Not long ago the computer was a mass of disassembled parts like those at left.

a Plan, a Computer and People

THE University of Oklahoma's new high-speed computer is an amazing mass of vacuum tubes and diodes and transistors and wiring and flashing lights which can perform the life work of a mathematician in a matter of hours. The story of this computer is a look into fields researchers have only skimmed, into industrial problems to be solved through more efficient use of personnel and material, into the preparation of O.U. graduates for a scientific world. Yet if the computer story is one of automation, it is also the story of men.

Men first grasped the idea of an electronic giant to free mathematicians from the time-consuming complexities which limited their work. Men at O.U. became intrigued by the possibilities that such a development held for the University. They designed the computer they wanted; they drew plans for the computer they needed, and piece by piece they built the computer they could not afford to buy.

When the completed computer goes into operation in the summer of 1961, the responsibilities of men to the machine will barely have begun. For all its awesome speed and versatility, the computer cannot think. Even the simplest of instructions must come from its human operator. Each problem must be set up by a highly trained programmer who can translate all the information and instructions into a numerical language that the computer can understand. The computer must be told to turn itself on and off, to read the instructions from a perforated tape, where to find the necessary information to solve the problem, which mathematical process to perform, what to do with the answers.

Once the operator has set the stage, he can sit back and wait for a modern miracle which can be measured in millionths of a second.

This is speed; this is progress; this is the future—a future made possible by men. This is the story of a computer:

continued

The Memory Tube
key to an electronic miracle

they couldn't buy it, so they built their own

NEARLY four years ago a faculty committee went before the Board of Regents and the Trustees of the University of Oklahoma Foundation with a do-it-yourself proposal that would have staggered lesser men. The faculty wanted to build a high-speed digital research computer. The Regents and Trustees decided that it could be done, and a mammoth undertaking was underway.

The University's electrical engineers, under Professor Gerald Tuma, '39eng, '41 m.eng, originally intended to duplicate the Atomic Energy Commission's Maniac II at Los Alamos, at the time a prime achievement in the computer field. But a visit to Los Alamos brought the Sooners up short. The plans for Maniac were gone—and so were the men who had built it. The engineers had no alternative but to take to the drawing board and design their own Maniac-type computer, drafting their own plans, incorporating their own improvements.

O.U. sent Professor J. Kenneth Watson, '51eng, to Rice Institute to work with computer expert Martin Graham in developing circuitry for the University's machine. He was gone two years. On the homefront, the component parts of the computer were being fabricated, many by the Seismograph Service Corporation of Tulsa. A building to house the computer, financed by the Merrick Foundation of Ardmore, began to take shape on the North Campus.

But as with most construction projects, progress and the time schedule could never quite get together. Professor Watson had been told to finish his work at Rice and return by the 1959 fall session. He arrived on time; the staff was set to begin putting the computer together, but men had to wait on materials. The Merrick Building was to be available for installation of the arithmetic units by September. The arithmetic units were ready by July; the building was completed the following May. If there was a low ebb in the entire project, this was it.

Costs began to rise. Because the engineers had had to start from scratch, the construction was taking much longer than had been estimated. The O.U. Foundation had followed an initial $50,000 grant from the National Science Foundation with a drive to raise the balance. More than a hundred state businessmen, corporations and foundations offered financial support. The businessmen of Norman raised 10 per cent of the total cost in a day's time. The NSF granted an additional $150,000.

Design and construction of the computer cost approximately one-half million dollars. Another quarter of a million went into the building. By the time the computer is in operation, the cost will have exceeded the present funds and pledges by $15,000, the amount still to be raised from new donors.

Construction progress is now at its peak within the completed Merrick Building. The computer, as yet free of its casing, is a study in brightly colored wires, minute electronic tubes and glowing bulbs, each one painstakingly placed in the intricate mechanisms by the O.U. engineers.

The units which perform the arithmetic processes have been completed and tested. The first section of the memory unit, where information for solving problems is stored, has been constructed and is being "debugged." The control unit, which interprets instructions and causes the computer to carry them out, will soon be finished. Auxiliary equipment is also in place, such as the flexowriter, a typewriterlike device for punching the coded problem on tape; the tape reader, which sends information from the tape to the computer, and a high-speed printer to turn out the answers.

Yet completion of this computer is not merely a successful job of duplication. The computer is a big step beyond its Maniac model. Its units incorporate the improvements made since Maniac was constructed. The methods employed by O.U. engineers in developing the computer have worked as well, and in many cases better, than more conventional methods and are vastly more economical.

