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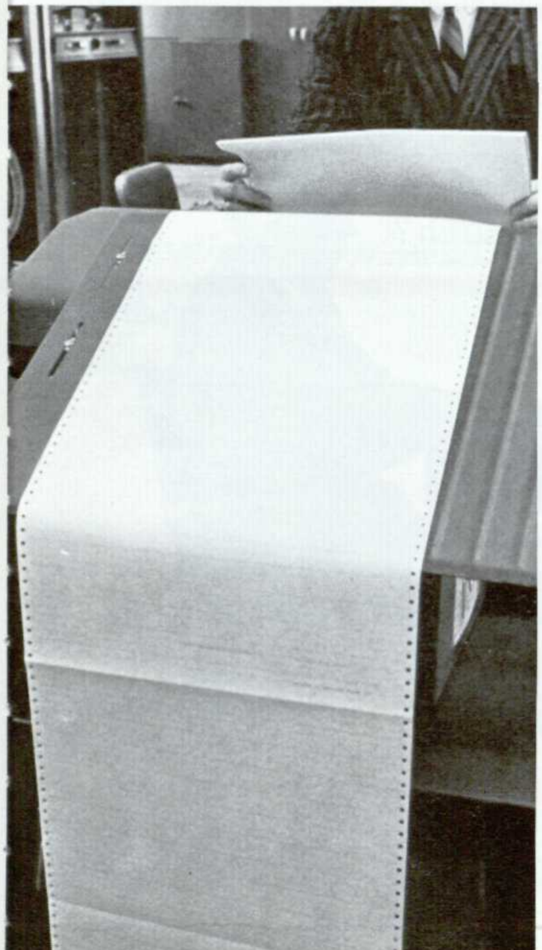

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Spartan Engineer

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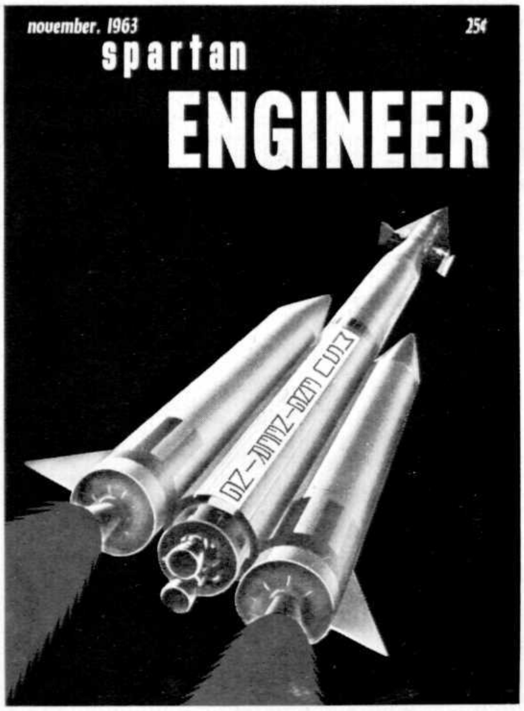

The November cover is a characterization of Michigan State's College of Engineering progress and bursting flight toward the heavens of advancement and achievement.

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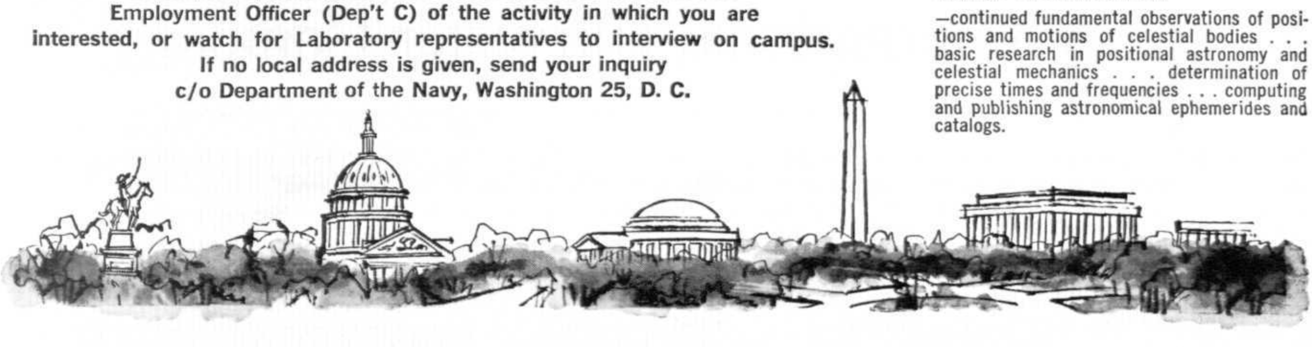

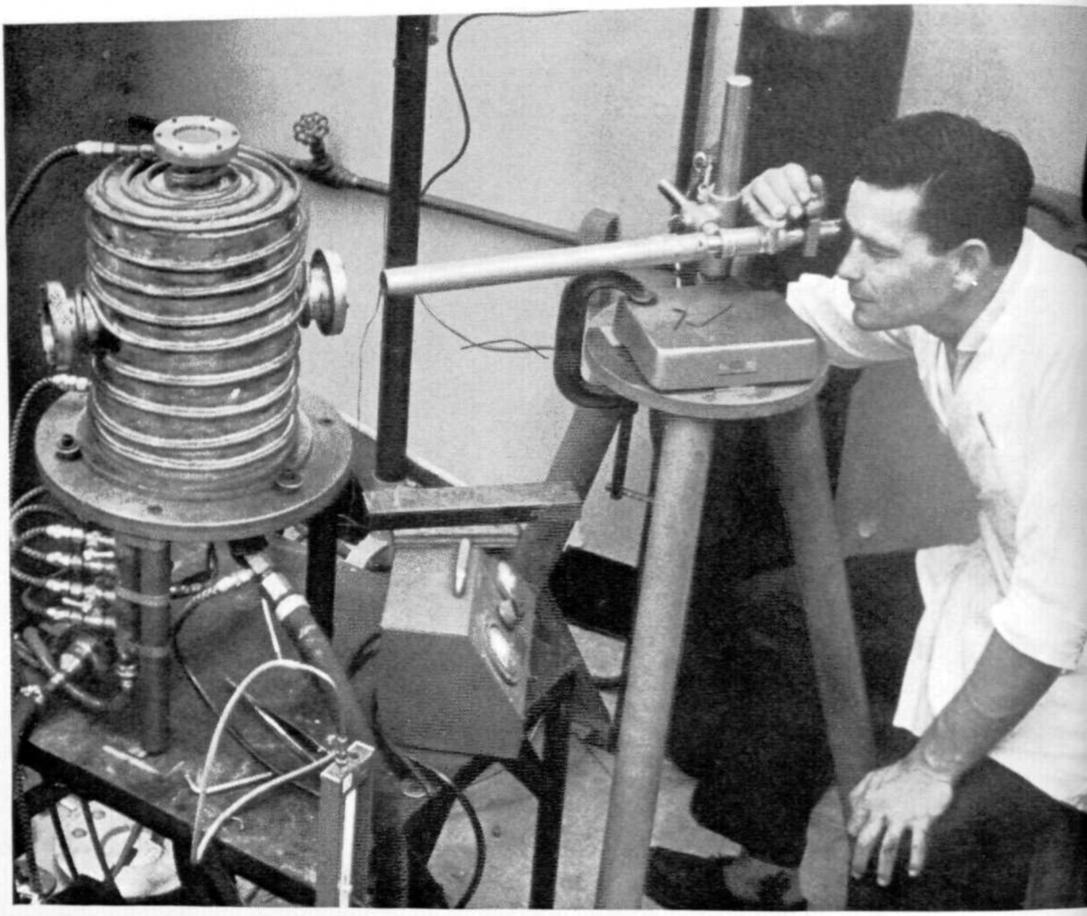

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Our Purpose

At the beginning of this year, the Spartan Engineer underwent a reorganization and regeneration that we feel certain will raise the quality of this year's issues.

In the past, the focus of the Spartan Engineer has shifted in varying degrees from industry and its research to a mixture of any available copy. In the future, we will focus our attention almost exclusively upon the Michigan State College of Engineering.

We have moved our offices to the Engineering Building and tried in many other ways to associate ourselves more closely with campus engineering activities. Reports of engineering research, organizations, comprehensive curriculum changes, and a general insight of the various offerings of the College of Engineering is our goal.

In general, we are striving to present our readers with material that will be as useful to them as it is entertaining. We will give them information which will greatly increase their knowledge of all the wonderful facilities, intelligent faculty, useful organizations, and expansive opportunities which the College of Engineering here at State has to offer.

We hope our publication will encourage even greater participation of engineering students and the College of Engineering as a whole in campus activities.

John B. Locke, Editor

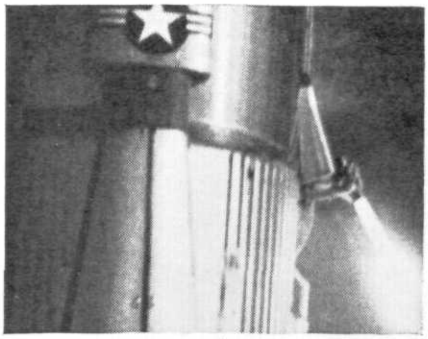
Dean's Letter

An engineering library has been one of our needs for many years. The construction of the new College of Engineering building made space available, funds were found by the College during the past year for equipment, and at the beginning of this school year our library began operations on a definite schedule. Located on the third floor, southwest side of the building, it is in a quiet, yet readily accessible, area. Currently it houses about 28,000 volumes plus engineering periodicals. The titles, and particularly the periodicals, are undergoing screening by a faculty committee to insure appropriateness to our present needs, in order that rarely used material may be returned to the Main Library for storage, thus freeing our shelves for additions to the engineering collection.

We are also very pleased to announce a gift of $25,000 through the MSU Development Fund, for improvements in physical surroundings, in reading room furniture, and to the collections. This gift is made through the generosity of one of our alumni, Benjamin H. Anibal, Class of 1909, and is the largest such donation received by the College since 1916. By the first of the year it is hoped that plans now being developed by the personnel of the Main Library, Engineering Librarian, Towne, our committee of Professors Lubkin, Dhanak, and Giacoletto, and the university interior decorator will have produced pleasant and comfortable surroundings, and an atmosphere conducive to study through use of these funds. The College certainly appreciates Mr. Anibal's interest in our welfare.

The hours at which the library is open are posted, and we hope that all of our students will develop habits which make a library search a part of the data-gathering and fact-finding process for all major engineering problems.

