepared, and their line has been neatly bisected for a gain of approximately 16.24 centimeters. Wait, wait a minute, please—there will be a penalty. Someone has omitted a constant of integration."

Each exam had eleven questions from which ten were to be answered. What were the exam questions like? Four typical questions from the two exams are given for your own enjoyment:

- (a) A function $u(x)$ being given, it is required to determine a formula giving all the functions $v(x)$ for which the derivative of the product u and v is equal to the product of their derivatives.

- (b) Work out the special cases of (a), obtained when

- (1) $u = \text{constant}$, different from zero
- (2) $u = 0$
- (3) $u = e^{ax}$, a is a constant different from zero
- (4) $u = \sin x$

- Determine the total area enclosed by the curve described by the point (x, y) as t varies from 0 to 2π , where

$$\begin{aligned} x &= \sin t + \cos t \\ y &= \sin t - \cos t \end{aligned}$$

- Determine the moment of inertia with respect to its axis of a right circular cylinder of height h and radius a , in which the density along a line parallel to the axis and at a distance x from the axis is equal to $b + kx$, b and k being constants.
- A point moves on a line subject to an

attractive force inversely proportional to the square of its distance from a fixed point O on the line. It is held at a point A at a distance a from O and then released. How much time does it require to reach O ? To reach a point midway between O and A ?

[The entire exam is on the MAA Gopher—see page 30.]

After the chalk dust had cleared, Dresden graded the examinations and reported the results. Army once again had defeated Harvard. The score was Army 98–Harvard 112. Cadet George R. Smith wrote the top paper with B. Feldman of Harvard placing second. Besides the prizes awarded by Mrs. Putnam, the cadet team received special congratulations from the Army Chief of Staff, General Douglas MacArthur. The yearbook noted the efforts of all “mathletes” on the Army “math squad,” with the write-up for winner George Smith one of the most humorous:

“Well, while my roommate is over seeing the Rhodes Scholarship committee about getting three more years

of education, I’ll give the world the lowdown on him ... It was, I believe, the inducement of a Snicker Bar that persuaded George to go into the Mathematical Contest with Harvard and take first place—so you see to what heights delicacies inspire him.”

While it is unlikely Smith received any endorsement opportunities for his winning performance, he could have been a spokesman for an advertising campaign touting the Snicker Bar as the “snack food” of math champions.

The Harvard–Army challenge match was not repeated. However, this match was the precursor of and the inspiration for the annual William Lowell Putnam Mathematical Competition that began in 1938 and is still going strong today. The Putnam Contest is open to individuals and three-person teams from American and Canadian colleges with almost 400 schools and 2500 competitors annually. The exam is given in two parts with 12 challenging problems presented to the competitors. Harvard has won this competition 18 times. While Army has never won the Putnam Contest, its teams have done very well in the Mathematical Contest

in Modeling (MCM), which began in 1985. The format for the MCM is different than the Putnam Contest. In the MCM, teams of three people solve an application problem over a weekend and submit a report on their solution. In 1988, both USMA and Harvard were winners, receiving the “outstanding” rating. ■

All the illustrations for this article are courtesy of the Special Collections Division, USMA Library, West Point, NY.

Editor's Query: When will the next match occur?

The Putnam Competition

Since 1938, the MAA has annually conducted a mathematical competition for undergraduate students supported by the William Lowell Putnam Prize Fund for the Promotion of Scholarship.

Students in the United States and Canada are eligible to participate and win honors for themselves and for their institutions. Each student works independently on the examination. A college or university with at least three entrants designates three of them as a team.

Prizes are awarded to the ten highest ranking individuals, to the mathematics departments of the top five teams, and to members of those teams. A graduate fellowship at Harvard University is awarded to one of the top five students.

Contest questions and solutions are published in the **American Mathematical Monthly** together with a listing of high ranking individuals and teams. Two volumes of Putnam Problems and Solutions have been published by the MAA covering the years 1938 through 1984.

Anyone wishing to receive a registration form for the competition should write to:

Professor Leonard Klosinski
Department of Mathematics
Santa Clara University
Santa Clara, CA 95053-0001
(408) 554-4525

Mathematical Contest in Modeling

The Mathematical Contest in Modeling (MCM) was the brainchild of Ben Fusaro of Salisbury State University. It began in 1985 with 90 teams and had over 400 last year from around the world. It is a true team competition; teams of three work over a four day weekend and can use any and all inanimate sources. They receive two questions and choose one to work on. The problems are open ended; there are no correct answers. These are real problems submitted by experts in industry, government and academe.

The “outstanding” papers are published in *The UMAP Journal* each year and the teams are invited to make presentations at the annual meetings of ORSA (The Operations Research Society of America), and SIAM (The Society

for Industrial and Applied Mathematics) and the Joint AMS/MAA (American Mathematical Society/Mathematical Association of America) meetings.

To participate, the advisor of the team must register by January 7, 1995 (team members do not need to be specified until the competition begins) with:

COMAP
57 Bedford Street, Suite 210
Lexington, MA 02173-9684
617-862-7878

Dr. Sol Garfunkel is Executive Director of COMAP (The Consortium for Mathematics and Its Applications) and Professor Frank Giordano of the U.S. Military Academy at West Point is the Director of the MCM.