Winter 12-1966

Volume 78 - Issue 3 - December, 1966

Rose Technic Staff
Rose-Hulman Institute of Technology

Volume LXXVIII, No. 3

December 1966

Rose Technic

* * * * *

PRINTED BY MOORE-LANGEN PRINTING AND PUBLISHING CO.
140 North Sixth Street, Terre Haute, Ind.

Publisher's Representative
LITTELL-MURRAY-BARNHILL, INC.
369 Lexington Avenue,
N. Y. 17, N. Y.
and 737 N. Michigan Avenue,
Chicago 11, Illinois

ECMA Chairman
PROF. J. R. BISSETT
Civil Engineering Department
University of Arkansas
Fayetteville, Arkansas

Published monthly except June, July, August, September and January by the Students of Rose Polytechnic Institute. Subscriptions obtainable by a $3.00 donation to the Student Activities Fund of Rose Polytechnic Institute. Address all communications to the ROSE TECHNIC, Rose Polytechnic Institute, Terre Haute, Indiana.

Entered in the Post-office at Terre Haute as second-class matter, as a monthly during the school year, under the act of March 3, 1879. Acceptance for mailing at special rate of postage provided for in section 1103, Act of October 3, 1917, authorized December 13, 1918. This magazine does not necessarily agree with the opinions expressed by its contributors.

DEAN'S NOTES

School Spirit!

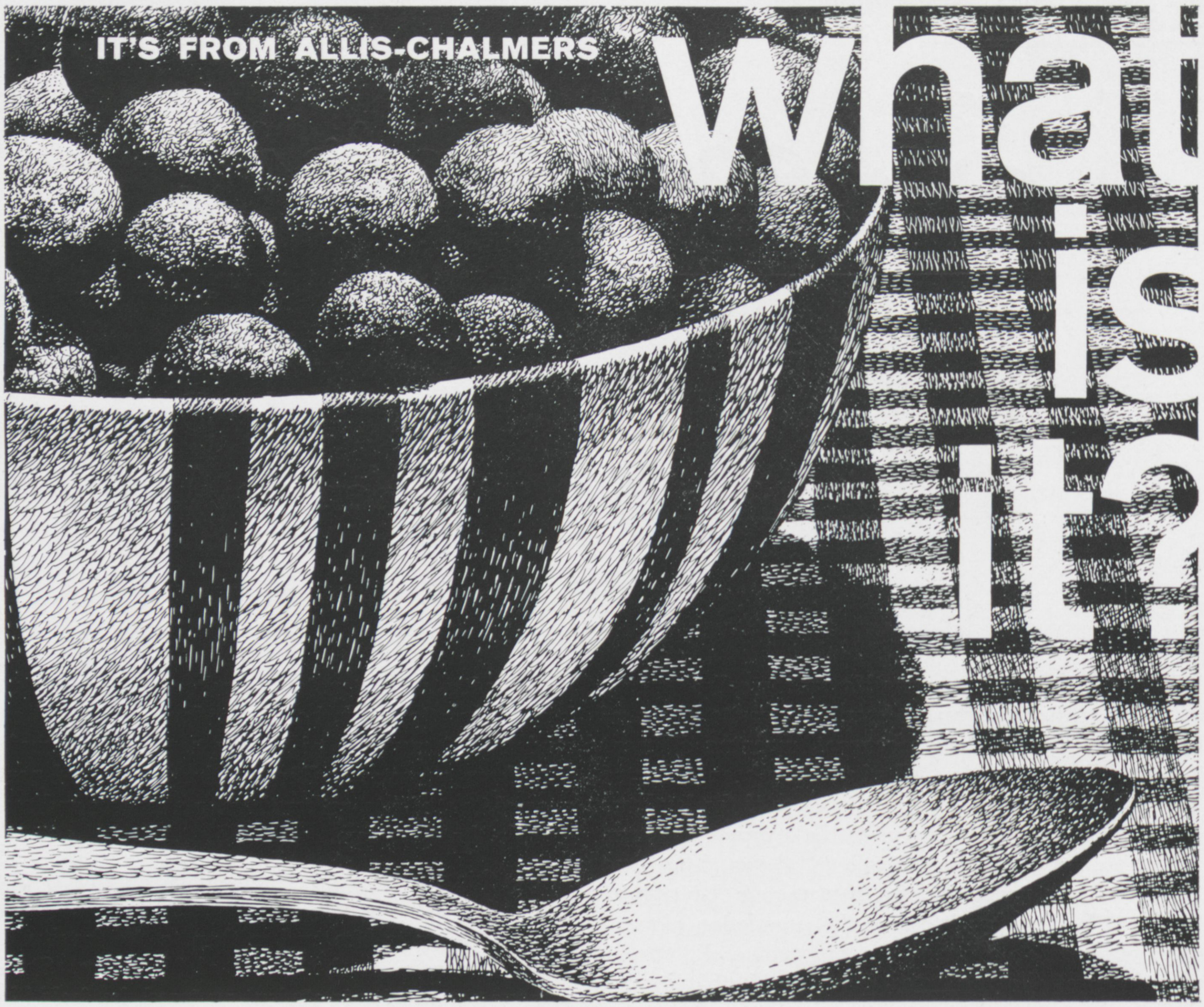
by Dean
Herman A. Moench

Trying to define that intangible quality called "school spirit" has, over the years, been a favorite sport of college men. It's an elusive concept, meaning different things to different people. All of us have been exhorted at pep rallies to show some "spirit" — as if the loudness of the yells and the cheering might be a proper measure of a man's commitment to his college. Again, from time to time, we are urged to demonstrate our "spirit" by extending a helping hand toward the completion of some project designed to advance the program and improve the facilities at the Institute. Certainly, both cheering and contributing are constructive activities but true school spirit runs deeper and stronger than these surface manifestations.

Unity of purpose, honesty of effort, and sincere commitment to high ideals of service underlie the enduring satisfactions that students, faculty and alumni take in belonging to the Rose family. Academic achievement is much sought after. Nevertheless, perceptive top-rank students who take pride in their own excellence still are humbled by glimpses of vast areas of knowledge not yet encompassed. But every student, regardless of his class rank, can properly take pride in the uncompromising honesty of the intellectual pursuits in his courses. The Rose tradition calls for professors who are competent in their own disciplines, who demand from their students genuine understanding and who are able to inspire these same men to intense efforts. The ideal teacher is scrupulously fair, thorough and objective in grading, never playing favorites, and yet he is patient with the slow learner. He meets his students where they are, rather than at some wished-for level. He does his utmost to bring along every man in his class. Rose has been fortunate to have perhaps more than its fair share of such dedicated instructors, teachers committed to the broad education and the whole development of serious students. A number of widely sought-after professors have been attracted to Rose by the quality and performance of its students, rather than by activities and rewards outside the classroom.

In this atmosphere it is not surprising that the typical student's attachement to the Institute runs deep. Rose is *his*. It belongs to *him*, rather than to the faculty, to the alumni or even to the Board of Managers. Since the campus community is student-centered, he feels like the owner, not like a customer. He enjoys his informal and friendly relation with faculty members and he prizes highly his close association with like-minded men. After holidays and vacations he returns to the exacting schedule of study with a joy and exhilaration both genuine and a little surprising. He looks forward to significant achievement and service in his professional life rather than to merely serving time.

It is natural, then, that Rose men, as alumni, have set a remarkable record of loyalty in supporting the Institute, not only by generous gifts to the Alumni Fund and to the Centenniel Development effort, but also by proclaiming the good name of Rose Polytechnic, by recruiting outstanding prospective students, and by working personally on special projects. This kind of commitment seems to be based on a deep appreciation of the "genuineness" of the work being done at Rose and a belief in the announced objective of providing a really liberal education in engineering and the sciences. Perhaps this belief or commitment on the part of all members of the Rose family comes closest to expressing real 'school spirit". Certainly its strength and depth augur well for the realization of our "great expectations" in the years ahead.



ALLIS-CHALMERS

Write us.

We'll tell you how it and hundreds of other new developments were created out of Allis-Chalmers unique combination of people capabilities.

Our answer can give you a *head-start* toward creating your own opportunity for a career with Allis-Chalmers—one of America's 100 largest companies.

BUILDING GREAT PRODUCTS MAKES ALLIS-CHALMERS A GREAT PLACE TO WORK.

AN EQUAL OPPORTUNITY EMPLOYER

MANAGER OF COLLEGE RELATIONS
ALLIS-CHALMERS
BOX 512
MILWAUKEE, WISCONSIN 53201

yes

I am interested in the opportunities for creating my own future with Allis-Chalmers

☐ *I would like an interview*

☐ *Send literature about the scope of the opportunites for me*

NAME ____________________ **ADDRESS** ____________________

EDITORIAL

JUST ANOTHER HANGER-ON

Printed below are two articles written by the staff of the first Rose Technic. They were but a small group of men, but, as the articles show, they had great enthusiasm. As the present editor I feel somewhat humble and a bit enviable. I knew that neither I nor most of my staff have this same enthusiasm. Yet, at the same time I feel proud for having been given the opportunity of working with these men who give of themselves so that the tradition of the ROSE TECHNIC does not die. Many of these men will be the leaders of tomorrow, for they are willing to work for something even though they know there will be no material reward. Read the articles printed below and then ask yourself this question, "Am I to be a leader or just another hanger-on who does nothing for his fellow man?"

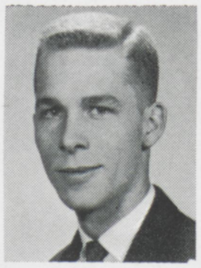
JWK

In the arena of college journalism a new factor today appears—THE ROSE TECHNIC. In character and in scope its predominating idea shall be the promotion of all interests of the Rose Polytechnic Institute, and that this may effectively be done, the editorial board solicits the warmest co-operation of every person connected with the institute. Undoubtedly there are obstacles awaiting us in the journey we have undertaken, but with each member of the faculty, each student and each friend of the institute an enthusiastic supporter, none are so great but that they may be overcome. The general plan on which THE TECHNIC will be operated contemplates a journal of intrinsic merit, one which will not only contribute to the pleasure of its readers, but to their education as well. In the development of this plan the editorial staff will be invaluably assisted by the faculty of the institute, each member of which has consented to contribute in rotation some article of scientific and philosophical interest. Assistance in this direction will also be given by your alumni, and thus there remains to the active board of editors only the pleasant task of collecting and presenting these valuable contributions as they are offered, adding to the same those features of local happenings ncessary to the varied phases of the successful college journal. Earnestly we solicit your sympathy and assistance, promising such recognition of the favor as it is in our power to give.

The TECHNIC is here to stay, thanks to a most liberal response from all directions. In June fears of success were entertained, but day by day the prospects brightened and now, should all indications be fulfilled, those fears will prove groundless. That commendable spirit which has characterized the students of Rose in all her undertakings has come to the aid of her journalistic enterprise, and failure is almost impossible. The local business men too have been generous in contributing their advertisements, and THE TECHNIC asks that the students remember them in the distribution of patronage. In return we shall aim to publish a journal worthy of the institute, the alumni and the students. No effort will be spared to constantly improve THE TECHNIC, and in such measure as the finances warrant will special features of interest be added. The projectors have but one aim and that is to build a foundation upon which in coming years will be erected a permanent institution known as the history of the rise and development of the Rose Polytechnic Institute and her students.

The Rose Man

by Morris Dovey



Morris Dovey is a Sophomore Math Major from Homewood, Illinois. He came to Rose from the U.S. Army and although this is his first appearance in the TECHNIC, he was the past Secretary-Treasurer of the IDC and appeared in the Rose production of "Waltz of the Toreadors". He is a pledge of Lambda Chi Alpha fraternity.

Tim Brown's representation of the Rose man.

What is a "Rose Man"? Certainly, he is more than just a warm body taking courses at Rose; but what, exactly, does the label imply?

The question is not easy to answer and it is possible that it cannot be answered at all. It may be that there are many answers. The approaches, at least, can be narrowed down to two: the objective and the subjective. I think that in many of the aspects to be considered the subjective approach will yield the most significant answers. I shall limit myself to my own opinions and personal observations.

First of all, the Rose Man is rationally oriented. To be sure, he is definitely not a purely rational being; but he is much closer to being so than, say, the usual liberal arts student. He prefers to see things clear cut, in black and white; and he tends to disregard and/or dislike the greys. I think that this is the most significant trait he possesses. It is reflected in nearly everything he does, from his choice of vocations to his political feelings. He shows this in his choice of a mathematics-oriented program of study and, far more often than not, in his political views when he says that he thinks that we ought either to do something about 'that' or forget it completely, be it in Vietnam War or the paving of a parking lot behind the dormitory. He doesn't like to see issues left undecided.

Secondly, he tends to be more introverted than, say, the "I.S.U. Man". Certainly there are exceptions, but generally speaking he prefers to speak his truth quietly and logically. This does not at all mean that his convictions are any the less strong, but, rather, that he prefers to keep them to himself until he feels that they are strong enough to stand on their own.

He is critical and often hard-boiled; and yet, at the same time he can be quite soft-shelled. He tends to be furious at those things which he considers wrong, be it another student's cheating on an examination, a poor meal in the cafeteria, or the failure of another person to live up to his image. He is angry with a sloppy job, be it his own or another's. When he feels that something is wrong, he does not make a big noise about it, but tries to find some way to rectify the situation

(*Continued on page* 30)

WHERE ARE WE ? & HOW DID WE GET THERE ?

by

Professor A. R. Schmidt

Part I - The Problem

Suppose you were invited to accompany a world-traveller on a sixty-day trip and were told that you could take only two suit-cases. What would you pack? Realizing that the answer to this question depends on where you are going, suppose you ask the traveller and he replies "I can't say for sure where I'm going, but I can tell you where I've been." Now how much do you know about your packing list? Perhaps the best you could do would be to pack those items which would be needed or useful wherever you go and hope to acquire specialized items of clothing and equipment when you arrive at the different destinations. But this means that at each destination you might have some equipment which is not now useful and might have to pay out good money for new acquisitions while past acquisitions are either allowed to waste away or be kept in reasonable repair in case they should be useful again.