J. D. Ryder, Dean



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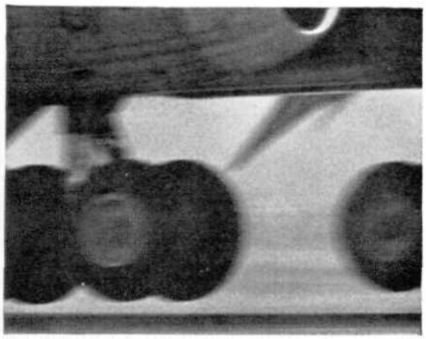

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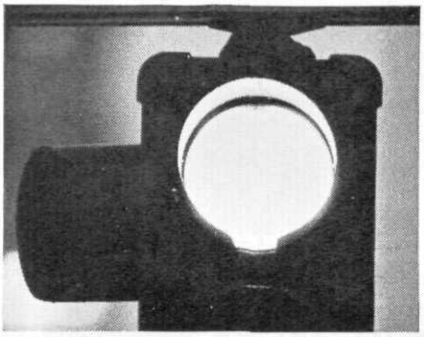

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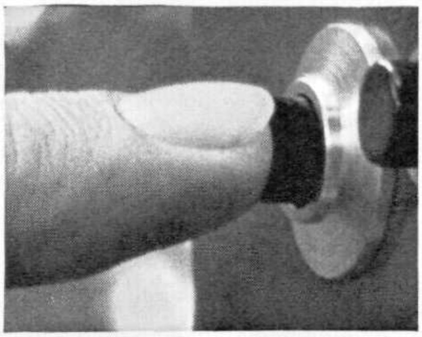

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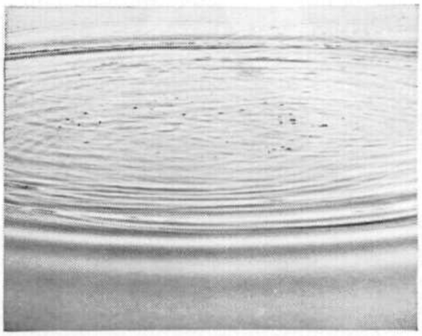

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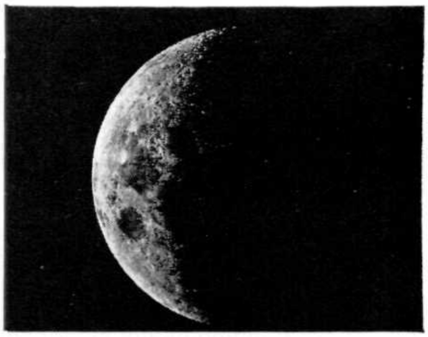

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Dr. Terry Triffet

FACULTY REVUE

by Phillip Kraushar

Today there is much in the news about the great American space program. But how many of us know anything of its feeble beginning shortly after the end of World War II?

The men who were there will never forget those days, however. One of them is now a professor of Mechanics and Materials Science at Michigan State University. Dr. Terry Triffet, who received his Ph.D from Stanford University in 1957, spent five years at the Naval Ordnance Test Station, China Lake, California. The housing district was at one end of a long desert valley, and firing ranges and test sites filled the other. As Dr. Triffet puts it, "We needed a lot of space then because we couldn't hit things very well."

He narrated one tale about one of our earlier guided missiles, the Lark. It was supposed to be guided from the ground, but shortly after take-off it took off on a lark of its own. Despite frantic button-pushing and switch-throwing down below, the rocket casually turned around, made a pass over the housing district, kept turning right back onto the range, and, luckily, into a mountainside.

Dr. Triffet also spent five years in radiological effects research at the Naval Radiological Defense Laboratory, San Francisco, California. There he studied the radiation characteristics and physical properties of fallout. One of the most difficult problems was to make measurements, and later to collect samples, from within the familiar mushroom cloud. Here his earlier experience with rockets proved useful in developing a successful solution.

Dr. Triffet's primary interest, however, is materials science. He teaches four graduate courses in this area; among them are Mechanics of the Solid State, Mechanics of the Fluid State, and Modern Mathematical Mechanics.

The projects in which he is now involved may not be as explosive as those of his past, but at least one of them is producing a few ripples in educational circles.

The Pilot Program, iniated by the Department of Electrical Engineering, is an attempt to set up highly integrated undergraduate engineering courses, providing up-to-date, material solidly grounded in mathematics and the sciences. The objective is to give the electrical engineering undergraduate a solid foundation in engineering before specialization in the senior year.

The Program has been divided into five areas; mathematics, humanities, systems, continua, and materials. "Mathematics and mechanics are the language and literature of engineering," says Dr. Triffet; and on this bedrock his part of the program, materials, is based.

There are two primary objectives in this area. The first is to teach enough about the properties of materials to enable the engineer to use them intelligently. To do this he starts with basic atomic structure and works up to the myriad complexities of behavior with which the engineer may someday have to deal. The second objective, skill and understanding in mechanics, is also taught starting with single particles and working up to systems of particles.

Is the program successful? Well, the National Science Foundation is sponsoring the Pilot Program through this year and the next two with a grant of approximately a quarter million dollars. One group has completed the Program, a second group is now part of the Senior Class, and a third group began this Fall.

Dr. Triffet says that a teacher feels good if he finds two students out of a class of twenty or so who really seem to be understanding in depth; but nearly half of a class who are products of the Pilot Program appear to fall into this category.

A UNIQUE TEACHING EXPERIMENT

by Orville Barr

Pilot Program. What's that? This may well be your response to the title of this article. To answer your questions you might ask one of the approximately 30 leading educators from American engineering schools who were here at Michigan State for three weeks during last August to observe it. They would all be willing to paint a glowing picture of it to you. Or, you might ask a member of the engineering faculty who is teaching in the Pilot Program. He also will sing praises of it to you. Or, if you want to, you might try some of the EE students who are enrolled in this experiment. Being students, you might expect them to give you some negative responses, but the picture is clear. The Pilot Program is important enough for you to investigate for yourself as a serious student in engineering at Michigan State.

To find out more about this wonderful thing, let us proceed as follows. Suppose we are studying classical physics. First we might study falling apples. In the process we learn a little about the mathematics involved in the theory of gravitation. Then we move onward to study ballistics and projectiles. Here again we learn how to apply the mathematics related to gravitation to a specific area of study. Then we study space travel and orbits. Here again we find it necessary to study gravitation in order to understand orbiting. But, would it not be better to study the mathematics of gravitation as it applies to all situations. We have lost nothing. And, instead of knowing all about apples falling, bullets flying, and space ships orbiting, we could be in a position to be able to analyze not only these but all problems that involve gravitation. We can solve these particular problems and also new ones as they come up. Then, does it not also make good sense to study those things that allow you to solve all problems of engineering rather than just those problems which you have studied in particular. After all, you can't study a problem if it didn't exist when you were in school.

Well, this is exactly what the Pilot Program is doing. The Department of Electrical Engineering, with support from the National Science Foundation, and with many interested onlookers all over the nation, is entering the third year of teaching a new type of discipline, called the Pilot Program. Before we find out what the Pilot Program is and what it can do for you, there is one word of caution. The Pilot Program is not a new way to teach the same old material. It is new, completely new, in concept, in philosophy, in outlook, in principle, and in practice. Also, it is not restricted to electrical engineering. Deans and professors are not just saying it can be applied to all engineering, indeed, in some of the major engineering schools around the country they are teaching all the engineering fields around principles similar to those represented by the Pilot Program here at Michigan State. And, even if you don't see that philosophy influence your course of study, you will have to compete in industry with engineers who have had the benefit of studying within such a framework.

Now, precisely what makes the pilot program so different. In the past, electrical engineering has been studied as a series of unrelated, hardware oriented technologies. You studied networks, control systems, antennas, rotating machines, electronics, transmission lines, semiconductors, etc. You studied specific areas of application, you gained knowledge that became outdated as soon as the machine you studied was put in the junk pile. Your knowledge of the basic disciplines of electrical engineering and their related mathematics was built up in a very illogical and incomplete manner. What the Pilot Program is attempting to do is prevent this type of learning that is outdated before it is acquired. It presents electrical engineering as three basic diciplines. These are systems, continua, and materials. The student, you, learns a comprehensive systems theory, a comprehensive fields theory, and a general knowledge about materials. This knowledge is applicable not only to all the areas of electrical engineering mentioned above and to those electronic and electrical systems of hardware as yet unthought of, but also equally applicable to hydraulic, pneumatic, mechanical, and magnetic studies. Also, this same mathematical theory can be extended into a multitude of areas in the social sciences such as economic systems, transporation systems, etc.

First we should define our three basic diciplines. When the engineer approaches a problem from the systems point of view, he looks upon it and mathematically analyzes it as an orderly collection of interconnected but separate discrete components or parts. Using his background in systems, he mathematically models each component, whether it be a capacitor, vacuum tube, lever, transistor, spring, hydraulic hose, servo motor; or a city, a busline, or a bank if he were studying the social system. He then mathematically models the interconnections between his components and is then able to predict how the system will operate before actually spending millions of dollars to build it.

At this point it is important to note that the mathematics and logic involved are completely independent of the type of system under study. To the graduate of the Pilot Program, the equation for an electrical inductor and that for a hydraulic damper are the same. It makes no difference in his method for handling the situation. He can and does treat them exactly the same. Compare this to the plight of the graduate of the conventional engineering curriculum. Either he must spend as much time studying hydraulic systems as he did electrical ones or he must let someone else handle his hydraulic problems. The student in the Pilot Program learns how to cope with both types and many others in precisely the same amount of time that it took the conventional engineer to learn the electrical fundamentals.

In a similar manner, the continuum or field discipline approaches each problem as though there were no internal boundaries. The problem is one large continuous field in which there are no distinct boundaries although there are variations in the densities of various characteristics. For example, look at a population map of the United States. From the systems standpoint, each city would be represented with a dot to indicate the presence of a population area, with some numeric indication of the intensity of the characteristic. However, on a map showing the fields viewpoint, you would see a continuous representation of the population, with perhaps the shading to indicate relative intensities. Thus our city would be shaded darker than the surrounding rural areas, but there would be no boundary between them, only a gradual blending of the two would be shown.

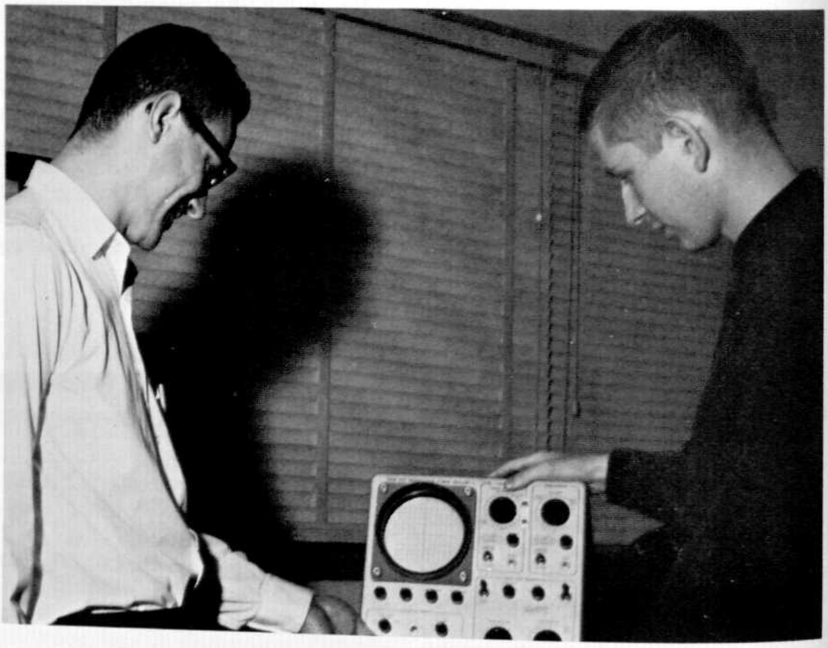
The third basic discipline of electrical engineering in the Pilot Program is materials. This is a study of the raw resources that the engineer has and how he can modify them so they demonstrate the characteristics he desires. No natural material can amplify, but the engineer can take ordinary germanium and by proper treatment, can make a transistor, with those characteristics, including amplification, that he desired.