If the University had been forced to buy a commercially constructed high-speed computer, the price tag would have been about $2 million higher. It would be difficult to estimate how long O.U. might have waited for its computer if men who could build such a machine had not been available. But even more important than the money they have saved is the experience they have gained.

Professors Tuma and Watson with Professors T. H. Puckett, '51eng, '60ph.d, and J. D. Palmer and Jack Reynolds, '56eng, '58m.eng, had virtually no experience in large scale computer technology. Completion of the project will give the University an electrical engineering staff of experts in this field. Their skill and experience will mean as much to the quality of engineering teaching and research as the computer itself will mean to the University and the state it serves.

the computer means progress for oklahoma

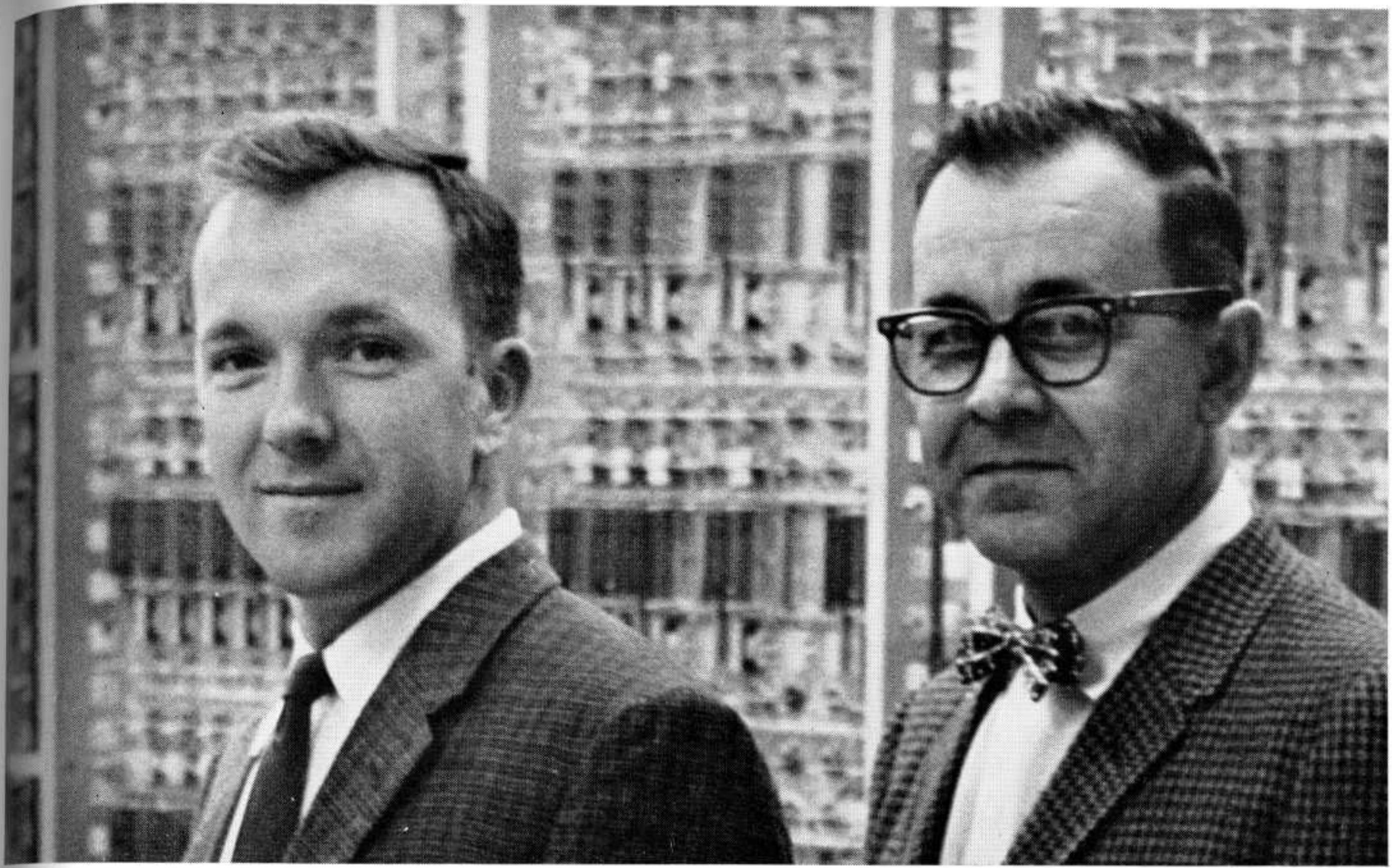
THE meaning of the new high-speed digital computer to the University and to Oklahoma is a many-sided story of advancement in research, education and service to industry, government and the public.