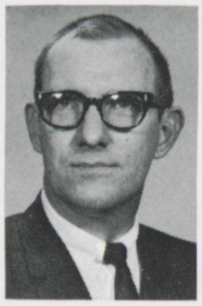
How much this resembles the design of an undergraduate education. As a student, you are invited to embark on a life-time journey for which you can pack only what can be contained in a four-year "travel-kit." It is quite impossible to say where all you might go, so it is also impossible to say what all you will need or find useful.

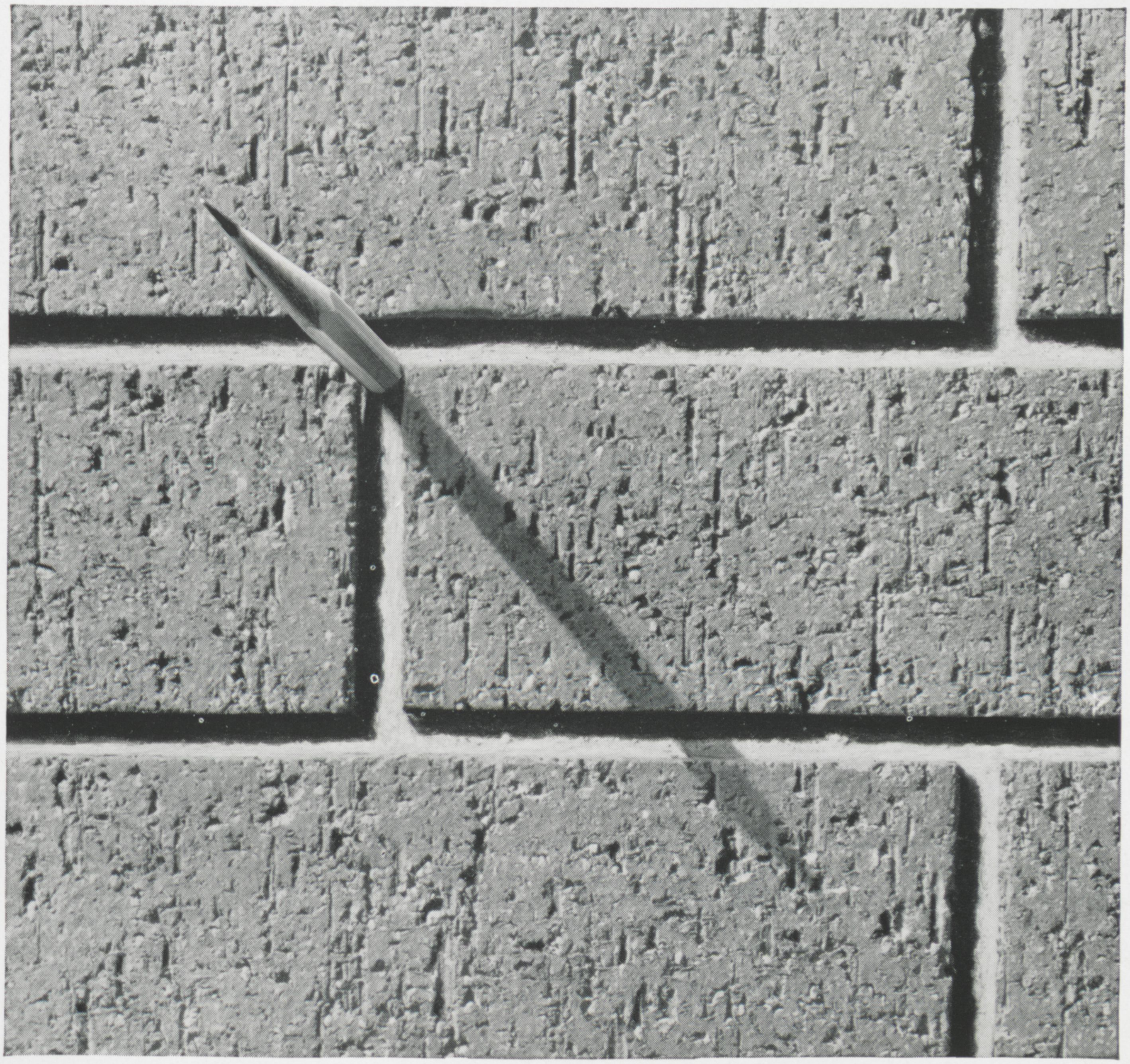
The situation is improved a bit, however, by choosing your first "general destination," say science and engineering as contracted with law or literature. With this choice, it is possible to decide on some articles which certainly will be needed and useful in that destination. But even the question of what to pack for this first destination has elicited controversy and slight 180° differences of opinion from respected authorities in the fields of education, science, and engineering.

A recent newspaper editorial [9] described the present-day dilemma rather well by stating:

> A paradox has developed in higher education which has driv-

(*Continued on page* 32)





An idea can go through anything

Here's a close-up of our new $5,000,000 facility called Timken Research.

We expect great ideas to come out of this building.

It's located outside Canton, Ohio, about ten miles from our headquarters and main plant.

Timken Research is one of the largest research and development centers in the bearing industry. Here we match up tough problems and inquisitive people.

Applied research flourishes here, cloistered, nourished and encouraged. Our engineers and metallurgists work on product development and equipment development. They have one aim: to produce Timken® bearings, Timken steel and Timken rock bits that will deliver even longer life at lower cost in more applications.

QUALITY TURNS ON **TIMKEN**® TAPERED ROLLER **BEARINGS**

An Equal Opportunity Employer

The Timken Roller Bearing Company, Canton, Ohio. Manufacturers of Tapered Roller Bearings, Fine Alloy Steel and Removable Rock Bits.

Timken bearings sold in 116 countries, manufactured in Australia, Brazil, Canada, England, France, South Africa and U.S.A.

Rose Twenty Years Ago

BY DEAN RALPH ROSS

Layout by Marvin Raymond

Dean Ralph M. Ross in 1946

The question is often raised in student circles, "what was Rose like twenty years ago?" Since my associations with Rose began in 1946, I shall attempt to answer in part this question.

One must bear in mind the country was just entering the post-war era in 1946. Veterans made up eighty-five percent of Rose's student body and the average age of a student was 23 years.

The curriculum was much the same as it had been in the late thirties; freshmen courses consisted of college algebra, trigonomerty, English composition, engineering drawing, general chemistry and basic R.O.T.C. Calculus and general physics were sophomore courses while differential equations was a junior elective and modern physics was not yet a course offering. Rose had but four areas of study leading to a baccalaureate degree, the engineering curricula in chemical, civil, electrical and mechanical engineering. The physical sciences, chemistry, mathematics and physics were supporting departments and did not offer curricula leading to a degree until 1958. It was at this time that calculus became a second semester freshman course and differential equations was required of second semester sophomores. General physics became a second semester freshman subject this same year.

Required senior courses twenty years ago included:

Chemical Engineering — thermodynamics, physical chemistry, industrial chemistry and chemical engineering problems.

Civil Engineering — structural analysis, sanitary engineering, highway administration and design, and hydrology and water power.

Electrical Engineering — A.C. machinery, E and M fields, high frequency circuits and thermodynamics.

Mechanical Engineering — machine design, manufacturing methods, aerodynamics and heating and air conditioning.

Lest one feels the curricula lacked the rigor of today's requirements in the engineering sciences let me remind you these curricula were accredited by all major accrediting agencies including the North Central Association of Colleges and Secondary Schools and the Engineering Council for Professional Development. Technology was on the brink of a tremendous forward thrust and grads from these years helped make rapid advances in technology possible.

Dr. Prentice in his presidential message to the class of 1947 wrote, "Your technical studies have not been slighted. Standards have been maintained. Your degrees merit full recognition which degrees from Rose always received." President Wilkinson wrote in the 1950 Modulus, "We—at Rose have no worry over the technical competence of Rose men. It is our expectation that your progress in professional life will be rapid and your contributions to the betterment of mankind numerous."

In the summer of 1946 student enrollment had built back to 275, about an average enrollment for pre-war classes. However, four terms of twelve weeks each per calendar year was initiated in 1946. This was to facilitate provisions for continuous subsistence allowances for veterans attending college under the G.I. Bill for Education and permitted a full four year academic program in three calendar years. New freshman classes were started each quarter until we reached a peak enrollment of 566 students during the 1948-49 school year.

The faculty in 1946 numbered twenty-five. Eleven of those members served Rose well for many years and have since retired: C. Wischmeyer, C. Knipmeyer, O. Stock, C. Sously, R. Strong, E. MacLean, R. Hutchins, B. Howlett, F. L. Brown, G. Greenleaf, and C. L. Mason. Nine additional members of the '46 faculty remain at Rose: H. Moench, J. Bloxsome, T. Palmer, I. Hooper, E. Eckerman, O. Knudsen, D. Criss, G. Haist and R. Ross.

College Boards were not required for admission twenty years ago. Requirements included fifteen high school units — 3 units of mathematics, 3 units of English and one unit

(Continued on page 14)

TWENTY YEARS

(*Continued from page* 13)

of a laboratory science were specified. Although catalogues did not so state, it was generally understood a student must have graduated from high school in the upper half of his class to quality for Rose admission. One hundred forty-four semester hours or two hundred sixteen quarter hours were required for a Rose degree.

Student activities were much the same then as now. Major social functions included the Homecoming dance, Military Ball, starlight dances on the tennis court, St. Pat's Dance and Junior Prom. The bonfire and senior cords were already traditional. The freshmen and sophomores had their difference which culminated in the freshmen-sophomore games in November even though the student body was predominately G.I. Rosie, our mascot, attended all athletic contests and was refurbished and maintained by the freshman class.

Campus housing consisted of Deming Hall and twenty converted army barracks erected in '46 and '47 by the Federal Public Housing Administration. These were located on the east and south side of the lakes. Four housed 64 single students while 16 apartment buildings housed 48 married students and their families.

For a period of time while the barracks were being erected "Spinter Hall," a name given our gymnasium by the students, was converted into a barracks for some 64 unmarried G.I.'s. Our present auditorium (reocnverted in '49) was the gymnasium in 1946. Where the mathematics and humanities offices are now located was our auditorium which we converted to classrooms for the influx of students during the post-war period.

Convocations were held under the big oak tree in front of the main building. One may occasionally hear the grads of that era speak of this tree as the assembly tree. Naturally convos were limited to good weather.

Commencements in '46 and '47 were held under a tent pitched on the site of the old Student Center (erected in 1956).

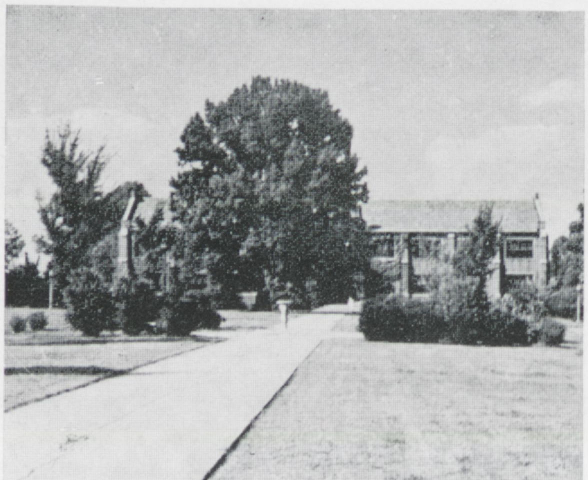
Phil Brown who served Rose as athletic coach for some 25 years did get together a varsity football and track team for the 1946-47 season. Our teams were made up primarily of veterans. Their age and training did not make for strong competitive teams but they made up in spirit what they lacked in strength. An interesting observation is that Herb Bailey (currently head of the mathematics department) was a member of the 1946 track team. He often entered as many as 6 events in a meet and was high scorer for the season with 46 points.

Coach Jim Carr joined the Rose coaching staff in 1948 and it was in the 1948-49 season that basketball and baseball were reinstated as varsity sports having been discontinued during the war and for the first two post-war years. Our field house was completed in early 1949 and intramurals were initiated this same year.

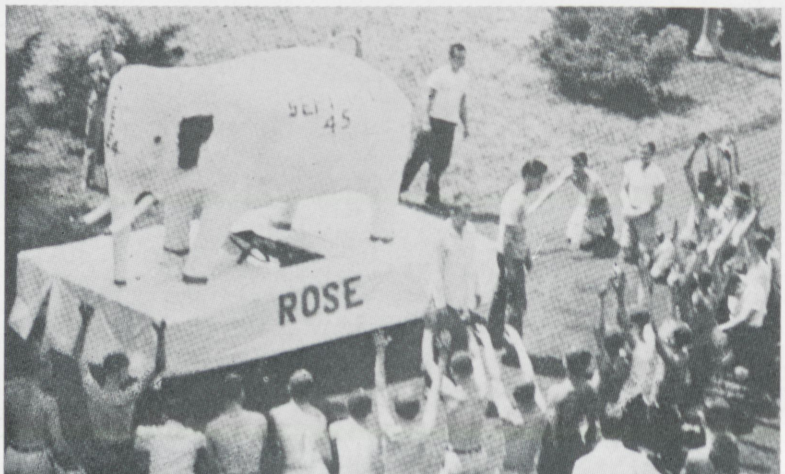
The evolution of Rose cannot be told in a few paragraphs but for the sake of brevity I have hit only some points in this evolution I thought might be of interest.

Rose has been recognized since its founding through its staff and through its product — the alumni. Rose has always made a conscious effort for excellence in engineering education. Curricula have become more sophisticated, equipment more refined, professors more exacting. These are the demands of an ever expanding technology.

Rose has always been respected by her sister institutions and by business and industry and is dedicated to maintain this recognition and respect in the society of tomorrow.