Now, before going into how the Pilot Program affects what the student studies, let us look briefly at the past history of the idea. For the past many years, systems have been quite extensively studied here at Michigan State. As a result, it was conceived that a curriculum based upon the theories being developed might be significantly better than the regular series of courses studied by students in electrical engineering. As a result, a pilot group of approximately 30 students, mostly transfer students from junior colleges because they were a convient group, were started in the Pilot Program in the fall term of 1961. These people graduated last June. The reason for using a small "pilot" group was to avoid the difficulties involved with coordination of faculty efforts until texts could be written. Now that the texts for these courses are being developed, more sections of classes are being scheduled for the Pilot Program.

The Pilot Program is being developed with support from the National Science Foundation. In the specific area of development of a laboratory course for the program, the National Science Foundation provided a grant of approximately $25,000 to assist in development of the equipment and then provided matching funds to purchase the actual equipment after the prototypes were developed here. The support from the National Science Foundation was to continue for three years. The Department of Electrical Engineering is now entering upon their third year of operations with the Pilot Program. As part of the arrangements, 30 educators came to the Michigan State campus for three weeks during last August to study what was being done here. It is notable that no one gave a negative response to what they saw. In fact, most gave their overwhelming approval. This enthusiasm also appears in the expressions of the faculty that teach in the Pilot Program. They say they could never go back to the regular method of teaching their disciplines. By the way, the faculty employed includes instructors from departments other than electrical engineering within the College.

Now, as far as the actual courses of study are concerned, there is a vast difference between the Pilot Program and the "old" way. During the freshman and sophomore years, the goal of the Pilot Program directors is to give the student a unified series of courses in microscopic, molecular, and atomic physics and chemistry. This will require about 20 per cent of the student's time. Another 40 per cent of his time will be devoted to the study of mathematics. And the other 40 per cent will be devoted to the areas of communication skills, natural

science, the social sciences, and the humanities. During the junior and senior years, the student will spend 20 per cent of his time studying material science. This will, when based upon a solid foundation in microscopic physics and chemistry, complete his instruction in the materials discipline of the profession. The student will spend another 20 per cent of his time in the study of continuous systems. This will, when combined with a thorough preparation in mathematics and accompanied with parallel development of the mathematical sophistication of the student, complete his unified, comprehensive field or continum theory. The junior or senior will spend another 20 per cent of his time in the analysis, design, and synthesis of discrete systems. This series of courses, again based upon his mathematical background and upon a parallel series of courses in mathematics, will sufficiently prepare him to cope with those problems which are best tackled as discrete systems. The remaining 40 per cent of the student's time will be split between mathematics and statistics and the humanities. The student may choose to split his time equally between the two or to swing more in one direction or the other. It is hoped that there can be developed a course in the philosphy of science that will allow the student to realize some of the implications of the work he is doing. However, this course will be held until late in the senior year because the student can not study the implications of his work before he actually does it.



At the present time, many of these courses have not been developed. This means the student still studies conventional physics and chemistry. Much of the mathematical background needed must be taught in courses labled systems and/or fields because there are no suitable courses offered elsewhere on campus. But the Pilot Program is rapidly pushing toward its goal as outlined above. Naturally, this goal is undergoing transormations as progress is made and experience is gained.

The pilot Program represents a significant change in the electrical engineering as taught at Michigan State. However, the student should not assume that things are happening only here. This is not the case. In particular, while the strengths of the work here at Michigan State lie especially in the direction of the systems discipline, notable progress has been made by the University of California, Los Angeles, in developing the continua and materials areas. Other work in systems has been done at the Massachusetts Institute of Technology and at the Polytechnic Institute of Brooklyn. Work has been done at Dartmouth in laying a logical foundation for the discipline of information theory and thermodynamics.

So, if you are a serious student of engineering, and all engineers are, because they must be, good students, you should check into how the work being done here at Michigan State in the Pilot Program is going to influence your chosen profession and your place in it.

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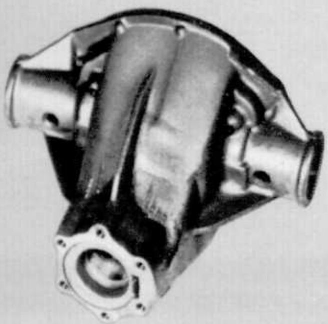

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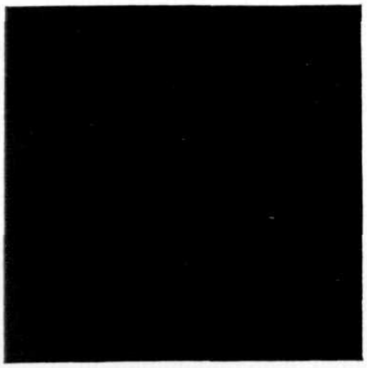

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MSU RESEARCH . . .

edited by John B. Locke

Dr. Shosei Serata

The objective of this research study is to develop numerical systems for describing the mechanism by which radioactive pollutants move through various environmental media; viz., air, rain, watershed, basin effluent, and milk. This subject has gained increasing attention in recent years in an effort to evaluate details of environmental pollution resulting from controlled and uncontrolled release of radioactive materials. Numerous investigations on the chemical and physical nature of the fallout fission products have been conducted in various aspects. The National Radiation Surveillance Network has been established for many years by the U.S. Public Health Service for continuous monitoring of radionuclide distribution in air, water, milk, and foods. More extensive programs of monitoring various radionuclides have been carried out in the areas of the major nuclear installations throughout the country.

Although these continuous surveillance programs are of vital importance to the public, such monitoring cannot by itself provide information on the dynamic movement of the radionuclides released into the enviroment, especially, in their process of eventual contact with man. A comprehensive understanding of the mechanism of radionuclide transfer through environmental media requires re-examination of previous investigations which have dealt with specific aspects of the whole problem. The subjects have been movement of atmospheric radioactivity, migration of specific radioisotopes through soils, absorption of radionuclides by ion exchange processes, tracing of disposed radioactive isotopes in streams, decontamination factor of water basins, and biological uptake of specific radionuclides.

No successful work has been reported as yet in the development of a theory describing quantitatively the transport mechanism of the radionuclides throughout the general environment. The effort to date has in the main reported observations of specific conditions but lacks in formulation of theories of the transport mechanism.

A considerable amount of progress has been made recently in automation of collection and compilation of various environmental data. An example is the radiological data which has been accumulated throughout the nation. The increasing accumulation of this data would have limited value for pollution control unless a numerical system for analyzing and interpreting it is available. Statistical analysis of the data can provide information on the probability of the occurrence of certain events, but describes nothing specific as to characteristics and condition of the pollutants. Therefore, for practical use of the data, numerical systems describing movement of individual radionuclides in specific environmental media are required. Unfortunately, however, it is not possible to describe mathematically every process of the movement of radionuclides in the environment since they are affected by numerous environmental variables, such as chemical and physical forms of individual isotopes, and meterologic, geologic, topographic, hydrologic, ecologic, and agronomic conditions of the environment.

The approach of the proposed study is to formulate and verify a hypothesis that the dynamic movement of environmental radionuclides can be described by a mathematical analogy of the environmental processes. The mathematical expression of such an analog model will lead to the development of the numerical systems describing the movement of the radionuclides. The merit of the approach is that is should be applicable to any natural environment in which the actual processes are too complicated to be known. The success of the proposed technique depends on an adequate hypothesis of the transport mechanism upon which the numerical systems are based, and the development of the hypothesis depends upon the experimental accuracy for determining the environmental parameters. Experimental evaluation of the parameters appears ideal at this time since an abundance of the fallout fission products of sufficient variety exists in the natural environment. It will become increasingly difficult to conduct such field experiments as the pending atomic test ban treaty becomes effective.

The study is directed at the development of numerical systems for describing the transport of radionuclide pollutants in a given watershed which can relate the dynamic movement and distribution of the pollutants in various media of the environment. The systems will be developed so that, for given concentrations of the pollutants in the air under a set of environmental conditions of the basin as a function of time, it will be possible to pre-determine the amounts of the radionuclides deposited on the ground, retained in the watershed washed out by run-off, taken up by crop vegetation, and then concentrated in milk.

The theoretical aspect of the study consists of three basic transfer processes of the radionuclides; viz., the uptake by rain in the atmosphere, the absorption and release in the ground, and the accumulation and biological uptake in a basin. In studying each transfer mechanism, a hypothetical model of the transfer is proposed and environmental parameters are defined characterizing the nature of the model. Adequacy of the hypothetical model will be tested by field experiments in an actual watershed of which the characteristics are well established. The specific behavior of the model predicted from the hypothesis will be compared with the field observation. After achievement of an acceptable level of accuracy, the model will be described by numerical equations.

The equations of the different processes will then be combined in order to synthesize specific systems of practical importance to the public health. At first, a system will be synthesized to compute the concentration of a specific radionuclide in an effluent of a basin for a given atmospheric concentration of radionuclides under certain climatological conditions. The radionuclides to be used for this study will be those fallout fission products with relatively long half-lifes, such as Sr-89, Sr-Y-90, ZrNb-95, Ru-Rh-103, Ru-Ru-106, Cs-137, Ce-Pr-144. Field measurements of the effluent will be made to examine and improve the synthesized system. Another system will be snythesized to pre-determine concentration of Sr-90, and Ce-137 in milk with respect to accumulated quantities of the nuclides and some environmental parameters of the basin. Computer programs for pre-determining each radionuclide in the effluent and the milk will be written. Predictions from them will be evaluated with the field observations.

Experimental Method of Procedure

The Sloan Creek basin, a small watershed with 9.34 square miles of basin area located near the Michigan State University campus, has been selected as the model basin for this study. This basin is the most common type in the area and has exceptional advantages since extensive documented records of its characteristics exist due to the fact it has been used for hydrologic, meteorologic, agronomic, geologic, topographic, and ecologic investigations by various research groups of the University and Federal agencies.

In the study of the air-rain transfer, concentration of the radionuclides in the atmosphere and rain will be determined continuously with simultaneous evaluation of environmental conditions such as type of rain, intensity and duration of precipitation, cloud height, degree of atmospheric turbulance, previous history of air mass and size distribution of aerosol particulates.