With the electronic marvel as their tool, O.U. researchers will be able to carry their investigations farther than ever before, whether the work is academically oriented toward master's and Ph.D. theses or on projects sponsored by the federal and state government, by business and industry. The University is continually in competition for the thousands of research contracts being awarded by these agencies. The presence of the computer on campus will have a great influence on O.U.'s ability to get the necessary financial support for an expanding research program.

But increasing the scope of faculty research is only one benefit of the program. Improving the quality of the faculty itself is another. The higher caliber faculty member is more likely to be attracted to the university which can provide him with the tools he needs to carry on his work. The same can be said for the superior student.

Although research in science and engineering is often the most widely publicized, it is not the only research which will make use of the computer. Research of one kind or another is going on in every area of the University.

In business, the computer will be able to move mountains of paper work built up by the growing complexity of business meth-



Professors Kenneth Watson and Gerald Tuma and their computer . . . a big step beyond its Maniac model.

ods. While employees might spend weeks digging through stacks of reports to reach routine decisions, the computer can grasp in minutes the same detailed information stored on its magnetic tapes. Forecasting business trends by statistical computation is another natural for such a machine.

In the social sciences, research is constantly going on to improve living standards and human welfare. On the University's smaller, slower IBM 650 computer, a study was recently made of the nutritional needs of grade school children for the state department of health—only one indication of what can be done with the new, faster, more versatile computer in similar fields.

University personnel will not be the sole users of the new computer by any means. The computer is envisioned as the center of the University's Industrial Research Park on the North Campus. On land adjacent to the Merrick Building, industries may establish their own research laboratories with access to the O.U. machine at costs far below rental time of commercial computers. Several companies have already located in the area—the electro-physics laboratory of ACF Industries, Inc., the Oil Recovery Corporation research laboratory, the Aero-Medical Center and the ground water branch of the U. S. Geological Survey. Negotiations are underway with other large industries interested in the Research Park idea.

Other businesses and industries of Oklahoma realize the value of computers in their operations. Many are already utilizing digital computers to solve problems of men and materials.

For example, a power company is faced with meeting a constantly varying demand for electricity caused by the change in seasons, new industry in the area, the addition of more electrical appliances in the homes. By computer methods, the company can keep a constant check on the capacity of its transmission system to handle the load. The corporation commission, in determining its oil allowables, could employ the same computer to figure the amount of oil which can be pumped from each of thousands of wells even though each well has a different producing capacity.

Important as research and public service is to a university, however, its primary business is still to teach, its primary product is still well-qualified graduates. The role of the computer is no less important in this area.

The finest computer in the world is worthless without the trained personnel to operate it. Supplying such personnel is the University's teaching objective.

The computer training program, under Dr. William Viavant, was initiated when the IBM 650 was acquired in 1957, with an eye to the completion of the new high-speed machine. Although few curriculums require the credit courses now being offered, the classes are jammed. Other students who are unable to work the course into their credit program, are enrolling in intensive three-week night courses. The word is getting around among engineers of the job advantage of computer skill, while many researchers are anxious to employ the computer in their projects.

Eventually the computer course will be added to the core curriculum for all engineers, increasing enrolment from the present 80 per semester to about 500. Enrolment from the biological and social sciences is expected to climb from 20 to 200 per semester.

A special program was initiated last spring to train a group of carefully selected students in the theory and operation of the new high-speed computer. With a grant from the Alumni Development Fund, 15 such students were hired at a small salary (after a training period) to work with the new computer. At least 50 other students have applied for this program without pay.

But training has not been restricted to University of Oklahoma students alone.

continued

Every Saturday students and teachers from 20 high schools are brought to the campus for instruction in computer programming and related mathematics. Some of them travel more than 200 miles each week to participate in this program, and yet only a fraction of the applications can be accepted.

Science and engineering professors from colleges all over the country have become students long enough for the University's summer computer course. More than 200 professors applied for the 36 vacancies financed by the National Science Foundation last summer. Three of these men are now directing the operation of new computer laboratories at their own institutions. Dr. Viavant hopes to be able to double the enrolment in this introductory course and to set up an advanced course for scientists and engineers as well as to establish a training program for professors of social sciences, humanities and other fields.

Researchers, businessmen and educators are turning to computers, and by the summer of 1961, they will have only to turn as far as the University of Oklahoma for facilities and services they need—needs to be filled by the computer which is the product of Sooner ingenuity, determination and foresight.

an artist looks at an electronic triumph

At the entrance to the Merrick Building hangs a mural—a study in diagramatic comparison and contrast—designed to reflect the atmosphere of the numerical analysis laboratory, home of the University's new high-speed computer.