ADMINISTRATION BUILDING



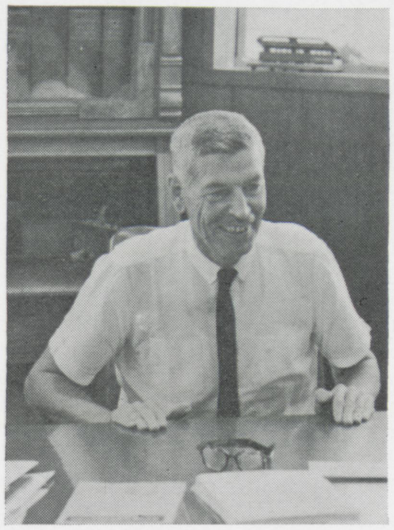
ROSIE IN 1946

A Liberal Education In Science and Engineering

by

DR. JOHN H. LOGAN

President of Rose



Dr. Logan

Layout by Mike Wright and Dan Kirklin

Rose Polytechnic was established in 1874. It was patterned in a general sense after the Ecole Polytechnique in Paris, but more specifically after Rensselaer and Sheffield at New Haven. Dr. Charles O. Thompson, Rose's first President, recognizing the opportunity which a new school provided, was not satisfied with mere imitation. He was concerned from the beginning with doing certain things uniquely well, and in his inaugural address said:

> "The Polytechnic is a professional school, and must concentrate itself upon its own special work; but the broader the base upon which it builds, the more massive the structure that can be reared. Whether the Polytechnic course shall rear an obelisk or a pyramid depends on the preparation of its students."

What about the Rose educational program in 1966? Is it still in the forefront — is it still innovational— is it creative — is it meaningful in the society in which we live — will it meet the social and technological requirements imposed by a world changing more rapidly than at any previous time in history? The answer should be — and is — a resounding "Yes."

In developing our present philosophy of education the faculty, administration, and Board have been motivated by an overriding objective; national recognition as the finest undergraduate program in science and engineering in the nation. A great deal of thought has been given to such matters as the increasing number of scientists and engineers who become managers; the increased professional responsibility of scientists and engineers for the kind of world we are building; the knowledge explosion; the threat of technological obsolescence and the growth of graduate education. It has become increasingly evident that undergraduate education, far from decreasing in importance, must still provide the basic foundation on which a professional career will be built. It is also evident that in order to meet our objectives we must provide a total educational experience at Rose, encompassing not only academic, but social, cultural, recreational and athletic aspects. There is also a need to develop programs which will increase the student's ability to study and learn. This broad kind of education, a truly liberal education, requires a faculty, curricula, and an educational environment developed with the ultimate goal in mind. Our long-range campus plan, the new Residence Halls, the Memorial Union, the proposed new Learning Resources Center, the acquisition of the Hudson Oil property east of the campus, the revitalized athletic, drama, debate and glee club activities and our Memorial Art Program are all an integral part of our long-range program.

In understanding or interpreting historic changes within a profession, outsiders often have a better prospective than those directly involved. For example, the aviator-writer, Antoine de Saint-Exupery, in his classic "Wind, Sand and Stars," sees science and engineering from a fresh point of view:

> "Have you looked at a modern airplane? Have you followed from year to year the evolution of its lines? Have you ever thought, not only about the airplane but about whatever man builds, that all of man's industrial efforts, all his computations and calculations, all the nights spent over working draughts and blueprints, invariably culminate in the production of a thing whose sole and guiding principle is the ultimate principle of simplicity? — In anything at all,

(*Continued on page* 26)

(*Continued from page* 15)

perfection is finally attained not when there is no longer anything to add but when there is no longer anything to take away, when a body has been stripped down to its nakedness. — Startling as it is that all visible evidence of invention should have been refined out of (the airplane) and that there should be delivered to us an object as natural as a pebble polished by the waves, it is equally wonderful that he who uses this instrument should be able to forget that it is a machine. — And thus, — the realities of nature resume their pride of place. It is not with metal that the pilot is in contact. Contrary to the vulgar illusion, it is thanks to the metal, and by virtue of it, that the pilot rediscovers nature. — The machine does not isolate man from the great problems of nature but plunges him more deeply into them."

Has an artist sensed a fundamental truth that is not generally understood? At this very moment jet aircraft are hurtling with the speed of sound over every continent and over all the seas of the world. Computers are performing analytical operations of a complexity far beyond the capabilities of the human brain at speeds which tend to surpass comprehension. Man-made satellites whirl around the earth; automobiles, trucks and buses, miracles of modern mass production, give personal and public transport a new dimension of flexibility and range; radar, television, skyscrapers, bridges, telephones and bulldozers all provide dramatic evidence of modern industrial creativity and productivity.

But it is at this precise moment in history that scientists and engineers are becoming most concerned about a liberal education — about the quality of man's physical environment — about the vital importance of the well-being of mankind.

Typical of our concern for the future is the emphasis being placed on the new Learning Resources Center. Using a Systems approach, a Committee under Professors Moench and Pao recently completed a basic program outlining the Center philosophy. A development contract has been signed with the architectural firm of Perkins and Will of Chicago for the structure and its facilities. The primary objective of the Center will be to increase the effectiveness of teaching. The Center will be built around a new kind of library, a data storage and retrieval facility able to store information not only in books and periodicals but through the use of computer, tapes, slides, film or other "hardware." The Center will provide facilities for group study through new classrooms, conference and seminar rooms; for individual study by means of individual study carrels, programmed instruction for routine material and through tutorials. Special efforts will be made to keep abreast in such fields as reading improvement, memory, concentration and motivation.

The scientist and engineer of the future must be able to organize and evaluate information, must be able to understand people and be able to communicate with them and be able to deal with them as groups and individuals. He must be able to acquire new knowledge and apply it, he must be able to think clearly, he must be able to understand basic principles, he must be able to perceive new problems and be able to solve them creatively.

Rose graduates over the past ninety years provide ample evidence that a Rose education has been highly effective. Today competition for faculty, for students and for money is greater than ever; at the same time there is a greater opportunity for institutions such as Rose to adapt themselves to new requirements and to take advantage of new techniques in developing a program which is unique and for which there will be widespread demand on the part of students, industry, Government and commerce. Building on the achievements of the past, Rose faces the future with confidence. The quality of the faculty and student body were never higher and our plans are sound. A Rose education is today, more than ever, the best possible preparation for the future.

Some Humor from the December '91 Rose Technic

Professor: "What is a harmonic conjugate?"

J.B.S.: "A musical Wife."

Fresh. "What does Professor Noyes lecture about?"

Soph. "About an hour."

Senior middle man: "Why is a hen unlike a draughtsman?"

Senior end man: "One hatches an egg, the other a cross-section."

Professor: "Can any one explain this problem?"

Class '93: "Professor, we don't quite understand it."

Professor: "It seems to me thats a favorite expression of this class."

Poetry from the November '91 Rose Technic

Examinations now are here,
Our misery is complete,
Soon we will write for all we're worth,
And — poor standing meet.
We'll chew the rag on language,
And scratch our heads in vain;
We'll flunk dead out on chemistry,
And wish we had some brain.
But soon the tug of war will end,
No more our way we'll beat,
We'll face the music like a chump,
And come out on both feet.

—M.R.T.

Her hands were full, her veil not tied, —
Her cheeks were rosy as the dawn;
"May I not hold your gloves?" he cried,
She answered, "When I've put them on."

—*The Blue and White*

CONSUMER PRODUCTS ★ COMMUNICATIONS ★ SEMICONDUCTOR PRODUCTS ★ GOVERNMENT ELECTRONICS ★ AUTOMOTIVE PRODUCTS ★ CONTROL SYSTEMS

hip chip

What is it?

Not the op art discs — we're not about to describe them. We are interested in the micro-photo just above — specifically the little rectangle in the center. It's a minuscule chip of silicon produced in Motorola's semiconductor labs—on the verge of creating a scientific revolution all its own.

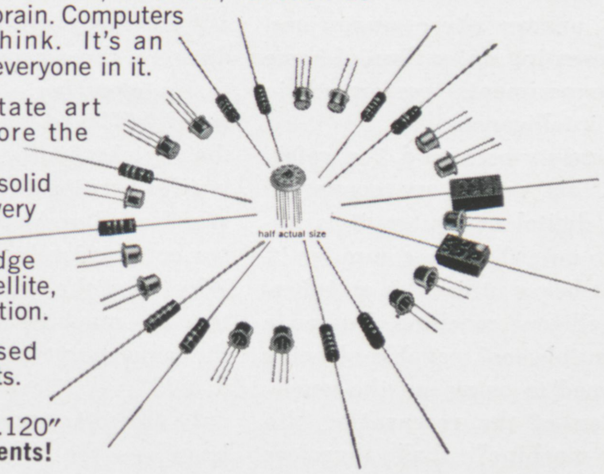
The chip's dimensions are 0.060″ by 0.080″—about the size of a baby B-B. That tiny area incorporates 14 transistors, 10 resistors and 2 capacitors—performing the same circuit functions as the 26 discrete components shown below. It's Motorola's chip off a new block of electronics—it's an integrated circuit.

But why all the fuss?

Because the integrated circuit is the key to untold electronics marvels, hitherto impractical. Because its small size, weight, and power consumption lessen the cost of complex systems and improve performance. Because it's more reliable, to boot.

Integrated circuits already are used in design plans for amazing new computers — computers which will, in effect, function as special extensions of the human brain. Computers which, in time, will almost think. It's an exciting business. It challenges everyone in it.

Within a year, the solid state art will develop the means to store the content of the Encyclopaedia Britannica in a one inch cube—a solid state memory system. One day, every important university library will have electronic knowledge banks connected, perhaps by satellite, for instant exchange of information.



People generally are impressed by the chip with 26 components. But hang on. We've now got one in the lab not much larger (0.120″ by 0.120″) . . . **with 524 components!**

Hip chip? You bet.

TRUST THIS EMBLEM WHEREVER YOU FIND IT

MOTOROLA

ARTIFICIAL INTELLIGENCE

by Bill Schendel

Introduction

The idea of a machine displaying intelligence is a difficult one to swallow, from the standpoints of credibility and of pride in the human intellect. Do machines exist that actually exhibit intelligence Has the "ultra-intelligent" machine, more advanced than the human mind, been built?

This article will discuss and attempt to answer these qupestions, while presenting an outline of some of the experiments performed in artificial intelligence.

While most work and the references in this article are connected with the digital computer, it is important to note that the computer itself is not being utilized as an inherently intelligent machine, but as a highly flexible *tool,* capable of being programmed to carry out the generalized plan of the researcher. "Intelligent machine" shall therefore actually refer to the programmed system being carried out by the computer during the experiment.

Artificial Intelligence

An often-raised objection at the onset of such a discussion as this is that a machine cannot actually "think." A coverage of the arguments most often cited by the negativists and positivists on this issue was assembled by Paul Armer, Head of the Computer Science Department of the RAND Corporation.[1] Mr. Armer includes the following arguments and counterarguments:

1. "The Argument of Invidious Comparison" — machines could not perform such tasks as recognizing the various designs of the chess men of various manufacturers' styles during a chess game, which a human easily identifies. Mr. Armer's return: " (This) . . . is like saying that the Wright brothers' aipralne could not fly because it could not fly nonstop from Los Angeles to New York, nor could it land in a tree like a bird. Why must the test of intelligence be that the machine achieve identically the same point in the continuum as man?"

2. "The Argument of Superexcellence" — the only evidence of machine intelligence that some negativists will accept is the achievement of particular tasks that men themselves are rarely capable of performing. Mr. Armer: " (One) . . . stated that he would not accept the fact that machines could think until one proved . . . Fermat's last theorem. By this logic one concludes that, to this date, no man has been capable of thinking . . . . "

3. "The Argument by False Extrapolation"—this position is based on the assumption that machine properties will be advanced no further, as in the argument that the number of vacuum tubes equal to the number of neurones in the human brain would not fit into the Empire State Building, would require Niagara Falls to supply power and the Niagara River for cooling. Mr. Armer states that the appearance of the semiconductor has already weakened this argument, and looks forward to the time when evaporated film circuitry will allow placing the number of logical elements in the human brain in a cubic foot of space.

4. "The Obedient Slave Argument"—Clasically: "The machine can only do what it is told to do." Mr. Armer states here that the machines may well be *told* how to perform an intelligent function, such as learning.

In the midst of the controversy, A. M. Turing, the late English mathematician and logician, inserted his thesis that the question "Can ma-

(*Continued on page* 40)


STATE

LINDA JAYNES MISS TECHNIC

Our December Miss is from Seymour, Indiana and is a junior at Indiana State University. She is majoring in English with a psychology minor. Linda is active in many extra-curricular activities at I.S.U. She is rush captain for Alpha Omicron Pi Sorority, a member of the Junior Union Board, and a member of the Standards Committee. This year Linda was first runnerup in the I.S.U. homecoming queen competition.

NEWS for ENGINEERING GRADUATES

1966
1967

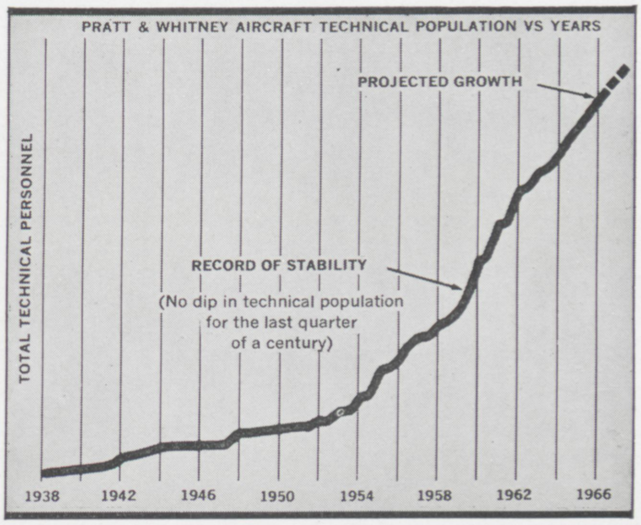
Continued expansion of our military and commercial business provides openings for virtually every technical talent.