In the study of the absorption and release in the ground, the individual radionuclides deposited over the model basin by rain and dry-fallout will be measured and compared with their concentrations in the effluent from the basin. Quantities of the deposited nuclides will be determined from radiochemical assay of the rain and the stream samples collected in the basin. In the study of biological uptake, milk will be chosen as the terminal medium of the nuclide transfer. Representative milk samples from cows raised in the basin will be collected in sufficient number and frequency to detect any change in the radionuclide concentration. The two fallout fission products, Sr-90 and Cs-137, will be analyzed as the principal tracers. Soil and grazing grass may be analyzed whenever the analyses of these intermediate transfer media are assumed to be of significance.

Radiochemical Assay

The present system of routine radiochemical analysis of the samples will be continued in the laboratory. The filter media for collecting the air samples are first analyzed by placing them directly in the well of the calibrated scintillation cyrstal to determine the gamma radiation spectrograph. The medium is then dissolved, oxidized to reduce the volume, and then placed into a proportional gas flow counter for beta analysis. Liquid samples including milk, rain and river water, will be processed through a column of mixed ion exchange resins in which the radionuclides are retained. The column will then be placed directly into the well of the scintillation crystal. For analysis of the pure beta emitters, the ion exchange resins are elutriated to separate them out for beta analysis. In the case of a large volume sample with high ion content which could break through the ion exchange column, a modified evaporation technique will be used which will process more than 18 of 10 liter samples for a 24 hour period. The gamma radiation spectrographs of air and liquid samples will be analyzed and quantities of the individual gamma emitters will be determined with the aid of the high speed computer.

Significance of this Research

The proposed study appears to be a novel approach in the development of numerical systems describing the entire movement of radioactive pollutants from air to water and milk. The systems are based on a mathematical analogy of the movement rather than a description of numerous individual physicochemical processes actually taking place in the environment. This approach should offer the best possible solution for computing the movement because there is no possibility of analyzing the actual individual processes of nature. A preliminary study by the principal investigator described in Section II-A, clearly indicates that such a mathematical analogy for describing nature's intricate balance over numerous random processes can be made.

The numerical system can be adapted to any segment of our environment by a logical evaluation of the environmental parameters for a given natural condition. The model could be extended to a large river tributary system such as the Mississippi River tributary by synthesis of individual subbasins of the tributary. Such a model would become an invaluable tool for computing the fate of radioactive pollutants in the case of accidental release of radioactive material into the environment. The systems would also serve to evaluate the effect of controlled release of radioactive wastes into our environment. Futhermore, the concept and method of this study are not only restricted to radioactive pollutants, but could be applied equally well to any form of environmental pollution.

The Radiological Health Laboratory of the College of Engineering of Michigan State University, will be used exclusively for this investigation. The laboratory contains a radiochemical assay room, a central radiation counting room, data processing room, and a large experimental area. In addition, the Air Pollution Laboratory of the Department of Civil and Sanitary Engineering will be used as the central air and rain sampling station. A permanent rain collector with 40 square feet of collection area, installed on the roof of the Engineering Building, is able to collect a sufficient amount of rain water for accurate radiochemical assay. An automatic control system is incorporated with the rain collector so that a rain may be subdivided and drained into a number of separate sample containers installed in the laboratory according to a preset time schedule for sampling. The continuous air sampling system, consisting of seven large volume air samplers, has been used for atmospheric nuclide analysis. This system is electrically syncronized with the rain sampler so that the two systems will provde samples for exactly the same periods of time.

The micro-precipitation network of the U.S. Weather Bureau, consisting of nine recording precipation gages in the model basin, have been incorporated in this investigation for securing field samples and recordings of precipitation. The automatic stream flow recording station established at the outlet of the model basin by the U.S. Geological Survey will also be incorporated in this study for recording and sampling of the basin effluent.

A Nuclear Data 512 Channel gamma pulse height analyzer and a proportional gas flow counter with automatic sample changer are available exclusively for this study. In addition, a single channel gamma pulse height analyzer and a manual gas flow counter are also available for use.

Previous Work Done in this Field

The proposed study is a continuation and extension of the Environmental Radiation project which was initiated some three years ago in the Radiological Health Laboratory of the University. The initial effort involved fundamental studies on determining counting efficiencies of the individual radiation counting systems, the calibration of air and water sampling devices, and the establishment of a systematic sample processing technique. The primary achievement of the previous work was field verification of the mathematical model technique as related to the environmental nuclide transfer through air, rain, watershed and basin effluent. The results are reported in four Master of Science theses completed dur-

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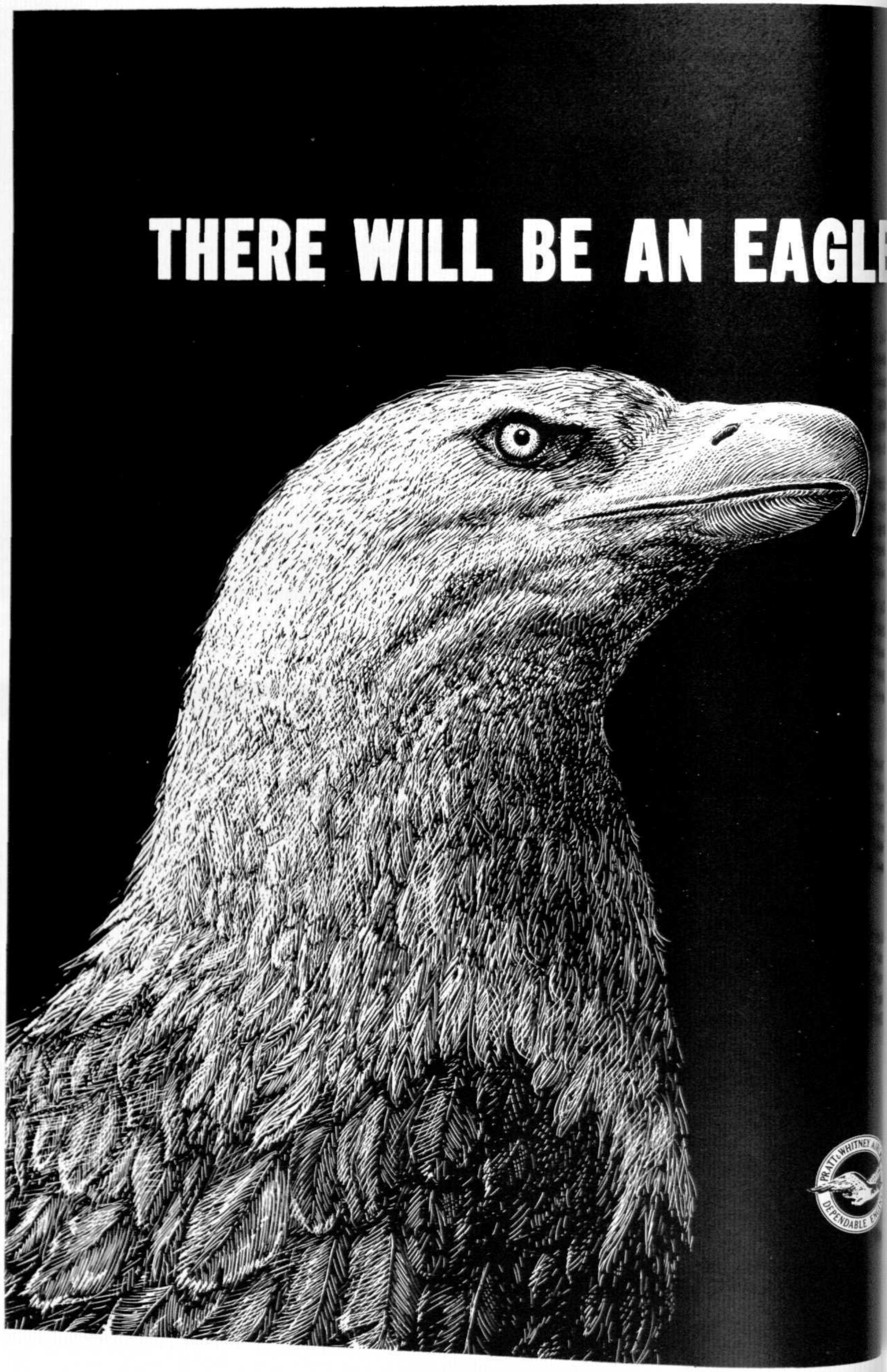