In the mural, designed by James L. Henkle, associate professor of art, the evolution of mathematics is presented in a form not unlike that of a sentence diagram in an English class.

Forming the subject or basis of the mural are the symbols found in the international algebraic language of computer programming. Cast in oxidized bronze, their black color is in sharp contrast to the silver backing.

Extending from the basic symbols are the arms of a diagram depicting the various historical aspects of mathematics in designs, letters and numbers. A Chinese abacus, cast in chrome and brass, forms one section of the mural. Above it in brushed bronze is a series of ancient numerals adapted from various cultures.

Modern aspects of mathematical history are depicted in chromium. The binomial system, used in computer work, is set on blocks below the diagram itself. Above and below the central figures are polished and brushed chrome rectangles with Anglican alphabetic symbols and Arabic numerals.

Reading from left to right, the mural ends in a display of progress in arithmetic evolution. Set in solid and shell squares which denote the development of computer techniques are the most recent mathematical symbols in the same polished and brushed chrome.

The entire mural is suspended from a slab of heavy plywood painted stark white which covers the wall at the end of the entrance hallway at the laboratory. The three-dimensional figures are given an aura of lightness by the effective use of lights to cast dramatic shadows on the white panel.

Between 9 and 10 months work went into the conception, design and completion of the computer mural. This is the third such undertaking for Henkle. The Phillips Collection mural in Bizzell Memorial Library and a portrayal of allergies for an Oklahoma City doctor's office are Henkle's.

The mural at the Merrick Building, however, is entirely different from Henkle's other assignments. "Each building suggests different forms," Henkle contends, "and will result in a unique design, always different from any other work."

When Henkle began work on the mural he knew very little about either mathematics or computers. Prior to coming to the University he had worked in Chicago as an industrial designer. He was graduated from the University of Nebraska at Lincoln with a bachelor of arts degree and received a certificate of interior design from Pratt Institute, Brooklyn.

In preparation for the technical aspects of his work, Henkle spent the first part of his project deep in research. He read technical books and explanatory literature and spent many hours talking "shop" with Dr. William Viavant, director of scientific computations.

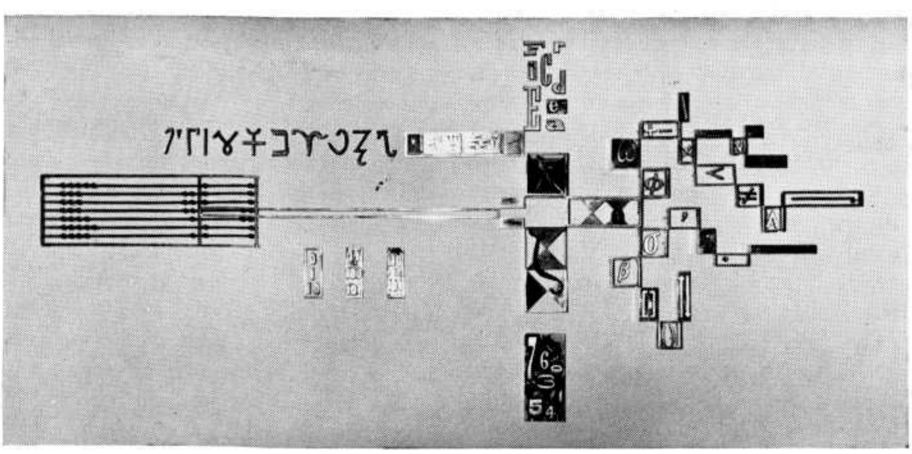
In his research Henkle tried to view the facts aesthetically in an effort to relate the various components of his subject matter. After he had conceived a few basic ideas, Henkle began sketching. Through hundreds of different designs, he finally achieved the desired effect. When the last sketch was complete, he made a wooden scale model of the mural. From this he made a full size working drawing.

As he formed the completed work, Henkle made the necessary changes and modifications. The final product was constructed through sand casting, silver soldering and machine work.

The subjective presentation of a strictly objective science is not an easy task. In his mural Henkle tried to reflect not only the machine itself, but the building and the people.

"Through design, color, dimension and general form," he says, "I have tried to show the precision of the computer. I wanted to create a mural which would seem to reflect expansion, change and new discovery.

"The mural represents the general feeling and quality of computers and progress," he explains. "There is nothing electronic here. It is primarily of people, but with a look of machine precision."



The computer—through the eyes of an artist.