As you contemplate one of the most important decisions of your life, we suggest you consider career opportunities at Pratt & Whitney Aircraft. Like most everyone else, we offer all of the usual "fringe" benefits, including our Corporation-financed Graduate Education Program. But, far more important to you and your future, is the wide-open opportunity for professional growth with a company that enjoys an enviable record of stability in the dynamic atmosphere of aerospace technology.

And make no mistake about it . . . you'll get a solid feeling of satisfaction from your contribution to our nation's economic growth and to its national defense as well.

Your degree can be a B.S., M.S. or Ph.D. in: **MECHANICAL, AERONAUTICAL, CHEMICAL, CIVIL (structures oriented), ELECTRICAL, MARINE, and METALLURGICAL ENGINEERING • ENGINEERING MECHANICS, APPLIED MATHEMATICS, CERAMICS, PHYSICS and ENGINEERING PHYSICS.**

For further information concerning a career with Pratt & Whitney Aircraft, consult your college placement officer—or write Mr. William L. Stoner, Engineering Department, Pratt & Whitney Aircraft, East Hartford, Connecticut 06108.



Take a look at the above chart; then a good long look at Pratt & Whitney Aircraft—where technical careers offer exciting growth, continuing challenge, and lasting stability—where engineers and scientists are recognized as the major reason for the Company's continued success.

SPECIALISTS IN POWER . . . POWER FOR PROPULSION—POWER FOR AUXILIARY SYSTEMS. CURRENT UTILIZATIONS INCLUDE MILITARY AND COMMERCIAL AIRCRAFT, MISSILES, SPACE VEHICLES, MARINE AND INDUSTRIAL APPLICATIONS.

Pratt & Whitney Aircraft

DIVISION OF UNITED AIRCRAFT CORP.

CONNECTICUT OPERATIONS EAST HARTFORD, CONNECTICUT
FLORIDA OPERATIONS WEST PALM BEACH, FLORIDA

An Equal Opportunity Employer

Read and Devise

Edited By Frank Nigh

MANUAL AND AUTOMATIC

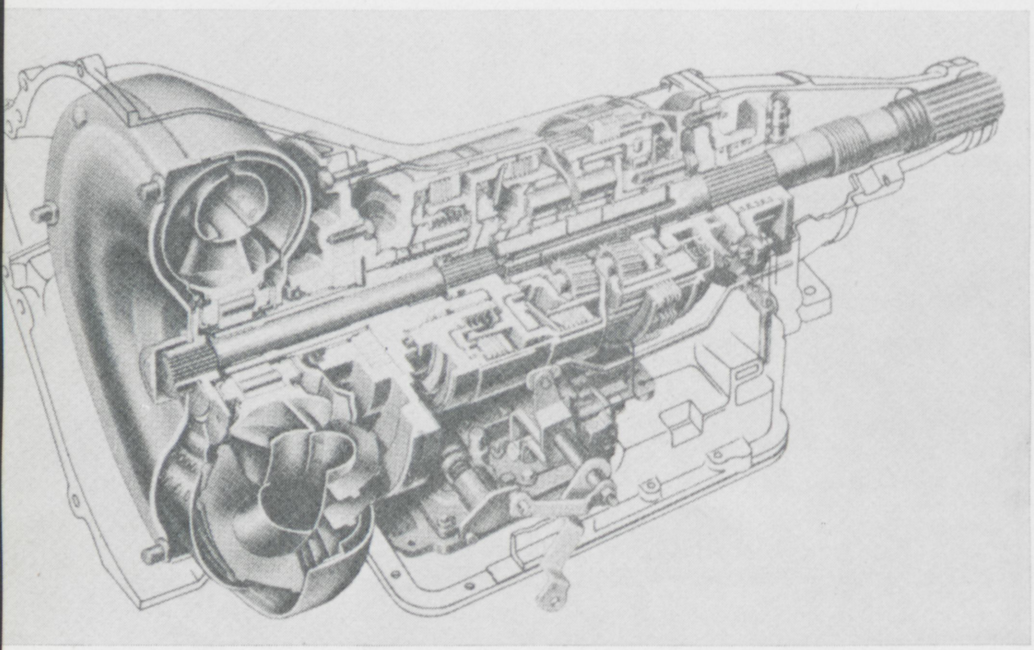
(in sketch below)

A major tooling investment underlies sweeping improvements in the Ford 1967 automatic transmissions toward more precise driver-to-car control, and increased driveline smoothness with high-torque engines. Standard on all automatic transmissions in all 1967 car lines is the manual override shift feature, which gives drivers the best of both worlds in manual and automatic shifting.

The driver now can manually upshift or downshift through first, second and Drive (third) gears if he wishes to override the automatic sequence. The selector is kept in Drive for conventional three-speed automatic shifting.

For passing and downhill braking, the automatic manually downshifts into second at any speed. For power-train protection, downshift to first is accepted only when car speed is less than 25 mph. Should the selector be moved from Drive to first at higher speeds, the gearbox will reject the shift to first, shifting to second instead. The desirable start-in-second feature (for mud, snow and ice) of the previous automatics is retained by starting with the selector in second. Also retained is accelerator "kickdown" into passing (second) gear, with selector kept in Drive.

Chief engineer for transmissions said, ". . . we made the manual-automatic standard for all car lines because we felt this had great plus value in driver control for all our passenger cars. No automatic gearbox can anticipate situations ahead on the road as well as the driver can. It can't . . . judge when to downshift for passing or engine braking, nor how long to hold in second.



On the other hand, no driver can equal the automatic's ability to shift at the optimum moment in terms of speed and engine load. The automatic does have a tremendous mechanical advantage for routine shifting situations in that is well nigh impossible to abuse the transmission or engine. This holds true for our manual-automatic".

Reliability of automatics in general has improved to the point where their durability record is better than manual transmissions in police cars and other heavy duty fleets. Additives have vastly improved friction, antifoaming and cool running properties of transmission fluids, while today's silicone seals are far superior to former types.

A HOME-MADE WEATHER FORECAST

An unusual addition to space-age history was recorded recently in Moorestown, N.J., when a "ham" radio operator captured on film the first usable photos ever received from an orbiting satellite by a person using do-it-yourself equipment.

Wendell Anderson, an RCA engineer, built his own ground station for the reception of TV pictures from space, and on March 2 he began receiving weather photos from the U. S. Environmental Science Services Administration's ESSA 2—the twelfth in the famed TIROS weather satellite series. Anderson's feat demonstrated that "ham" operators anywhere in the world can obtain good weather pictures from space by adding a few relatively inexpensive items to their existing receivers. Since the Weather Bureau has encouraged other countries and private citizens to use information transmit-

To Fit Our Need

Layout By Andy Spence

ted by the satellite, this augurs well for the success of the project.

The homemade receiving station was built at a total cost of less than $600. Of this amount, some $250 was required for the picture-receiving equipment Anderson added to his "ham" radio receiving equipment.

For an antenna, Anderson used an ordinary cable of the type used for TV antennas. To record signals from the satellite, he bought his most expensive item, a magnetic tape recorder that cost $199. To transfer the signals to film, he bought a $15 microscope and hitched it to an argon eelctric light bulb. The bulb microscope apparatus operating in the dark scans an 8-by-10-inch sheet of film, which is wrapped around a rotating film, which is wrapped around a rotating cylinder. The cylinder is an ordinary rolling pin with the handles removed; for smooth rotation it is cushioned by a rubber band.

The rolling pin is operated by two toy-sized electric motors ($10 each), one of which rotates the pin while the other drives the microscope horizontally very slowly so that it can register on the film the numerous line that make up the weather picture. He then develops and prints the film in his darkroom.
ment packages may not degrade per-

SCRATCHES UNDER PRESSURE

Designers of deep submergence equipment often have questioned whether scratches and normal handling in service might cause glass spheres to break under pressure. Recent tests by an oceanographic design and engineering company concluded that scratches on the outside of spherical glass floats and instruformance of the spheres under the sea.

Severe scratch and pressure tests were conducted on two 8-inch-diameter hollow glass spheres supplied by Corning Glass Works. Each of two spheres tested were first deeply scratched with a carbide scriber in about 100 places. Some of the scratches actually were gouges as 0.06-inch wide, 0.03-inch deep and 2 inches long, whereas wall thickness of the spheres was 0.230-inch ± 0.020-inch. The shperes were then tested by holding them in a hydrostatic chamber for 16 hours at their design pressure rating of 15,000 psi (equivalent to more than 30,000-foot ocean depth).

The spheres were still serviceable after the test. The pressure testing actually improved the condition of the scratched spheres. The sharp edges of the scratches spalled off leaving the spheres smoother. Glass normally fractures under tension, not compression; this is why glass is extremely strong under compressive loading. Fractures are usually initiated by surface flaws such as scratches. Engineers theorized that in testing under hydrostatic loads the compressive forces greatly reduced the stress concentrations normally associated with scratches.

Eight-inch diameter glass sphere, deeply scratched for testing, survived hydrostatic loading at its design pressure of 15,000 psi for 16 hours. The same sphere was then ground with an abrasive wheel, leaving a still wider notch one-third the wall-thickness in depth. With this severe damage the sphere went to 9,500 psi before failure.

The principal reason such a fragile material as glass is useful in the sea is its buoyancy (high strength-to-weight), which allows relatively thin-walled components to meet the requirements of deep submergence.

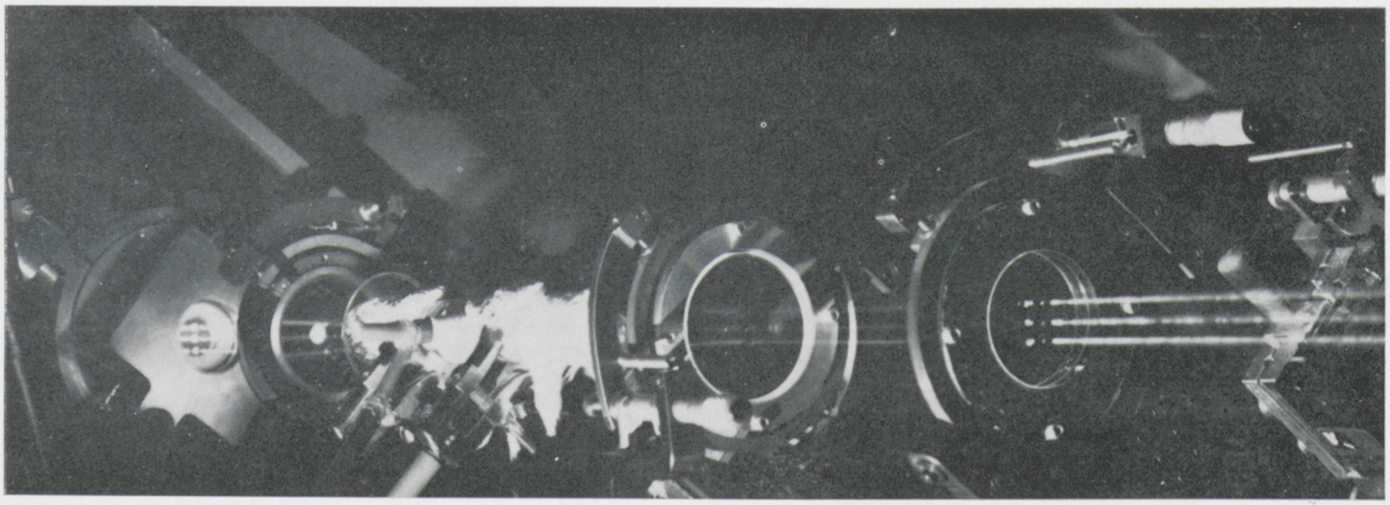
CONTROL WITH AN ELECTRON BEAM

A new scaning laser is of unusual interest because the beam direction is selected inside the laser cavity, taking advantag of the sharp threshold of operation of a laser to achieve beam selection with a small amount of power. In addition, nearly all of the active volume of the laser contributes to each output beam.

In its present form, the IBM "scanlaser" consists of a mercury vapor gas discharge tube mounted in a carefully designed optical system. Lenses in this optical system make it capable of supporting a large number of different modes of oscillation, all with approximately equal gain. (A mode of group of modes correspond to a beam direction.) The mirror at one end of the laser cavity is mounted inside a cathode ray tube, and has a coating of KDP (KH_2PO_4).

Mode selection in the scanlaser is accompained as follows. Losses in the cavity are caused by phase re-

(*Continued on page* 26)



Control of Scanning Laser by Electron Beam.

(*Continued from page* 25)

tardation in a strained quartz window in the cathode ray tube and the polarizing effect of the Brewster-angle windows of the Hg+ tube To select a mode of group modes, an electron beam is directed against a point on the dielectric mirror backing of the KDP crystal inside the cathode-ray tube. The electron beam deposits a charge at this point, producing an electric field across the KDP which in turn produces a phase retardation in the light passing through the KDP at this point. When the electron beam is directed to another point on the mirror, a new set of modes is turned on and the other is turned off as soon as the charge on the mirror decays to a level below threshold.

PATTERNS FOR PEOPLE AND ELECTRONS

Most people don't wear electronic designs . . . or do they? Look through the microscope at the pinpoint world of super-efficient, miniature circuits for some surprises. Focus on tiny devices with such imposing names as beam lead integrated circuit, or waffle transistor, and you'll see a wool-jersey print or a Greek temple straddling its reflection. Other patterns, like the ring-dot transistor, resemble paisley prints for men's ties.

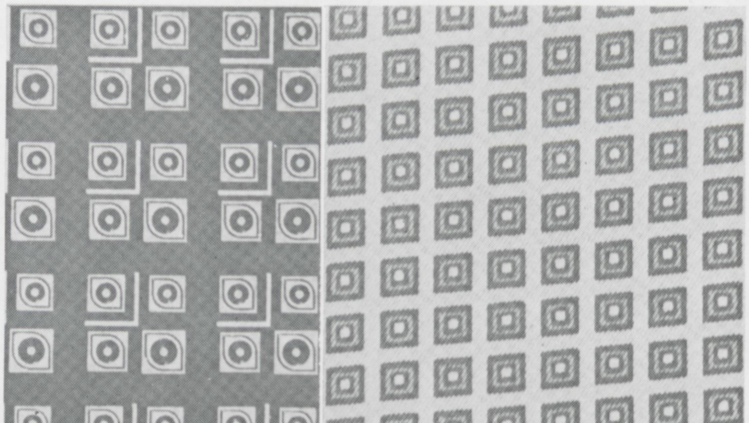
Communications Education Project.