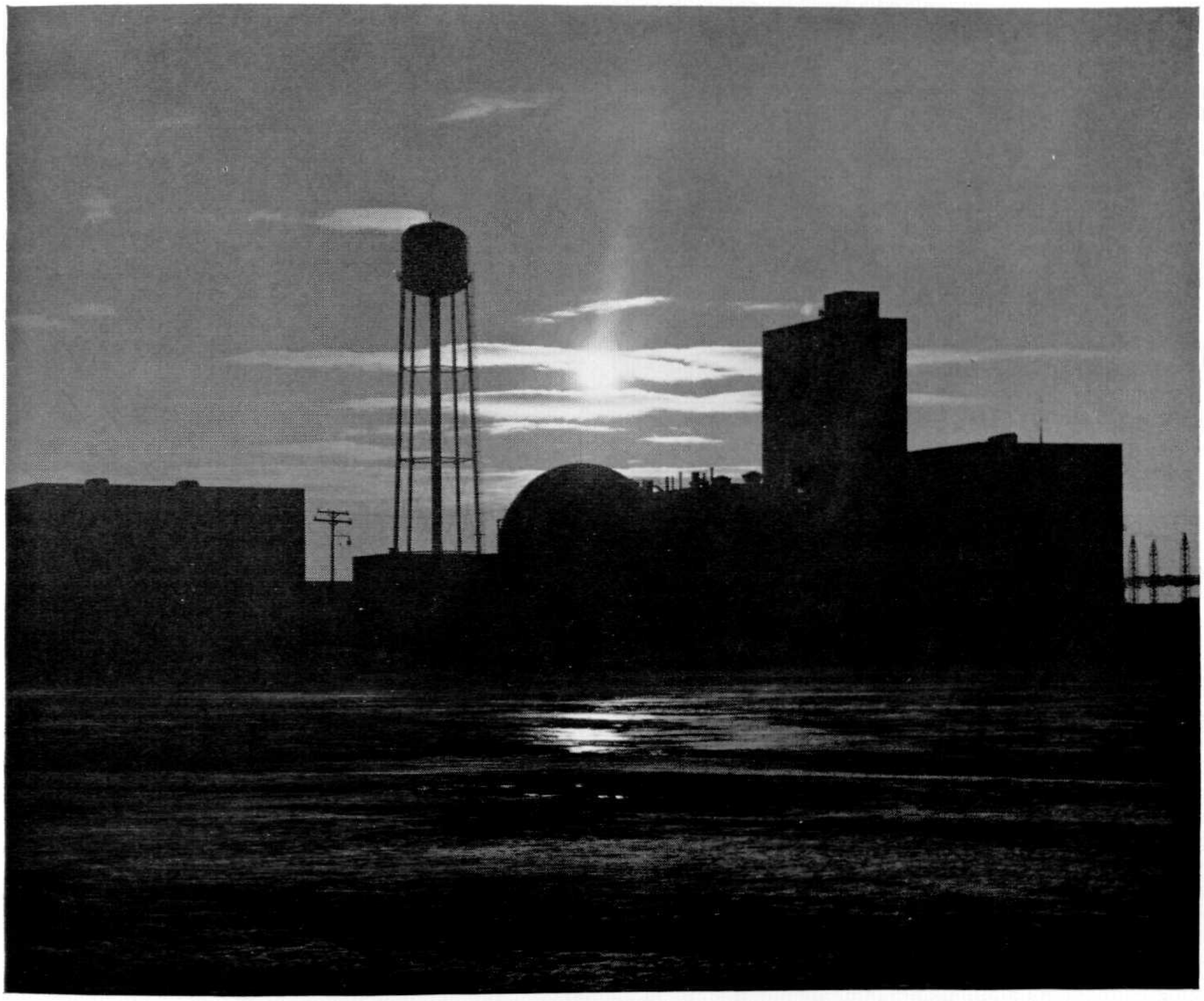

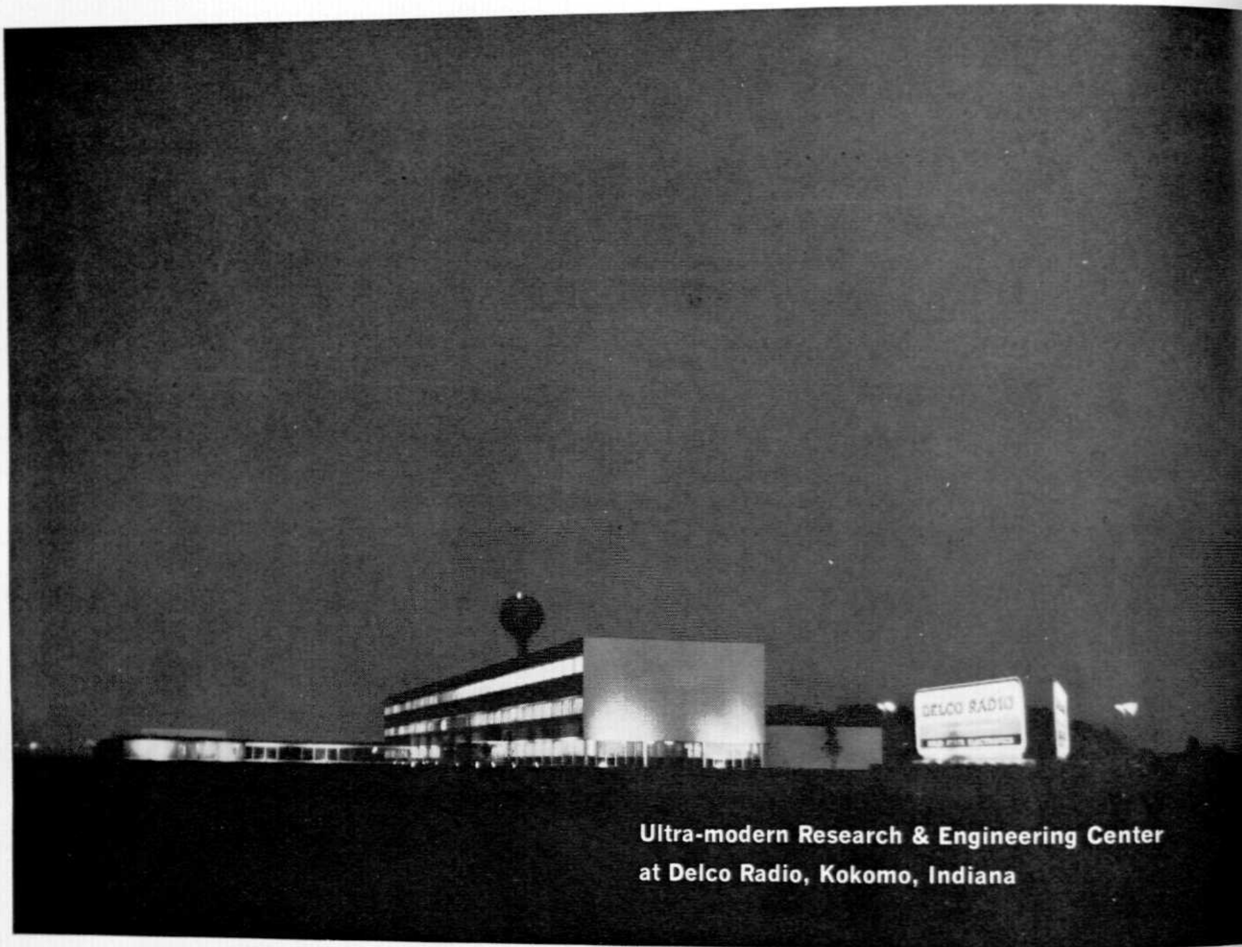

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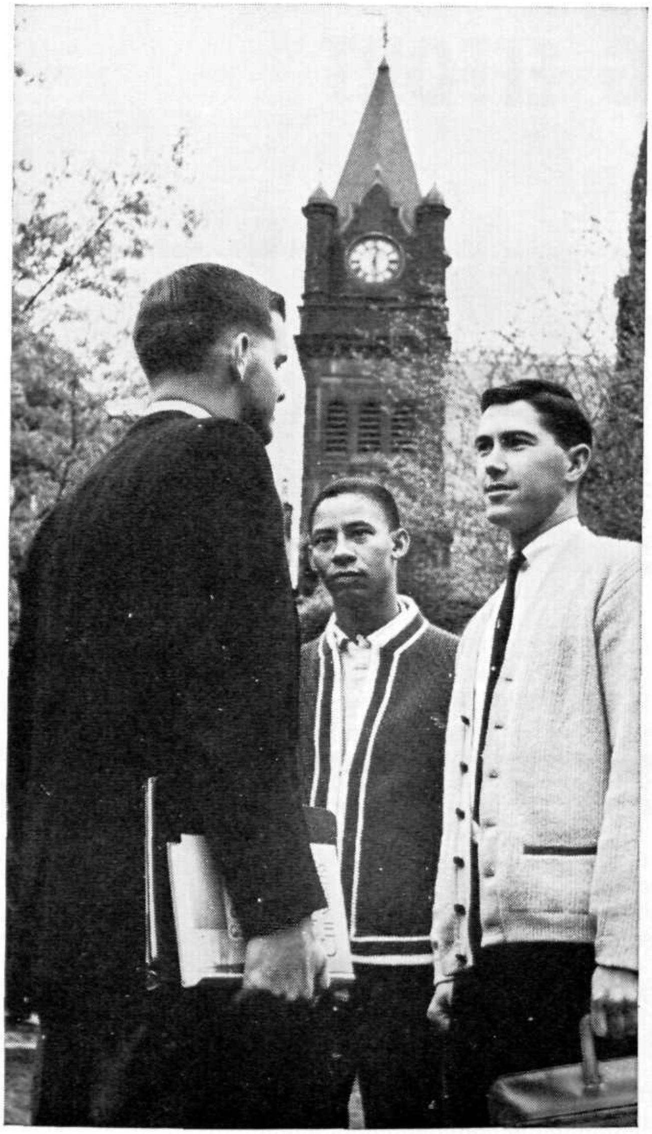


A WINNING EFFORT

A 1963 Engineering Exposition Winner

edited by John Locke

EDITOR'S NOTE: This article has an important purpose. It is our hope that the potential 1964 Engineering Exposition entrant will herewith realize the time and effort needed to prepare an exhibit and will begin preparations now for the Exposition to be held Spring term.

Marlyn Stroven, a 1963, mechanical engineering graduate, began his project for the Engineering Exposition in January of 1963. He was interested in the characteristics of internal combustion engines, and decided to conduct a study on the changes in flow coefficients of the intake valve caused by various pressure drops across the intake valve and changes in the piston position.

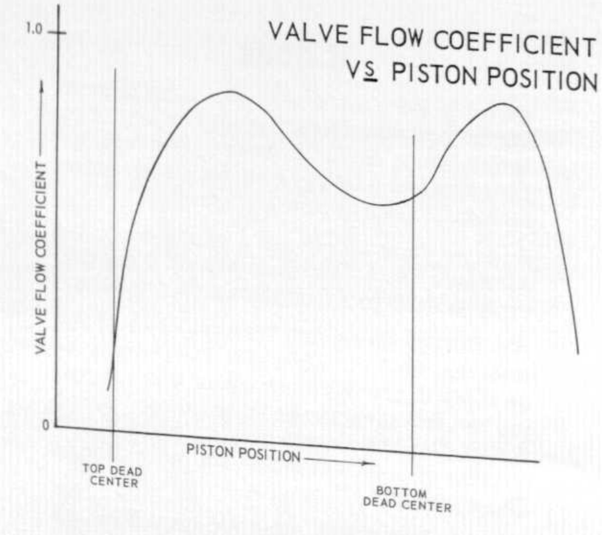
Marlyn chose the British-built J.A.P. motorcycle engine to perform his experimental analysis. This engine had a single cylinder with an overhead valve and a hemispherical combustion chamber.

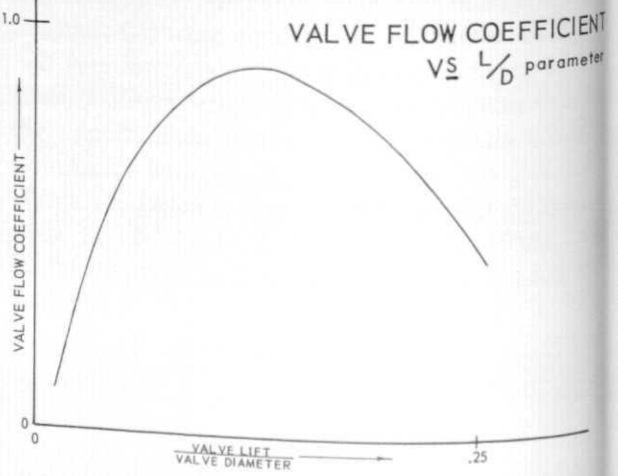
The engine had its flywheel divided into equal increments such that it was possible to determine the position of the piston relative to the position of the inlet valve very accurately. The position of the inlet valve was determined through the use of an Ames gage attached to the engine. A water manometer was use to find the pressure within the combustion chamber. An air meter which measured the volume of air entering the engine operated an electronic recorder.

Marlyn took three complete sets of data from the engine: one for normal valve timing and two others after the timing of the inlet valve had been changed. From these three sets of data, he was able to determine valve flow coefficients for each trial he ran. From these cases he was able to determine the relationships between inlet valve coefficients and the crank angle of the engine (an indication of piston position) and between inlet valve coefficients and the lift of the valve (as found by the dial gage measurement).