The patterns are formed by individual devices manufactured in a group-sometimes as many as 3,000-on a silicon wafer about the size of a half-dollar. Western Electric's Allentown Works makes the devices under the most exacting manufacturing conditions in the world.

Machines that reduce hand movements a hundred-fold and precise photo etching methods-much like stenciling-produce the fine circuits. Hospital-clean surroundings are required because in the Lilliput world of microscopic circuitry, a tiny speak of dust becomes a boulder, altering precise electrical circuit properties.

Why make such small circuits un-

GOOD PATTERNS FOR MILADY. You could find either on a wool jersey suit, but only the pattern on the top is for people—the other is for electrons.



WHICH DO YOU WEAR? These two square-and-dot patterns serve widely different purposes. One is found beneath a man's chin in the form of a paisley tie. The other, magnified many times, is a set of microscopic transistors. (The pattern on the left is for electrons—the other is for people.)

der such demanding conditions? The answer is that such devices are cheaper, more efficient and more reliable than larger circuits with conventionally wired components. Each tiny circuit might contain 20 or more transistors and other devices joined by deposited material instead of fine wires. Wire conections are potential weak links; the new circuits eliminate this weakness and the cost required to make the connections. Also, their smaller size means the electrical paths between components in the circuit are shorter-making them operator faster. Circuits of reduced size and weight with greater reliability are invaluable to communications systems now and of the future.

Who knows that people will be wearing then?

GRAPHICAL EXPRESSION

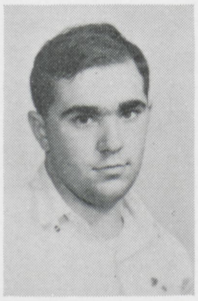
In a large-scale undertaking to improve "visual literacy" in the nation's schools and among young Americans everywhere, Eastman Kodak will join with the Ford Foundation in support of a new Visual "The objective of the project is to begin to train teacher to teach students to express themselves visually. Many knowledgeable persons emphasize that understanding of visual communication is essential to the improvement of literacy in an age increasingly dependent upon perceptual awareness. This awareness should aid in creating more effective communications and greater student interest, motivation, and curiosity related to intellectual pursuits. It should create a greater potential for success in any chosen occupation or profession. It should develop a better understanding of, and the ability to cope with, some of the problems and complexities of living in a crowded, scientific, fast-moving world. It should aid in raising the general level of aesthetic appreciation and in learning to make wise use of increased leisure."

The concept of visual communication education is much broader in scope than the traditional graphic arts education and would include not only printing and publishing but also the many facets of photography; graphic design; audio-visual, educational, and business communications; advertising; graphics of motion pictures and television; microfilm; cartography engineering graphics; and related techniques and processes.

A noted expert stated, "In our rocket age world, where exploding technology is changing traditional patterns overnight, our students must learn to use the tools of graphic communications, the chief means by which this erupting knowledge is spread . . . graphic arts should be integrated into the general curriculum for all students, whether they intend to use them to communicate, use them to earn a living helping others to comunicate, or, as citizens in our society, use them in understanding and appreciating communication." The facility to express visually should come to be recognized as belonging with the more traditional marks of an educated person: the ability to express oneself in speech and in writing.

SPORTS

ROSE'S FOOTBALL PAST



The author is Don R. Riley, a junior majoring in electrical engineering from Akron, Ohio. Don is a member of Lambda Chi Alpha fraternity, and is also active in the Glee Club.

by DON RILEY

Layout by Marty Goodwine

Earlier this year, the future prospects of the Rose football team were reviewed by Senior Gary Meek. After reading this article, curiosity led me into the past highlights of previous Rose football teams. I found some curious rivalries and some very interesting and occasionally amusing highlights, which I will now share with you.

With all the football attention centering in Lafayette this year, let's go back a few years to a crisp, fall afternoon in 1909. That day, the Rose Poly eleven met Notre Dame in what was to be the first and last meeting of these two teams. Notre Dame walked away with a victory that day, but not before Rose had scored more points than any Irish foe in two years. Later that season, Rose met Franklin. The score at halftime was 12-11 in favor of Franklin. But, the Rose team went wild in the second half. The final score was Rose 57, Franklin 12.

Four years later, Rose met Moores Hill in a defensive battle." Moores Hill couldn't get their offense moving that day, but Rose managed to move the defense. The final score read 121-0 in favor of the Fighting Engineers.

Moving ahead a few years to 1930, Rose rolled over all opponents on their way to the first undefeated, untied season in Rose football history. The following season, Coach Phil Brown came to Rose from Butler, to become head football coach and athletic director. He found the football team in good shape that fall as many lettermen reported to practice. That season, the Engineers fought their way to a 6-2 record under Coach Brown's guidance. However, in 1932, Coach Brown was faced with the problem that was to haunt Rose for many years. Working with inexperienced teams for the next nine years, he finally found the winning combination in 1940. The record that year was five victories, three defects. In the fall of 1941, virtually the entire 1940 team was back for practice. The winning combination clicked that season for seven victories and the second undefeated season for Rose.

World War II forced intercollegiate athletics to the sidelines after the 1942 season. But, before the mobilization began, Eddie McGovern, a Rose halfback, scored 165 points and became the nation's leading scorer. He lead Rose to a 5-1 season, with the team averaging 48 points a game.

Returning to the gridiron in 1946, Coach Brown began to build a new football team. Having lost all his lettermen via graduation, the task was tremendous. Rose won only one game that season, an upset victory over Indiana Central to celebrate the annual homecoming. The final game that season was played against present rival Principia. Hampered by six inches of water on the field, the two teams "swam" to a 0-0 standstill.

The following season brought Coach Carr to Rose as Assistant Athletic Director. Together, Coaches Brown and Carr built and rebuilt the "pore little boys" trying once again to find that elusive winning combination. In 1949, Rose played the Knights from Canterbury for the homecoming celebration. Playing before a crowd of 2,000, the Engineers couldn't budge the Knights. Final score was 13-0. However, Rose emerged from the seven game season with the first post war winning season colecting four wins.

For the next seasons, Rose won only two games, but each week, the spirit of the Fighting Engineers remained high. In 1952, Rose won three of their last four games. The following season, remembering those last five games, they swept the P.C.C. title with a 6-2 record.

Trying desparately to capture the P.C.C. title for the second straight year, Rose met Principia in the last game of the season. The motto for both teams read "To the victor go the spoils." Principia's defense had allowed only two touchdowns that season and Rose couldn't alter that record. Rose lost that day 31-0 to a highly polished Principia team.

In 1956, Rocky Herakovich reported to practice in the fall. He was to see plenty of action before his graduation. As a junior, Rocky led Rose to another Prarie College Conference title. He was the leading rushes in Indiana with 777 yards in 71 carries, scoring 17 touchdowns for 102 points. The entire team returned the following fall. They won eight straight games, extending their winning streak to 15 games. Rocky led college scorers with 168 points.

The folowing season, Coach Brown retired after 30 years at Rose. A lot of credit is due Coach Brown for his persistence and determination. However, Rose had a fine coach in Jim Carr, and he filled the vacancy left by Coach Brown. Three seasons later, Rocky Herakovich returned to Rose as head football coach. And in 1964, Coach Martin took over as gridiron chief. Coach Martin began immediately to rebuild and in 1965, he had Rose to their first winning season since 1958.

This season, Rose lost several close games and came within one game of a winning season. However, there were no seniors on the squad. The fall of 1967 could be a big one for Coach Martin and the Fighting Engineers.

Reviewing the football history of Rose has led me to one conclusion. Despite the many losing seasons, the hardships and let downs, every football squad has deserved to be called "THE FIGHTING ENGINEERS."

Don R. Riley

THE FIGHTING ENGINEERS OF 1896

S. G. Mead. P. W. Klinger. E. A. Darst.

A. L. Robinson, Jr. W. L. Decker. W. J. Klinger G. M. Walker.

R. Meriwether. F. A. Whitten. E. R. Burtis. S. G. Brown. H. T. Liggett.

B. D. O'Brien. F. H. Miller. C. M. Ridgely. L. E. Troxler. N. M. Austin.

Ads which appeared in Vol. 1 of the Rose Technic

TERRE HAUTE IS IN IT, and don't you forget it!!! Make a note of it!!! At the last Vigo County, Evansville, Tri-State, and the Great St. Louis Fairs, the Terre Haute Carriage and Buggy Co. swept the platter, as they were awarded the First Premium over all competitors.

"SOUTHWESTERN 4 LIMITED"

Between the Great Cities of the Middle and Western States.

St. Louis, Terre Haute, Indianapolis, Cincinnati, Columbus, Cleveland, Dayton, Springfield, and

NEW YORK and BOSTON.

A Solid and Independent Daily Train Over the Great Four Track N. Y. CENTRAL and BOSTON & ALBANY Railroads.

Vestibuled.
Gas Light.
Steam Heat.

ELEGANT WAGNER SLEEPING AND DRAWING ROOM CARS.

Superior Cafe and Dining Car Service.

Passengers arrive at and depart from Grand Central Station, New York City, convenient to all Hotels and Car Lines. New York Ferry transfer avoided via this Route.

Tickets on sale at Sixth Street Depot, and City Office, 710 Wabash avenue.

E. E. SOUTH, General Agent.

ROSE MAN

(*Continued from page* 8)

without making a big scene. He would rather visit the dean about an unfair examination than burn a professor in effigy.

I have heard it said that the Rose Man lacks the "activist" spirit which has become so obvious on many of the college campuses these days. I would like to suggest that perhaps there is more to be said for the man who quietly tries to change what he considers undesirable than for the man who goes about shouting for someone else to do something.

How about the soft-shelled Rose Man? I think that most of us, for one reason or another, make some effort to hide this particular quality. After all, it has to do with a man's weak spot; and perhaps with ours particularly, with our rationalistic outlook. The Rose Man would rather be thought of as a "Thinker" than as a sensitive person. He would like the world (and himself) to believe that he is the master of his feelings. Yet, how does one explain the fact that a surprizing number of Rose Men manage to cultivate ulcers and take on a definite "beanpole" appearance by graduation time? If you think that it's the academic load, I suggest that you reconsider. I have several times heard the Rose Man described as a 'duck in a pond", in that while he may appear calm and unruffled on the surface, he is really paddling like crazy under the surface.

Another thing I have noticed in the Rose Man, which I have seen in no other place to the same extent except in the Army, is his nearly religious attitude toward small children. I don't know from where this comes, or why it should manifest itself particularly at Rose, but it is present.

Thirdly, the Rose Man has an esprit de corps that I am sure must be unique. Perhaps he classes it with his other feelings and prefers to not show it at times. Many of the Rose Men seem almost indifferent about supporting school teams by going to games; yet the first question ask-ed whenever someone mentions a news report in which some student has been arrestd is: "It wasn't a Rose Man, was it?" He seems to express his strong esprit de corps in the form of concern and, again, in relatively quiet ways.

The relationship between the individual and the group is almost more of a family type than a school one, wherein the 'member" does not need to go about making an issue of his belonging, but is none the less proud and glad because of his relationship. I have noticed, too, that the Rose Man is very much concerned about the face which his "family" presents to the public. It is acceptable to have squabling among the members, but woe to the outsider who would criticize — or to the member who would injure the reputation of the group!

Another aspect of this issue is the Rose Man's willingness to be classified according to the actions of his contemporaries. I think that his desire to be identified with, and by, the actions of the entire group speaks well for all Rose Men. It is no small thing to be able to say: "I am a Rose Man." with the confidence that he will be respected by an outsider for it.

This also implies some form of internal social control among the members of the group, and I think that there is little question of their existence. The students at Rose have a fairly clear notion of what is expected of them by their fellow students, and of the consequences which would follow if they did not live up to these expectations. Usually, when prodding in the right direction is needed, it is given first humorously, in the form of joking, but cutting, remarks, like the "Run out of socks again?" that I heard not long ago. Occasionally an individual may find himself being showered or laked because of some mistake. If he is generally considered a "lost cause," he is excluded from membership in the family.

Rigid conformity, however, is not the rule. Living up to the traditions of Rose is. The difference is great. If a man wants to wear a suit to class, it is all right. If he wants to wear a sweatshirt to class, that also is all right. But if he is an underclassman and wears corduroy with either, he will hear about it in no uncertain terms from the seniors. If he is a freshman he will find that being the greatest guy in the world will not save his name if he doesn't get down with his classmates to help build the bonfire for Homecoming.

Fourthly, he is serious about life. He is concerned about nearly everything — intensely concerned. There is actually very little about which he is not concerned. He cares. I mention this because I think that the intensity of his caring implies a sense of personal responsibility much greater than normally found throughout an entire student body.

What does it all mean? That the Rose Man is someone super-wonderful and better than students elsewhere? Perhaps not; but I think that a great many students elsewhere could take a lesson or two from him. Certainly, the credit would not all be his, since his family brought him up and sent him to Rose, and the faculty and long line of Rose Men have done the greater part of the work in making him a Rose Man. They are the Rose-ness of this Rose Man. What is to his credit is that he is the Man, for no amount of parental love and guidance, nor academic paedagogy, nor age old tradition can force this quality upon him. He must, himself, take his own share of all three and make of himself what he will.

Then what is a Rose Man? How may I sum this all up? I cannot. There is no "magic plug" for a man, not even for a Rose Man. In the preceding few paragraphs I have managed to list a few of his qualities, those which I feel make him a distinct type of individual. However, a list of qualities out of context does not serve to describe the man. The Rose Man is Rose, and Rose is the Rose Man. Both are flexible, and neither is complete without the other. I would suggest that you take the best available materials — and build your own Rose Man.

Poetry from Vol. 1 of the Rose Technic

A MIDNIGHT ROMANCE

The night was cool, the air was still,
The moon-beams danced on the window sill,
And a Poly boy with a date to fill,
Went by the Artesian bath house.

He stopped at a doorway farther east,
And rang the bell three times at least,
Then paused as the beats of his heart increased
And waited as still as a mouse.

The door flew back and revealed a maid,
In a dainty evening gown arrayed,
And her smile her pearly teeth displayed,
In a manner really charming.

To the youth the evening almost flew,
And as time went on as time will do —
The antique clock struck one, struck two,
In a fashion quite alarming.

The light was dim, the fire was low
His fair blue eyes seemed all aglow,
He loved but dared not tell her so,
He could only stoop to kiss her.

But his desires of bliss were nipped in the bud,
She struck him out once, that once drew blood,
He fell in the street with a sickening thud,
And they carried him home on a shutter.

"My daughter," and his voice was stern,
"You must set this matter right;
What time did that Sophomore leave the house,
Who sent in his card last night?"

"His work was *pressing,* father dear,
And his love for it was great,
He took his leave and went his way,
Before a quarter of eight."

Then a twinkle came in her bright blue eyes,
And her dimples deeper grew,
"Tis surely no sin to tell him that,
For a quarter of eight is *two.*"

More Poetry from Vol. 1 of the Rose Technic

They were sitting in the moonlight,
And looking at the stars,
He told her how he loved her;
And smoked up two cigars.

He put his arm around her,
And drew her to his breast,
And as he "pressed the question,"
She sweetly did the rest.

—*EX.*

We don't like this durned town
We wish they'd put some sidewalks down
Sidewalks for our muddy feet
To save our walking in the street.

I made her a verse
One bright summer's day
But I could not do worse
Than to make her a verse
For with words that were terse
She sent me away —
I made her averse
One bright summer day.

—*EX.*

The maid expects her beau to-night,
And fills her stove with anthracite,
Because the air is raw and damp,
But quite forgets to fiill the lamp.

—*Bema.*

When I the query for your hand
Did tenderly impart,
You said you'd gladly give the same
With all your precious heart.

But when a rapturous kiss I gave
I learned, by sudden pain,
You gave instead, that little hand
With all your might and main.

—"95"

WHERE . . .

(*Continued from page* 10)

en the two main divisions of educators — those who prefer liberal arts and those who advocate scientific curricula—farther apart.

The paradox is that technological advances and complexities in world problems have brought a demand for greater specialization *and* a need for a broader understanding of the world and its troubles.

....

Behind the controversy of liberal arts versus specialization is the more fundamental question, just what is the purpose of higher education? Is it to prepare the individual for a productive place in society, or is it to open a whole array of intellectual doors for the student to sample and later, if he wishes, choose one to explore more fully?

In the final analysis, of course, it is not the educator, but the student and his parents, who decide this question . . .

....

Choosing a vocation does not mean the student should shut out the world of knowledge beyond his narrow perimeters. The successful men of any vocation are those whose interests are broad, who can relate their endeavor to the work of others, and who are quick to recognize a potential application to their work from another field.

Discussions of education frequently suffer from vague distinctions between "education" and training." Melching [7] proposes a pragmatic distinction by stating

> One important difference between education and training can be found in the *source* of the objectives stated for each. If they originate from bodies of content (prescribed courses) whose relevance to future work is only generally established, they can be called *educational objectives.* If they originate from the specific activities a [student] must perform on the job at the successful conclusion of training, they can be called *training objectives.*

Elliott [2] offers a more general, but still pragmatic, description:

> Education is not training. It is the equipping of an individual with the tools, the capability, and the desire to continue in his personal and professional development as long as he lives. It is an attitude of mind; not a terminal degree.

And to this, Dr. Karl Compton's observation [3] can be added:

> the ultimate value of an undergraduate education depends far more on the quality of intellectual and moral discipline and inspiration than it does on the particular course of study which is the vehicle through which this discipline and inspiration are imparted.

Then what is an education in science or engineering? Aside from the obvious demand for scientists and engineers in their respective fields, the education in these fields has other uses. Evans [3] states that "It has been found repeatedly that the *habits of quantitative thought* which characterize our undergraduate training in engineering and science are a superb preparation for other professional fields." To this, Logan [5] adds that "without fully recognizing the importancet of a rigorous analytical training, undergraduate education in science and engineering has proven . . . to be the most successful preparation for a career in top management; it is increasingly the preferred preparation for graduate business schools."

If education in science and engineering is to serve as a foundation for such diverse roles, one might wonder about the attribuates of an educated person in these fields. Logan [5] believes that

> in order to be adequately educated, engineers and scientists should be highly competent in reading, writing, perception, concentration, organization of material, objectivity, problem-solving, decision-making, and creativity . . .

And adding to the argument on the need for ability to communicate, Gengerelli [4] points out that

> anyone who has a firm grasp of the conceptual foundations of his subject will be able to communicate adequately . . . with the intelligent layman; indeed, anyone who cannot do so without lapsing into jargon is very probably not a scientist but an artisan. Concepts and relations constitute the quintessence of true knowledge, and these can always

(*Continued on page* 34)

WHERE . . .
(*Continued from page 32*)

be set worth for non-technical purposes, in simple, honest prose.

....

Scientific education that is concept-centered and that does not attempt to cram into the mind of the student all of the existing knowledge in a narrow area opens the way to other and wider consequences.

We come, then, to the problem of how to achieve the desirable qualities and goals of education in science and engineering. Certainly, there are many diverse (and often heated) opinions. In Gengerelli's view [4],

one derives the impression that our scientific education has its center of gravity in technology rather than in basic understanding of subject-matter . . . Students are well grounded in mathematical, statistical, and laboratory techniques, but they are over-trained and undereducated.

....

Knowledge of technology and mathematical and experimental methods, and familiarity with specialized procedures, are, of course, necessary to the mastery of a particular scientific problem,, but these should not be permitted to occup the center of the educational stage. Of methodologies and technologies there is no end; no mind could hope to encompass all those items of method and gear which might prove useful . . . They can be learned readily enough when needed *if the learner has mastered the necessary conceptual basis*. [Emphasis added.]

All this implies that scientific education in a subject should begin with the study of its foundations . . . It is customary to counter suggestions of this sort by asserting that fundamental ideas are abstract and can best be understood . . . [after the student] has had a great deal of concrete experience with the technical aspects of the subject matter in question. This is a psychological mistake. By the time the student has acquired a certain technical competence in a scientific discipline, he has very little patience with beginnings. He is, without knowing it, well on his way to expertness, and the misplaced confidence which this brings.

And diametrically opposed to this last assertion of Gengerelli, Mechner [6] reports that

Hull on one side of the Atlantic and Piaget on the other showed that abstract concepts are learned by generalization from concrete instances, and that *in concept learning, the specific must precede the general.* [Emphasis added.]

In trying to determine suitable (and attainable) objectives of a Rose education, we must keep in mind that we are working with students of varying abilities, varying backgrounds, and varying desires. We do engage in a selecting process in filling each freshman class. But we then proceed as though our selection process gives us a homogenous class of nothing but potential scholars (in both ability and desire) — overlooking the fact that a true "scholarly attitude" is not to be found permeating any entire class.

Benezet [1] offers the criticism that

we are not entirely certain that the combination of tight admission screening plus maximum dollars spent on academics is producing a superior educational

Ad from Vol, 1 of the Rose Technic

result for every student . . . There is clear evidence that for the top level of scholastic students, the combination of tight academic screening and high dollar investment in specialties has produced superior results. It has speeded up progress into graduate school and thereafter into research, production, and other outstanding professional work . . . The trouble is, we speak of [highly selective] colleges as if they enrolled no students except potential scholars and researchers. Yet every college, even the most selective has a lower level of student body. Most of these are highly educable but are not necessarily inclined toward a life of scholarship and research. What kind of education are the colleges presenting for their needs?

We cannot dismiss this question lightly, for it directly influences our reputation and [1]

> public reputation in a college as in any business is not only the result of, but, much more, ,the actual means to success and quality in the product.

"How good, then, is a college? *A college is as good as the permanent improvements it brings about in the largest majority of its students.*" [1]

Perhaps we can agree to describe the problem of building an educational program as having the following four steps:

1. the choice of fields of study (or, "first destination");
2. the choice of an optimum program—both academic and non-academic—for preparing for *these* fields *and* fields to which these may lead (i.e., the "packing list") consistent with our environment and our capabilities;
3. the choice of methods of implementing this program,, again consistent with our environment and means;
4. the continual re-examination of our goals and the effectiveness of our education program in the light of changing needs and a changing freshman class.

Part II - Our Present Approach to a Solution

Our present academic program and its implementation was developed some two years ago after the (*Continued on page* 36)

Ads from Vol. 1 of the Rose Technic

From the Dec. '91 issue Rose Technic

AT THE FOOT BALL GAME

"The ball is much like a young lady," quoth she, "the center of attraction of thousands.

"Yes," quoth he, "and, as usual, quite inconsistent. Constantly changing sides."

"Nevertheless often imposed upon and trampled under foot," answered she.

"Much more frequently hugged," suggested he.

"Not of its own accord," blushed she.

"But submitted to without remonstrance," contended he.

"Of graceful form, you must concede," sighed she.

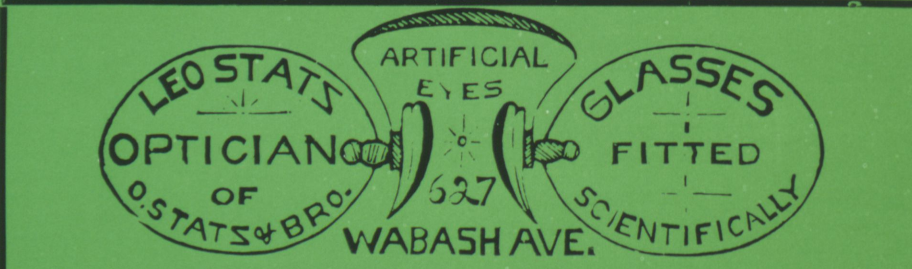
"Although laced together," replied he.

"Constantly sought after," argued she.

"But always to be played with," retaliated he.

"You mean thing" concluded she.

Ads from Vol. 1 of the Rose Technic



"MELANGE"

The new and popular Quadrille, also Oxford Minuet, Spanish Yorke, Hungarian, and other new dances, taught by

OSKAR DUENWEG,

ACADEMY, 665½ WABASH AVE.

New Class for Beginners, Ladies and Gentlemen, commences Tuesday evening, Nov. 10th, at 7:30 o'clock.

Class for Beginners, Misses and Masters, commences Tuesday, Nov. 10th, at 4 P. M.

Advanced Class for Ladies and Gentlemen, begins Monday, Nov. 9th, at 7:30 P. M.

Advanced Class for Misses and Masters begins Wednesday, Nov. 11th, at 4 P. M. (*References required from strangers.*)

—EXCHANGE—

Artesian Bath House and Swimming Pool.

Pool Heated in Winter by Steam. Tub and Vapor Baths.

Opp. Union Depot, **TERRE HAUTE IND.**

decision to concentrate on an excellent *undergraduate* education in the direction of a broad, liberal education in science and engineering and as a result of several considerations. Among these were the changing national views concerning education in science and engineering; the rapid advances in science and technology; the need for more flexibility in the curricula and in scheduling of classes; the expanding enrollments of college-age persons; the need for more classrooms; increasing costs of operation; and the changing patterns of placement and graduate studies undertaken by our graduates.

After studying various arrangements of the school year, it was decided that the present quarter system appeared to be best suitaed to our needs. The curriculum was then examined relative to a quarter system and it was decided that the old semester system of having five or six courses constitute a normal load required the student to fragment his attention to the point where the majority of students could give only superficial study to each course. It was decided that the curriculum for the quarter system should be designed so that four concurrent courses, studied in more depth, should constitute a normal load. With these decisions made, the next step was an examination of specific courses to determine how much "common core" could be used for *all* students. Included in this common core is the new and exciting approach to the humanistic studies and those courses in chemistry, mathematics, and physics which are considered "fundamental" to the understanding of the "fundamental" engineering sciences which include mechanics, thermodynamics, and electrical science. Aftaer this, each department planned its curriculum to build on this common core and to present a structure which emphasizes understanding of concepts and, hopefully, minimize the amount of material which may be doomed to early obsolesence by new discoveries — more "why" and less "how."

Accompanying this academic planning was planning for the non-academic parts of the Rose educational program. New dormitories and a new Campus Center were considered essential to the whole environment in which the academic program is to be pursued, and these have been constructed, Much remodeling has been done in the main building to provide modern laboratory spaces, offices, and three new larger lecture rooms which are designed to accommodate some of the various teaching aids such as movies, overhead projectors, and demonstrations. Furthermore, student organizations and activities have been endorsed by the Faculty as being a definite and important contribution to the range of experiences a student may acquire during his undergraduate years.

Since all this planning and building is for the education of students, the Admissions Staff has been expanded to seek out students who are interested in and who can reasonably expect to be successful in the kind of educational program Rose offers.

Part III - Epilogue

Thornton Fry, formerly with Bell Laboratories, suggested [10] that in order to get a glimpse of both the qualitative and quantitative changes and developments to be seen in the next fifty years, one need only look backward fifty years. The number of scientists and engineers today is vastly larger than then, and research today is pursued at an unprecedented pace. Consider all of the developments in science, technology, manufacturing, transportation, entertainment, communications, recreation, building materials, medicine, agriculture, biology, and so on almost without end, which today are almost commonplace but were unheard of and even undreamed of fifty years ago. One can then begin to sense the immensity of the task of formulating an education which will indeed prepare a student for a career in science and engineering of the future. This extrapolation makes it abundantly clear that

> for tomorrow's productive citizen, continuing education, training, and re-training must become a way of life . . .
> Educationally, the problem may be stated as the cultivation of the incentive and the technique for continuing self-development in a field of knowledge. Hereto, this ingredient has been primarily concentrated in graduate education. We have, of course, long been *saying* that self-development is a prime goal of all education, but most of us must admit that there has been more lip service to this philosophy than practical application [2].