From these graphs, it is evident that the inlet valve coefficient begins at a low value when the valve begins to open, increases to a higher value as the valve opens further, falls off somewhat, rises to a maximum value again, then falls to its minimum value again. This relationship is shown when the valve coefficient is plotted against piston postion. When the valve coefficient is plotted against the ratio of lift of valve divided by the diameter of the valve, the coefficient begins at a very low value as the valve just begins to open, increases to a maximum as the valve is partially open, then falls off when the valve is nearly fully opened.

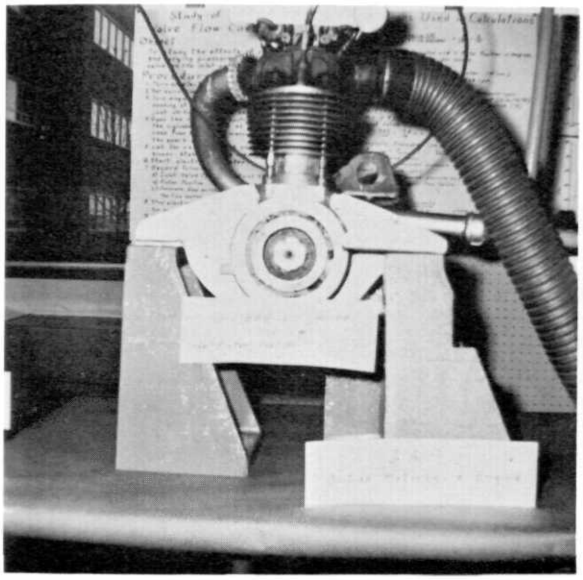
Marlyn supposed that the reasons for this type of variations of the valve coefficient were that the top of the domed piston interferred with air flow through the valve when the piston was near the top of its stroke, the restricted flow through a very slightly opened valve caused a lower valve coefficient, and that at large valve openings, the flow became separated and turbulent, causing a lower flow coefficient.



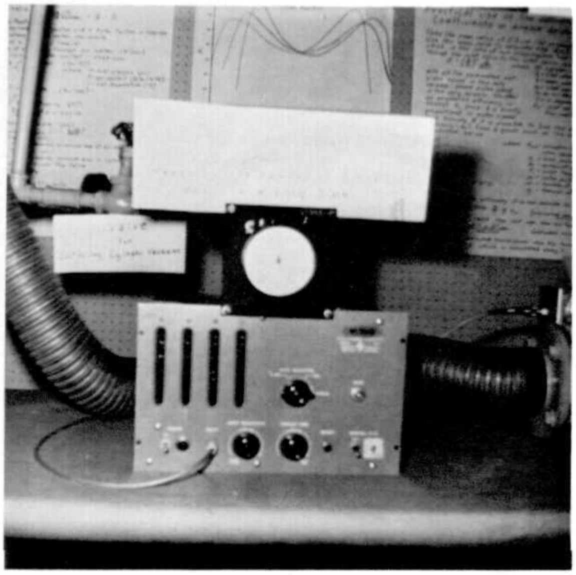


$$\text{VALVE FLOW COEFFICIENT} = C_i = \frac{m}{A\sqrt{2g\rho\Delta P}}$$

m = mass flow rate (lb m/sec) ρ = density of inlet air
A = area of valve opening (ft^2) ΔP = pressure drop