Whether a student stays in science and engineering on a research level, in a production or administrative capacity, or whether he chooses a different career, he is still faced with the necessity of working with and for other people. He must sell himself as well as his ideas. And, just as important, he must also develop enough varied interests to allow him to enjoy a "good life," not just a "good living." As a responsible citizen in society, he must develop an awareness of other people, their needs, their problems, and their sensitivities; an awareness of his civic and religious responsibilities; and of the requirements of the ethics of his profession. Admittedly, not all these traits can be limitations and because these are traits which require a degree of maturity not commonly present in this age group. But the important point is that *the seeds of these traits can be sown in the undergraduate years,* and we would be remiss to overlook the opportunity. The responsibility that these needs place on the Faculty of Rose is made very real by the observation [8] that

> the kind of culture that the college student assimilates, given some choice, depends heavily upon the social organization of that college; there will be a strong tendency for him to take over valued beliefs from the group that has the strongest social appeal for him.

Of one thing we can be certain: By the time *a* solution is formulated, the problem has changed. The world changes, science advances, social needs and desires change, etc. Hence there is no such thing as "a" solution to "the" problem. The path an educational program takes may be

(*Continued on page* 38)

ROSE POLYTECHNIC

R—P! R—P! Rah—Rah! Rah—Rah!
R—P! R—P! Rah—Rah! Rah—Rah!
Hoo—rah! Hoo—rah!
Rose Polytechnic
Rah! Rah! Rah!

'92

Wax—co—Wax—co—Wax—co—Wax!
Tari—o—litz—o—litz—o—litz!
Hulla—boloo! Hula—baloo!
Rose Polytechnic '92

'93

Rah—hoo—rah, Yah—hoo—yah!
Hiro—kiro, Zip—boom—ah!
Flies on you, None on we
Rose Polytechnic, '93

'94

Whoop—to—razzle, Terre—goo—hoo!
Best on record! Horse on you!
Ausgezeichnet! Hear us roar!
Rose Polytechnic, '94.

'95

Razzle-dazzle! Zip-rah-boom!
Whoop—la, whoop—la! Give us room!
Rose Polytechnic, '95

More "wit" from Vol. 1 of the Rose Technic

A TALE OF WOE

The hero of this tale, for learning had ambition;
And to the "Poly" hied, in search of erudition.
Believe me, as a Freshman, in his class, he had no equal.
His fall may prove a warning, now listen to the sequel.

His fall came through a maid; 'twas ever thus, 'tis said;
'Twas through no fault of hers he failed, no blame rests on her head.
He struggled bravely 'gainst his fate; heaved sighs both long and deep.
But 'twixt him and his open book her image oft did creep.

And now as he burned the midnight oil, his theme was not geometry;
He studied the maiden's photograph, instead of trigonometry.
When he vainly essayed to study, his eyes would seek the air,
And with the pencil of Fancy, draw the form of the maid, so fair.

And thus the hero of this tale,, as a Freshman gained renown.
As a Sophomore flunked ingloriously, then quickly fled the town.
The moral here is plainly seen, by a discerning eye:
Maids and books, wil never mix, there is no use to try.

He writeth best who stealeth best.
Ideas great and small
For the great soul who wrote them first
From nature stole them all.

—*Ex.*

described as a polygonal line, each segment of which heads in the direction of most probable success toward an everchanging set of goals and means. *The only permanent goal is to help the student learn to become his own teacher.*

There is nothing to justify the pessimistic feeling expressed in the verse from the Rubiayat of Omar Khayyam which states

"Myself when young did eagerly frequent
Doctor and Saint and hear great argument
About it and about; but evermore
Came out by the same Door as in I went." (Vs. 27)

For to wish for an end to the need for ever-changing educational programs is to wish for men to stop thinking, discovering, inventing, writing — or perhaps even to stop living.

These changes are *challenges* to all of us, not reasons for despair!

REFERENCES

[1]L. T. Benezet. The Myth Persists, But There Is No College Rating System. An article in *The National Observer,* 15 June 1964, p. 20.

[2]Martin A. Elliott. *The Engineering Profession and the Obsolescence of Skills.* An address given at I.T.T. to the Society of Plastics Engineers on 12 Mar. 1964.

[3]R. D. Evans, et al. *You and Your Students.* A pamphlet prepared by a faculty committee of M.I.T. under the chairmanship of Professor Evans, published by the Office of Publications, MIT, Jan. 61.

[4]J. A. Generelli. The Education of Future Scientists. *Journal of Higher Education, XXXV, No.* 2, Feb. 64, (61-70).

[5]J. A. Logan. *A Liberal Education In Science And Engineering.* An address given at Tri-State College, 8 Apr. 64.

[6]Francis Mechner and Donald A. Cook. *Behavioral Technology and Manpower Development.* Basic Systems Inc., (1964).

[6a]Francis Mechner. *Science Education and Behavioral Technology.* Basic Systems Inc., (1963-64).

[7]W. H. Melching, at al. *A Handbook For Programmers of Automated Instruction.* U.S. Army Air Defense Human Res. Unit, Ft. Bliss, Texas, Sept. 1963.

[8]Nevitt Sanford. Development of the Individual in College. *The World of Wiley, Col.* 1, *No.* 1, 1963.

[9]Broader Base. An editorial in the *Terre Haute Star,* 31 Aug. 64.

[10]Thornton Fry, Mathematics as a Profession in Industry. *American Mathematical Monthly,* Vol. 63 (1956), (242-245).

Ads from Vol. 1 of the Rose Technic

We have a Full Line of Holiday Goods

Trunks, Valises, Satchels,

Traveling Bags, School Bags, Shawl Straps,

Children's Toy Trunks,

AT

DICKHOUT'S FACTORY,

646 Wabash Avenue.

Novelties in Suitings,
Novelties in Trouserings,
Novelties in Vestings,
For Spring.

A Complete Line of READY MADE CLOTHING always on hand.

J. T. H. MILLER,

Clothier, Tailor and Men's Furnisher.

522 Main Street.

chines think?" is in itself meaningless.[2] Turing substituted an alternate question, known now as Turing's Test. He suggests a situation in which a human interrogator communicates by teletype with both a machine and a human being. When the interrogator is unable to correctly determine whether he is communicating with man or machine, Turing's Test is satisfied.

The task of artificial intelligence, then, has become one of imitation of the behavior of intelligent man. A related but separate concern, the simulation of intelligence, should not be confused with this behavioral problem. Simulation is a modeling of human processes.

The work being done in artificial intelligence falls into several categories, according to the aspect of intelligent human behavior being studied. These categories include aspects of learning behavior, heuristic programs (those programs that decide themselves upon the best method for attacking a task), machines that understand the natural language of man, and pattern recognition machines.

Before examining some of these types of machines, a particular characteristic of all of them is to be noted. Intelligent machines require a *clear-cut goal* toward which they may direct their attempts at progressive action. The learning machine needs an objective indication of its successful learning, the heuristic program must have a guide for selecting the best approach to a problem, the natural language program must have some language key against which to perform and the patter-recognizer must seek given patterns. In the chess- or checker-playing machine, the heuristic integrator, and the natural language machine, establishing a goal is simpler than creating the machine. The goal is simply the won game, the correct translation, or the properly learned solution.

It is in the areas to which these machines are *hoped* to be applied or are just beginning to be applied (election-prediction, military defense and offense, and economic studies) that the importance of a clear goal becomes the focal point of attention. The inability of the programmer to state a complete goal in these complex areas, coupled with the design of the machines to seek a given goal by any means open to them, has caused considerable concern in the scientific community. The late Norbert Wiener, distinguished mathematician and philosopher, suggested that certain "sinister possibilities" might grow out of the game-playing machine, applied to such systems.[3] He feared that man would be too willing to accept the results of machine decisions, oriented to reach goals so complex that the accompanying consequences are hidden their arrival.

Experiments in Artificial Intelligence

The learning machine has been approached experimentally in two separate ways—via the *constained* machine and via the *general* learning machine. The constrained machine is milited in its activity to a particular pursuit (e.g., to winning the game of chess). The general learning machine is not constrained (hopefully) by its design, and is free to seek any goal toward which it may be directed by knowledge of its success or failure at accomplishing an assigned task.

The learning machine, constrained or general, utilizes a process not unlike natural selection. In attempting to perform a task, the machine produces some response, or output, for a given stimulus, or input. When the machine's response is a deirable one, as determined by a previously established goal, the response is *reinforced.* The machine keeps a record on the performance of a particular method, and reinforcement is simply a modification of the success record to indicate further success. By examining the records of several methods, the machine may determine its most successful approach. When particular methods gain a low record of success, they are discarded for newly-generated approaches.

This reinforcement process will be seen in the checker program to be discussed as a modification of the board-scoring polynomial upon which the machine depends for judgments. In the general learning program referenced, the process is a modification of the success records of individual instructions in the program.

In 1955, Mr. A. L. Samuel, of the International Business Machines Corporation, developed a checker-playing program which displays aspects of learning behavior.[5] This constrained machine's goal—winning at the game of checkers—was chosen because it was not considered deterministic in the practical sense. No known method exists which will guarantee a win or draw, and a look-ahead by the computer at all possible future moves to the game's end, at the rate of three choices every 10^{-9} second, would require 10^{21} centuries, acording to Mr. Samuel. In addition, a clear-cut goal of winning the game, along with an intermediate goal of minimizing the number of opponents pieces on the board, provides a clear goal.

The basic checker-playing program operates by looking ahead at all possible next moves for a given number of moves, or *depth.* The resulting board positions are then examined and scored by the machine on the basis of their relative advantages. The scoring is performed using a linear polynomial, each term of which represents a particular weighted factor in the game (e.g., piece advantage, mobility, etc.). Rather than have the machine look ahead a set number of moves, the program itself decides when to stop exploring a particular path. Originally looking ahead at least three moves, the machine will stop and evaluate the board positions reached unless: (1) the next move is a possible jump, (2) the last move was a jump, or (3) an exchange is possible. If any of these conditions occur, the look-ahead can continue until eight moves, at which point it will cease if (1) or (3) is not met. At ten moves or greater, the look-ahead will cease if (1) is not met, and at twenty-two moves, the process will cease if neither side should have a two-king advantage. The look-ahead stops regardless of all conditions at forty moves. As the number of pieces on the board decreases, the breakpoints (the look-ahead depths listed above) are adjusted for greater depth.

One can begin to grasp the complexity of such a program at this piont. The degree of specialization, or constraint, of this program clearly renders it a *constrained* learning machine.

To this point, only a basic checker-player has been described. The machine scores the possible moves, assuming that the opponent will make the most advantageous moves for himself, and arrives at an optimum machine move by this *minimax* process. Learning behavior has not yet been discussed.

The first aspect of learning utilized was rote learning. In this technique, the particular board positions, along with their computed scores, are stored in the memory, for reference when identical situations are reached. In Mr. Samuel's words, "This can hardly be called a very advanced form of learning; nevertheless, if the program then utilizes the saved time to compute further in depth it will improve with time."[6]

In order to keep the number of records of positional values stored in the computer within reasonable size, special culling techniques had to used. Each positional record was tagged with an *age* term, and upon every use of a record its age was reduced. The age was also periodically increased on *all* terms, and the more useful records became distinguished from the lesser-used records. Terms over a preset age limit were discarded.

Using thse techniques, the machine was set to play itself and to follow published games, in addition to playing conventional games. The program became a "better-than average novice, but definitely not . . . an expert."[7]

At this point Samuel removed the rote-learning ability of the program and developed a procedure for learning by *generalization*. Under this method, the machine adjusted the terms of its board-scoring polynomial acording to its success with various coefficient values. With this new ability, the machine developed a good middle game, and a strong end game, as contrasted to the master openings played by the rote-learning machine. Mr. Samuel concluded that rote learning was best suited for situations where results of a specific action are long delayed or highly specialized techniques are involved, while learning by generalization operated better in situations of large condition-permutations or short reaction times.

In 1962, the Samuel program bested former Connecticut checkers champion R. W. Nealy. According to Mr. Nealy, "In the matter of the end game, I have not had such competition since 1954, when I lost my last game."[8]

Mr. Samuel concluded that learning schemes that will greatly outperform an average person are now devisable, an dsuch schemes may eventulaay be feasible as applied to real life problems.

Mr. R. M. Friedberg of the International Business Machines Corporation developed a program for *production* programs that solve simple problems.[9] Mr. Friedberg's machine generated programs that were 64 instructions long, which were used to operate on data in a 64 bit (*bi*nary dig*it*) data area. The programs were to perform such operations as the addition of particular pieces of data, and logical AND and OR functions. Each instruction of a generated program carried with it a *success record*. The records were increased by one for each success of the entire program. The success record of a particular instruction then became an indication of the worth of the instruction at the particular point in the generated program.

The details of the program-writing program, while interesting, are beyond the scope of this article. It can be noted, however, that the random aproach of the machine required a large number of trials in order to develop valid procedures.

In the first experiment, the reinforcement segment of the program was set up to detect success in the task of making an output bit equal to an input bit. One implicit requirement of the program was therefore that a particular location be for input, and another for output.