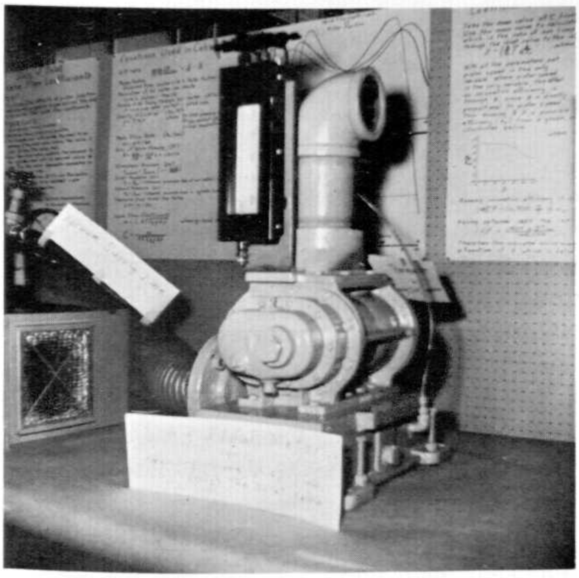


DIVIDED FLYWHEEL TO SHOW
PISTON POSITION

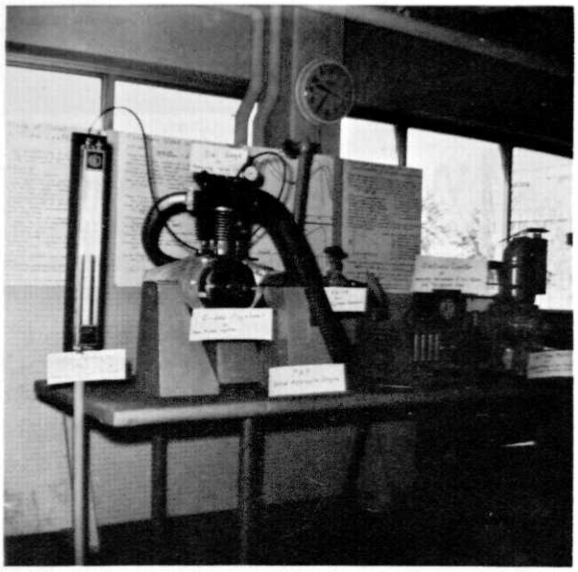


ELECTRONIC COUNTER FOR MEASURING
THE NUMBER OF AIR PULSES AND
THE ELAPSED TIME

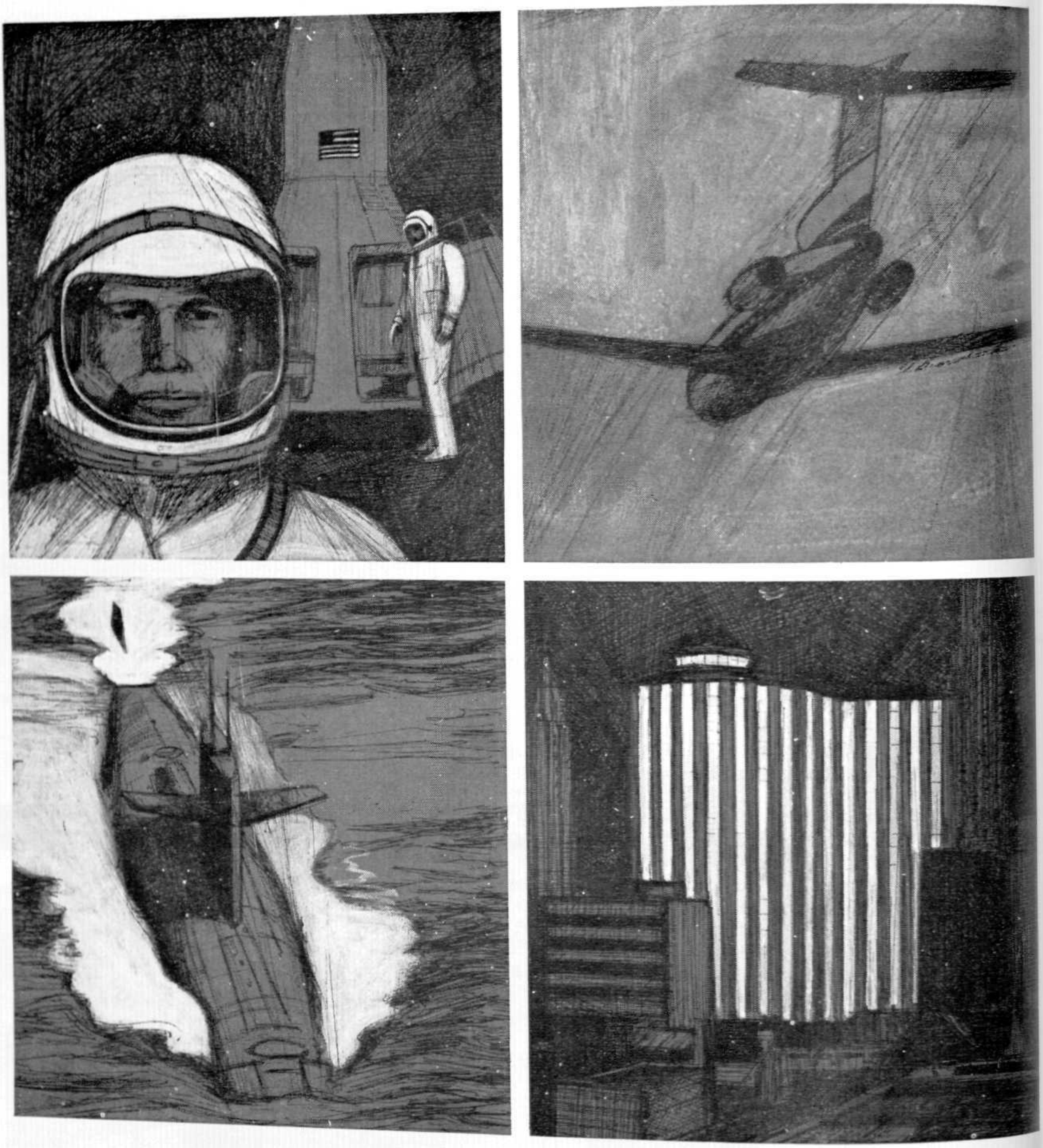
JAP
BRITISH MOTOR CYCLE ENGINE



AIR FLOW METER FOR MEASURING AIR FLOW
THROUGH THE INLET VALVE



MANOMETER
VACUUM IN CYLINDER



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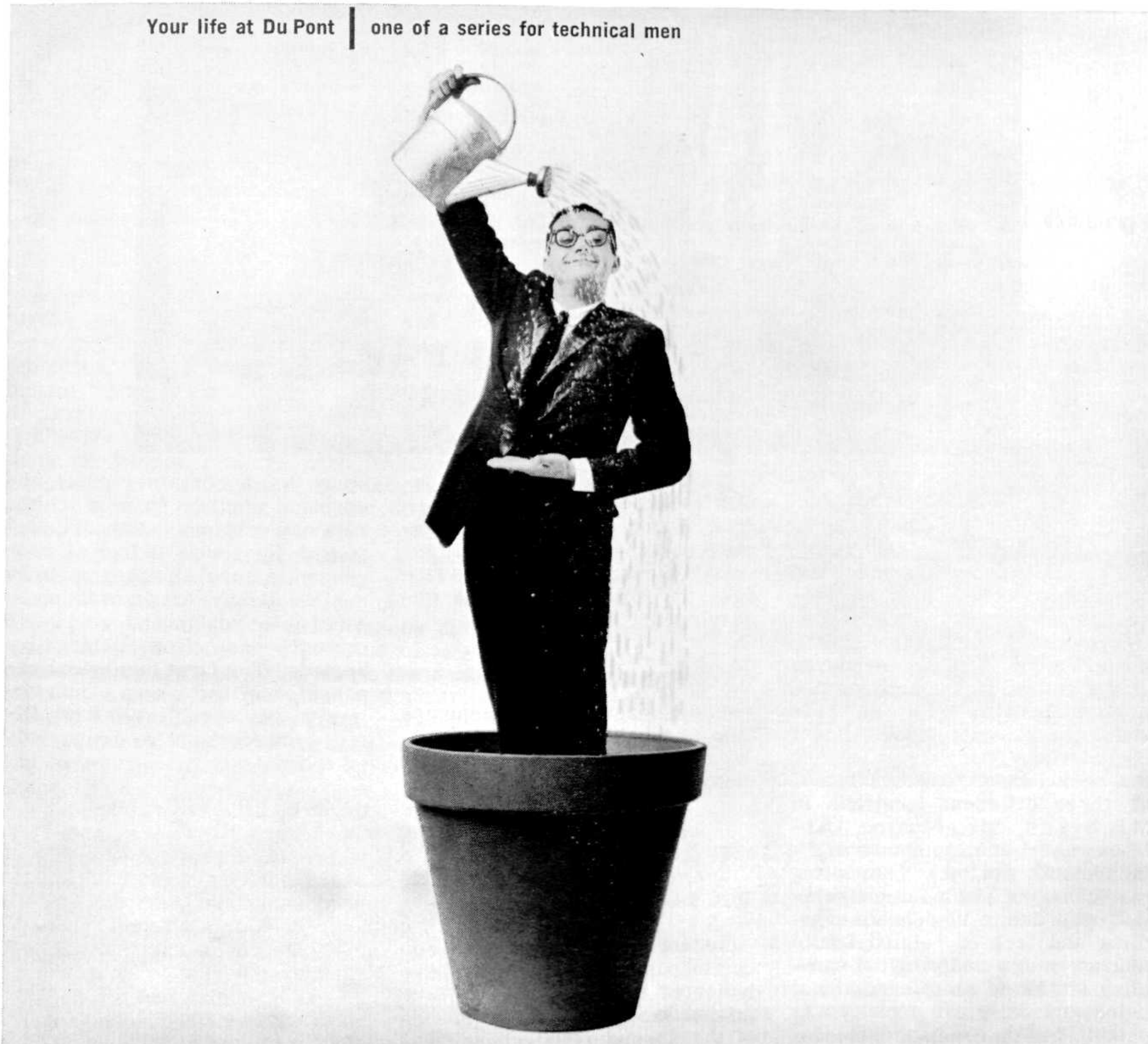

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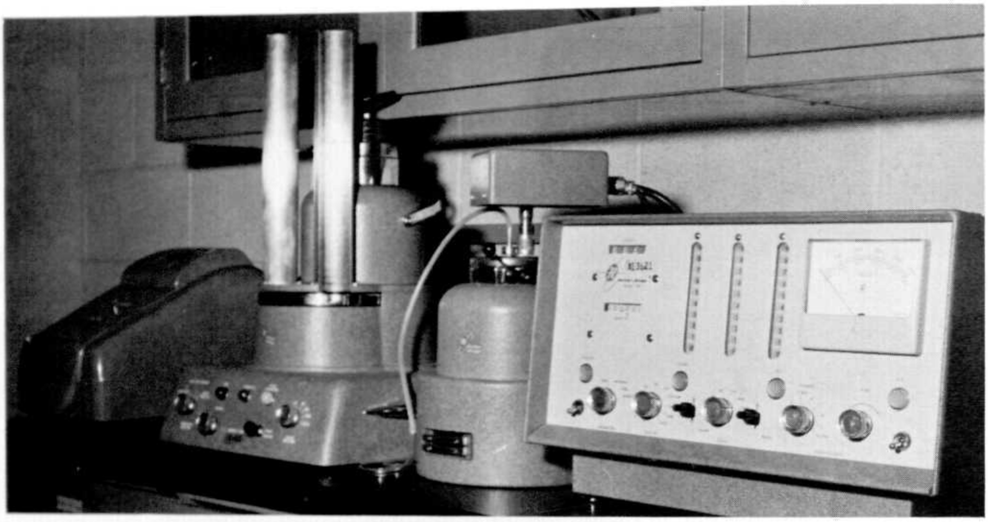


Continued from page 27

ing the last two years under the supervision of the principal investigator.

The first step taken in the initial study was investigation of the statistical correlation between gross beta activities of air and rain samples. Insignificant correlations were found among the weekly average data collected at three different locations in Michigan; viz., Monroe, Carleton, and Lansing, for an eighteen month period. Suspecting that cause of the poor correlation was due to inadequate sampling and lack of related information, a new radiological sampling station to sample individual rains and daily air activity was established on the roof of the Engineering Building in the summer of 1962. The analysis of the data obtained at the station during the summer and fall of 1962 revealed a remarkable correlation between the gross beta activities of the rain and air samples. It also disclosed an important correlation with air turbulence and types of rain. Further investigation to examine the correlation in the individual nuclides of the air and rain rather than their gross beta activities has been continued. The study has shown a definite improvement in the correlation of the invidual nuclides. Furthermore, the study, together with other findings, led to the conception that the main transfer mechanism of the individual nuclides was due to collision capture of the air particulate matter containing a specific radionuclide by descending rain droplets. Based upon this transfer mechanism, the first numerical model of the isotope uptake by rain was established. Using a particle size equal or larger than 0.1 micron as a daily average, the following equation was developed:

$$dA/dt = c\,A^n\ (1+pV^m)$$

where dA/dt = rate of isotope uptake by rain in $\mu\mu$c/1/day

A = air concentration of the isotope in $\mu\mu$c/m3

V = wind velocity in mil/hr

c, p = linear coefficients, 324, and 3.0×10^{-3} respectively

n, m = non-linear coefficients, 1.20 and 0.90 respectively

Recent field studies, based on continuous hourly analysis, have indicated that the model will be further modified after evaluation of the secondary effects such as type of rain, seasonal variation, cloud height, rain intensity, rain duration, rain droplet size, humidity and barometric pressure. The particles ranging from molecular to sub-micron size do not, however, follow the above transition model of the particles of larger sizes. The behavior of the sub-micron particles is now under investigation by using a gas adsorption technique followed by filtration.

Concurrent with the air-rain analysis, the absorption process of the radionuclides deposited by rain in the model basin of Sloan Creek has been analyzed from field measurement of the gross beta activity. Definite characteristics of the absorption process have been determined from continuous evaluation of input and output of the nuclide in the model basin. A mathematical model of the basin was devised from the study as a container of an absorption medium from which the retained radionuclides are removed by three principal processes, natural disintegration by nuclear decay, transportation by surface runoff and release through base flow during dry periods. The first numerical expression of the gross beta removal was established from fifteen consecutive five day periods as follows:

$$dA/dt = k_1\ R^m D + k_2\ A_B + k_3$$

where dA/dt = rate of decrease of basin activity due to hydrologic processes in $\mu\mu$c/period

R = Rainfall runoff ratio

D = radioactivity deposition rate in $\mu\mu$c/period

k_1 = coefficient of surface washout as 4.10

m = coefficient of runoff ratio as 1.86

A_B = accumulated basin activity in $\mu\mu$c

k_2 = coefficient of base flow release as 2.00×10^{-5}/period

k_3 = constant to compensate for activity present in basin before beginning the analysis as 3.2×10^7 $\mu\mu$c/period

Investigation of the basin has been continued in an attempt to examine the model for the individual radioisotopes with consideration of other environmental variables, such as agronomy, ecology, and climatology of the basin. The previous studies have proven the existence of statistical laws which describe the overall movement of the radionuclides in the environment. From the field measurement a mathematical analogy of the laws has been found to exist which describes the process of the movement with excellent accuracy.

MICHIGAN INDUSTRY

edited by Fred George

A new technique for creating crosswind forces on a moving automobile has been developed by General Motors Research Laboratories. The technique utilizes an experimental rocket engine mounted on the side of a passenger car or station wagon body.

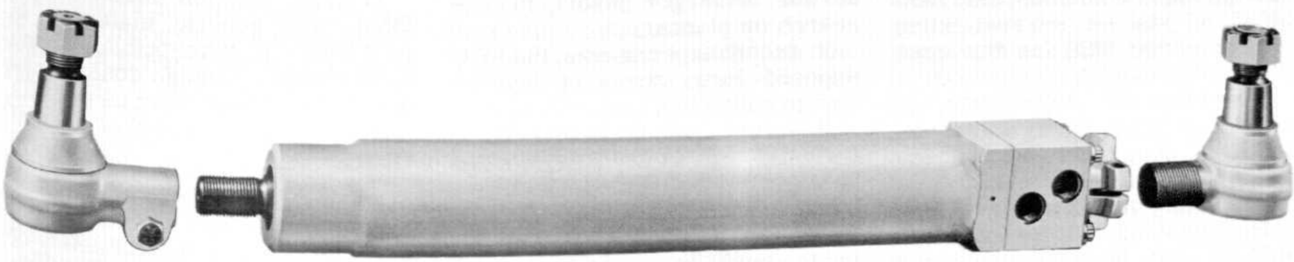
The result has been verification of equations of lateral motions used in computer simulation of car handling. By recording vehicle motions when the rocket engine is fired, GM Research engineers proved that the computer method accurately simulates crosswind effects.

Another feature of the technique is that it provides a relatively quick means of investigating the crosswind stability of an actual automobile. Ability to locate the rocket engine anyplace on the side of the car -- front, middle, rear -- also enables engineers to predict the effect of crosswind forces that would be obtained with different body shapes.

Burroughs Corporation has developed a near-billion character On-Line Disk File-Data Communications System with at least five times better access speed than disk files currently available.

The new system provides twenty-millisecond average access time to 960 million characters of alphanumeric information, a speed comparable to magnetic drum devices at far less cost than equivalent drum storage.

Designed for initial use with the Burroughs B5000 and B2000 series computers, the new file system includes remote communications capability through typewriters and teletype machines. There may be 120 typewriters and 5,985 teletype remote stations connected to the file.



New power steering units mark Clark's entry into this mobile equipment field. They are designed for vehicles having axle load carrying capacities between 6,000 and 50,000 pounds.

Clark says that valve design of its power steering units give them multiple uses in heavy-duty, off-highway vehicles and commercial trucks. A single valve with a capacity of twenty gallons per minute can be bolted to any two of four cylinder sizes in Clark's steering line to make integral linkage units. All power steering units are designed to operate at pressures up to 2000 pounds per square inch.

MSU NEWS NOTES

EAST LANSING, Mich. -- Michigan State University will undertake large-scale basic research on plants for the Atomic Energy Commission.

An agreement to negotiate a contract was reported by Michigan Senator Philip A. Hart.