The progress of the machine is recorded in Table 1. Since the prob-

(*Continued on page* 42)

TABLE I

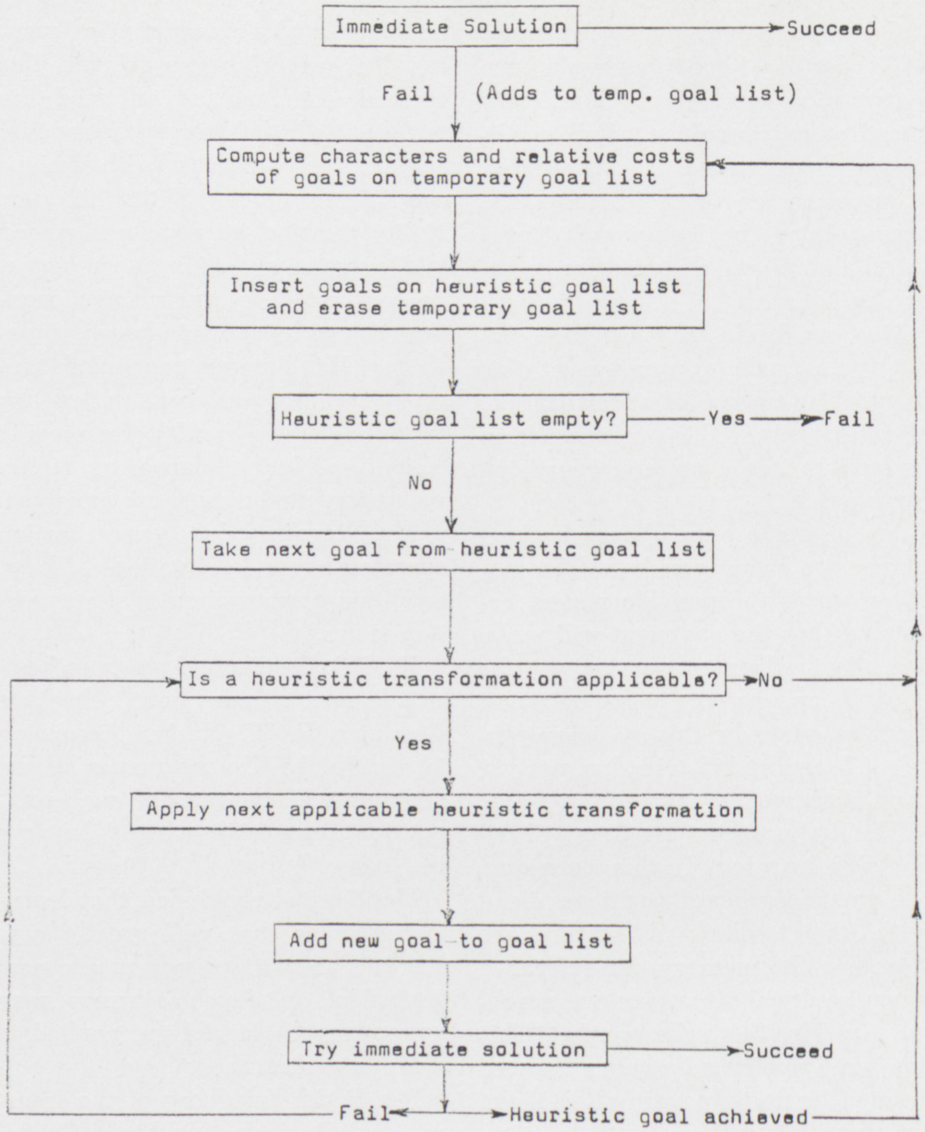
SUCCESS OF THE FRIEDBERG LEARNING MACHINE

(TASK: OUTPUT = INPUT)

Block of 10,000 Trials	Number of Successes
1	26
2	511
3	1,822
4	3,057
5	3,853
6	4,648
7	4,741
8	4,601
9	4,387
10	4,623
11	4,123
12	2,488
13	4,246
14	4,554
15	4,382
16	10,000
17	10,000
18	10,000
19	10,000
20	10,000

Fig. 1

SAINT FLOW CHART



(Reproduced in part from Computers and Thought, p. 199.)

ability of producing the correct binary output is 0.5, it can be seen that at first the programs did not reach a success level that chance itself could allow. Mr. Friedberg comments that at this time most of the programs were probably taking longer than 64 instruction times to execute. The machine was designed to consider any more than 64 instruction executions as a failure. In the early stages the machine was therefore developing a program that too kless than the maximum 64 instruction times to execute.

After 15,000 attempts, a perfect program was achieved, giving the proper output each time. The machine was rerun with different random initializations eight times with similar results. On the tenth trial, the machine failed to develop a successful program.

Another task given the machine was the addition of two input bits. No successful program was ever developed, although the machine did gravitate to a program that always finished within the 64 instruction execution times allowed.

As an example of a *heuristic* machine, the SAINT (Symbolic Automatic INTegrator) program of Mr. J. R. Slagle of the Lawrence Radiation Laboratory may be studied.[10] The Slagle machine was designed to find a symbolic expression (answer) for a given indefinite integral of difficulty similar to those integrals encountered by college freshmen in engineering areas. The procedure contained the heuristic aspect that a relative *cost estimate* was made of alternative methods of solution, which were expressed as *goals*. The goals were then ordered by their relative costs, and the machin proceded to attack the problem according to the goal list.

A published flow chart of SAINT is shown, to illustrate the executive procedure of the program (Fig. 1). As indicated by the chart, two goal lists were used. The *heuristic goal list* is the ordered listing of possible procedures, ordered by cost. The *temporary goal list* is a temporary listing of goals generated by an attempt at an *immediate solution* (namely, the accomplishment of the complete integration). Immediate solutions are attempted at several points, and the temporary goals they generate are merely the procedures the machine belives will finish the integration.

Costs are computed from the relative complexities of integrands, and *heuristic transforms* are those transformations of goals not directly handled by algorithms, which, while correct, have some degree of risk in their contribution to a solution.

As a test of SAINT's effectiveness, 86 integrals were provided, 54 selected from an MIT freshman calculus final, and the other 32 provided by Mr. Slagle. SAINT solved all 32 of Mr. Slagle's problems, and was also able to solve 52 of the 54 MIT problems.

The MIT problems solved each required less than one minute for solution, and the longest other run was on the integration for which SAINT required 18 minutes.

A modified SAINT was run without the ability to order goals by cost, and four problms were found to run at different rates than in the original program. Of these, three ran faster in the original program.

The average cost of a solution on the IBM 7090 computer on which SAINT was run was about fifteen dollars. Mr. Slagle states that using SAINT on the faster IBM 7030 (STRETCH) machine would increase speed by a factor of eight hundred ,and decrease costs to about four cents per precompiled problem.

Slagle concludes that a machine can perform in a way that, if duplicated by a human, would be called intelligent.

The breadth of work done in artificial intelligence by far exceeds any attempt to describe all areas in this article, and therefore the reader is referred to the bibliography for descriptions of further experiments. All works in the bibliography may be found in the Rose library. Important expeirments include *pattern recognition*, use of *natural language*, and *theoremproving* machines. The interested are encouraged to investigate these, for many experiments provide insights into possible methods for arriving at intelligent or near-intelligent behavior.

Conclusions

Because the recognition of some form of *artificial* intelligence strips away a portion of human uniqueness and dignity for many individuals, considerable argument against the existence of any artificial form has been raised. Much of the thought that artificial intelligence is overrated, over-extrapolated, unrewarding, or even dangerous comes, however, from an objective, scientific viewpoint. In the same fashion, much work and prediction has been on a careful, scientific basis. Unfortunately, both camps have had their share of extremists.

In a discussion quoted in a collection of computer advances, Mr. Irving Good, of the Atlas Computer Laboratory and Trinity College, discusses to length "the first ultraintelligent machine."[11] He states that such a machine would be the *last* invention that man need ever create, provided the machine is docile. He further concludes that this machine shall be built in the twentieth century.

In *Computers and Common Sense: The Myth of Thinking Machines,* Mortimer Taube may also be found out on a limb, painting an inhibitory picture of a scientific world deluding itself with the notion of artificial intelligence.[12]

In a review of Taube's book, Walter R. Reitman has this to say: "The bulk of it consists of allegations presented as facts, of misunderstandings, of debaters' tricks identical to those he decries in others, and of statements about the work of others which are simply untrue."[13]

Exteremes are generally balanced, it seems, and many of the arguments raised against the experimenters' claims are quite valid. As Taube points out, machines are often supposed to be capable of translating languages, learning in a human sense, and making reliable decisions about complex systems. This is in many cases a convenient extenion from work being done *towards* those goals. While Good is predicting a machine more intelligent than man will use a *nueral-net approach* (a model of the human brain's neural structure), Friedberg has been unable to educate his program, grounded in the neural-net concept, to add two binery digits!

In the author's opinion, the greatest danger, possibly already manifest in harm done, is in placing under the control of allegedly intelligent machine the powers to interfere with the balances of society and nature, without adequate understanding of the systems. The machines concerned are not necessarily deemed intelligent as yet, but the powers controlled by such machines seem to indicate an implicit trust in some intelligence.

The complex systems of economy, democratic elections, and military decision are not adequately understood to warrant the insertion of machines with overall power into the ssytems. The voting prediction machines already tell Americans how the vote will go before the polls have closed. The military use complex data processing and communication systems, far beyond the complete understanding of any one individual, to inform them of military situations. Who is to check the checker?

Norber Wiener's sound warnings on the use of goal seeking machines in systems where certain implications are unclear are to be carefully noted.[4]

The results of experiments in artificial intelligence should be seen as what they are. It is now possible for a machine to outperform man in certain limited areas of intelligent behavior. While this should be of encouragement to researchers, foolish predictions are to be avoided, and care must be observed in entrusting machines with large responsibilities.

Just as some machines transcend man's physical limitations, so others may trancend his mental limitation. The unsinkable *Titanic* was sunk by an unforseen iceberg, however, and so may the *mental* tools of man meet with disaster, carrying man down with them.

FOOTNOTES

1. Paul Armer, "Attitudes toward Intelligent Machines," **Symposium on Bionics; cited ir.** Feigenbaum and Feldman, **Computers and Thought** (New York, 1963), pp. 389-405.
2. A. M. Turing, "Computing Machinery and Intelligence," cited in Feigenbaum and Feldman, **Computers and Thought** (New York, 1963, pp. 11-35.
3. Norbert Wiener, **The Human Use of Human Beings** (Cambridge, Mass., 1950), p. 203.
4. **Ibid.**, p. 212.
5. A. L. Samuel, "Some Studies in Machine Learning Using the Game of Checkers," **IBM** Learning Using the Game of Checkers,," **IBM Journal of Research and Development,** III (1959), 210.
6. **Ibid.**, p. 218.
7. **Ibid.**, p. 218.
8. Edward A. Feigenbaum and Julian Feldman, **Computers and Thought** (New York, 1963), p. 104.
9. R. F. Friedberg, "A Learning Machine, Part I, **IBM Journal of Research and Development,** II (January, 1958), p. 2.
10. Feigenbaum and Fieldman, **op. cit.**, p. 191.
11. Irving J. Good, "Speculations Concerning the First Ultra-intelligent Machine,"; cited in Franz L. Alt and Morris Rubinoff, eds., **Advances in Computers,** VI (New York, 1965), p. 31.
12. Mortimer Taube, **Computers and Common Sense: The Myth of Thinking Machines** (New York, 1961).
    135 (March 2, 1962), p. 718.

BIBLOGRAPHY

Alt, Franz L., Rubinoff, Morris, ed. **Advances in Computers.** New York, 1960-65.

Feigenbaum, Edward A., Feldman, Julian, ed. **Computers and Thought.** New York, 1963.*

Friedberg, R. M. "A Learning Machine, Part I," **IBM Journal of Research and Development,** II (January, 1959), 2-13.

Friedberg, R. M. "A Learning Machine, Part II," **IBM Journal of Research and Development,** III (June, 1958), 282-287.

Minsky, Marvin L. "Artificial Intelligence," **Scientific American,** 215 (September, 1966), 246-260.

Reitman, Walter. "Fact or Fancy," **Science,** 135 (March 2, 1962), 718.

Samuel, Arthur LL. "Some Studies in Machine Learning Using the Game of Checkers," **IBM Journal of Research and Development,** III (1959), 210-229.

Taube, Mortimer. **Computers and Common Sense.** New York, 1961.

Wiener, Norbert. **Cybernetics.** Cambridge, Mass., 1948.

Wiener, Norbert. God & Golem, Inc.: **A Comment on Certain Points where Cybernetics Impinges on Religion.** Cambridge, Mass., 1964.

Wiener, Norbert. **The Human Use of Human Beings.** Cambridge, Mass., 1950.

*An excellent bibliography of the works in the field is contained in this book.

Nov. '65: Esteban Ruiz faced ruin. Then Union Carbide started the Managua Airlift.

Esteban Ruiz Garcia grows cotton in Tipitapa, Nicaragua. In a good year, his 25 acres produce about 55 bales. Enough to support Esteban, his wife, five of his children and seven of his grandchildren. Not in luxury, but in independence.

In November 1965, an invading army threatened Esteban's land. Bollworms. By the millions. Eating five times their own weight every day.

Esteban needed help, and so did his neighbors. And 2,000 miles away, Union Carbide started it moving. 50 tons of Sevin insecticide were flown to Managua. 225 tons followed by sea. Sevin saved the Nicaraguan cotton crop, as it has saved many other kinds of crops all over the world.

This wasn't the first airlift of Sevin. Often no other insecticide will do the job. Discovered by Union Carbide in 1953, Sevin takes over where DDT leaves off. It won't show up in meat or milk. And on many crops you can use it right up to the day you harvest.

Someday, Union Carbide's researchers may come up with an even better insecticide than Sevin. We never stop trying. And there's precious little we don't get into.

That's why we're always looking for talented young people to help us.

Your placement office has more information about Union Carbide. An equal opportunity employer.

UNION CARBIDE

THE DISCOVERY COMPANY

General Electric engineers and scientists are helping to satisfy the needs of society...

Like rapid transportation

Your technical career at General Electric can cover a wide range of engineering innovation. Take today's rapid transit problem for example. Inquisitive minds in research and design at G.E. have developed circuitry, radar controls and propulsion systems that can run and guide a 150 mph transit train. Manufacturing engineers have developed methods and machines to produce these transit systems as efficiently as possible. And technical marketing specialists are working with cities and government, planning their transportation networks. Good reasons why at General Electric innovations start and finish with the technical man.

For more information on career starting points available to you with G.E. (in research, development and design; manufacturing, or technical marketing) write: D. E. Irwin, Section 699-19, Schenectady, New York 12305.

GENERAL ELECTRIC

An Equal Opportunity Employer