Involved is the construction of a research building, costing about $2 million, a staff of about 90 persons and a budget of $1 million a year by 1967.

Research will be aimed at understanding in detail the basic processes by which plants live.

This understanding is expected to furnish answers to questions about how radiation affects plants and how damage from fallout to the nation's food crops could be minimized in event of a nuclear war.

Additionally, it is hoped that MSU researchers can find plants which largely exclude radioactive materials or plants which concentrate them and could be used to scavenge the earth. Either type would help to eliminate these materials from man's diet following a nuclear war.

"The project," said Senator Hart, "will make Michigan State a national center for research on the effects of radiation on plants and on fundamental plant studies generally.

"The choice of MSU for these studies is excellent recognition of the high quality of research going on in our state."

Dr. Richard U. Byerrum, MSU dean of natural science, said AEC officials visited several sites and selected MSU as the most desirable.

Favoring the University, he noted, were its strong biological sciences programs and its record of success with many interdisciplinary projects.

He reported that the research will be led by a director and about eight professors and associate professors. In addition, there will be visiting professors, pre-and post-doctoral researchers, technicians and office workers.

The director is to be applied first. He will be in charge of recruiting staff and establishing scientific emphasis.

The operating budget is expected to be about $500,000 for the first year and to reach about $1 million annually by the time the program is fully operative.

Under terms of the agreement, MSU will construct a plant research laboratory of about 63,000 square feet, which, with its built-in equipment, will cost about $2 million.

AEC will be charged a fixed annual rental for use of the building which will allow for amortization of the construction cost over a 10-year period. The agreement provides for continued occupancy at no further cost.

The laboratory will include a greenhouse and an underground radiation chamber containing a 3,000-curie, cobalt 60 source. This facility will allow MSU researchers to expose plants to radiation over long periods. The plants will be contained in five or more movable plant chambers which provide temperature, light and humidity control.

Dean Byerrum said the AEC has found that the effects of radiation on plants are more damaging and more complex than was previously thought.

In its early studies, he explained, the AEC placed more emphasis on effects of radiation on man and laboratory animals.

Now, the Commission wishes to devote a larger effort to research on plants.

In recent experiments, the AEC exposed large acres of vegetation to radiation.

Results, said Dean Byerrum, indicate that heavy widespread radioactive fallout in a nuclear bomb war would likely cause considerable destruction to the basic source of man's food.

In its formal proposal to AEC, Michigan State outlined two research projects as examples of the types of study to be undertaken.

One involves the process by which plants take in nutrients through their roots and their leaves and transport them to other parts.

Many plants have a tendency for taking in and concentrating radioactive materials. For instance, they "mistake" strontium 90 for essential calcium.

While the mechanisms by which plants absorb and transport minerals is understood in general, much important detailed information is lacking.

There is also a need for greater knowledge of the kinds of plants which take on radioactive substances most readily and those which exclude them.

The second example given of worthwhile projects is research on the complex chemistry by which plants live and grow.

Such work might reveal the chemical step or steps most vulnerable to radiation.

For instance, MSU scientists would like to know why it is that all cells within a plant contain the same genes (determiners of heredity) but that these same genes direct construction of many different kinds of cells -- for leaves, roots, blossoms, seeds, etc.

One theory is that cells contain special proteins which enable only part of the genes to operate.

Recent experiments indicate that these "repressor proteins" may be suffering radiation damage.

Other studies indicate that DNA, the genetic material, is particularly susceptible. In one experiment, damage done by radiation to biological material was undone by the addition of normal DNA.

In establishing the radiobotany research center at MSU, the AEC departed from its policy of setting up its own research centers separate from universities.

Having the research at a university will enable the scientists to teach as well as do research and thus help to reproduce their own kind, Dean Byerrum pointed out.

The researchers are to be appointed to the Plant Research Laboratory from MSU and other universities. They will be given, or will retain, academic rank in the appropriate University departments.

"Interchange of students and staff between the laboratory and existing departments," the MSU proposal noted, "will strengthen the research and training roles of both."

The laboratory is to be constructed on MSU's growing Science Complex.

This complex includes a Biology Research Center and a nearly-completed planetarium. A cyclotron and buildings for chemistry and biochemistry are under construction. Construction of a veterinary medicine building will start soon.

Members of the committee who prepared the proposal were Dean Byerrum; Philip J. May, vice-president for business and finance; Dr. Thomas K. Cowden, dean of agriculture; and the following professors: Drs. Robert S. Bandurski and Leo W. Mericle, botany and plant pathology; Dr. M. John Bukovac, horiculture; Dr. Fred C. Elliott, crop science; and Dr. N. Edward Tolbert, biochemistry. --M.S.U. Information Services

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EAST LANSING, Mich. -- With just six hours instruction, high school students are solving problems on a computer at Michigan State University.

Emphasis in this rapid course is on telling students about computers in general rather than giving them a thorough course in computer use.

Nevertheless, they learn enough that with assistance from the instructor, they can submit a simple problem to the computer and get the correct answer.

The students, 100 boys from a nine-state area, arrived at MSU for a two-week session of the Junior Engineers' and Scientists' Summer Institute (JESSI). The Institute is designed to broaden the students' horizons and help them chose careers.

They met in groups of 25 during the day with MSU engineers and scientists who tell them what is going on in various fields. Evenings are devoted to discussions about careers by representatives from industry.

After four hours of classroom work at the Computer Laboratory, each group divides into sections of about six students each. Each of these sections works on details of programming, the process of presenting a problem to the computer in language it can understand.

The problems are quite simple but demonstrate the speed of the computer and its ability to tackle more complex problems, notes Dr. Martin G. Keeney, assistant professor in the Computer Laboratory and instructor of the classes.

One of the problems was finding the greatest common divisor of two numbers. For instance, in just a matter of a few seconds the computer was able to tell them that the greatest common divisor of 3,232,375 and 323 is 19.

Actually, the computation itself could be measured in tenths of a second but it took the machine a few seconds to "read in" the material and print out the answer.

Another problem included finding the least number and types of coins needed to make change for purchases of various amounts.

Dr. Keeney noted that computers are being used more and more in industry and university research. Most engineers today, he said, need to know how to program computers.

The computer used was the Control Data 160A. This computer was obtained by MSU from the Control Data Corp. to supplement MISTIC (Michigan State Integral Computer).--M.S.U. Information Services

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For three weeks during August M.S.U. played host to representatives from twenty-six leading American colleges and universities, who were here to learn more about a significant new concept in engineering education being developed at State.

The three week seminar was sponsored by the National Science Foundation through a $90,000 grant made to M.S.U. for curriculum development in engineering. In charge of the grant is Dr. Lawrence W. Von Tersch, chairman of electrical engineering at Michigan State University.

The aspect of curriculum development emphasized was the systems approached to teaching engineering.

The M.S.U. systems approach, Dr. Von Tersch says, is aimed at giving students a means of analyzing and designing the systems that make up rockets, airplanes, automated factories and other complexities of modern technology.

Traditionally, electrical, mechanical and other types of engineers speak different languages. The M.S.U. systems approach allows them to communicate in the mathematical language they both use and effectively describe complex systems using many types of parts.

Since the new approach emphasizes the principles of systems in general, there is less need for separate technology courses which use large, expensive machinery.

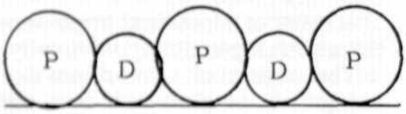
Students, instead, assemble systems on workbenches, using small motors, hydraulic pumps and other components. The characteristics of these components are then measured.

The M.S.U. systems concept was formed five years ago by Dr. Herman E. Koenig, Dr. William A. Blackwell and associates in the electrical engineering department. Since then, several pilot courses at M.S.U. have been taught using the new concept. Graduates of these courses are doing well in industry and graduate work, Dr. Von Tersch reports.

Dr. Koenig and others believe that the systems approach will find application in other fields, including social sciences, humanities and biological sciences.
--M.S.U. Information Services

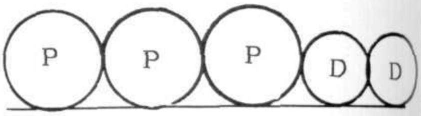
BRAIN TWISTER

This little conundrum which was casually suggested by Scientific American should intrigue anyone who likes money or numbers. Arrange three pennies and two dimes in a row on a table, alternating the pennies and dimes as shown in the illustration. The problem is to change their positions to those shown at the bottom of the illustration in the shortest possible number of moves.



A move consists of placing the tips of the first and second fingers on any two touching coins, one of which must be a penny and the other a dime, then sliding the pair to another spot along the imaginary line in the illustration. The two coins in the pair must touch at all times. The coin at left in the pair must remain at left; the coin at right must remain at right. Gaps in the chain are allowed at the end of any move except the final one. After the last move the coins need not be at the same spot on the imaginary line that they occupied at the start.

If it were permissible to shift two coins of the same kind, the puzzle could be solved easily in three moves. However, the proviso that each pair shifted include a dime and penny makes the problem more challenging.



The dime and penny puzzle can be solved in four moves as follows:

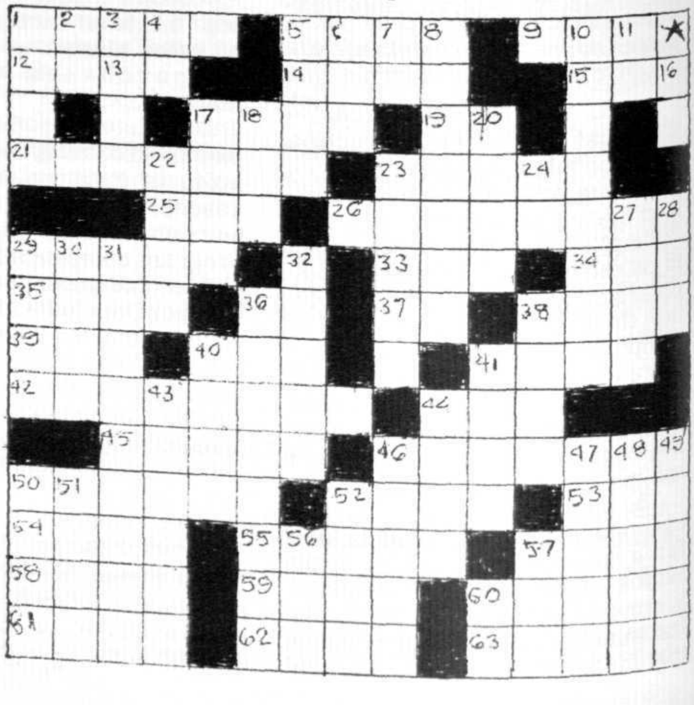
1. Move 3,4 to the right of 5 but separated from 5 by a gap equal to the width of two coins.
2. Move 1,2 to the right of 3,4 with 4 and 1 touching.
3. Move 4,1 to the gap between 5 and 3.
4. Move 5,4 to the gap between 3 and 2.

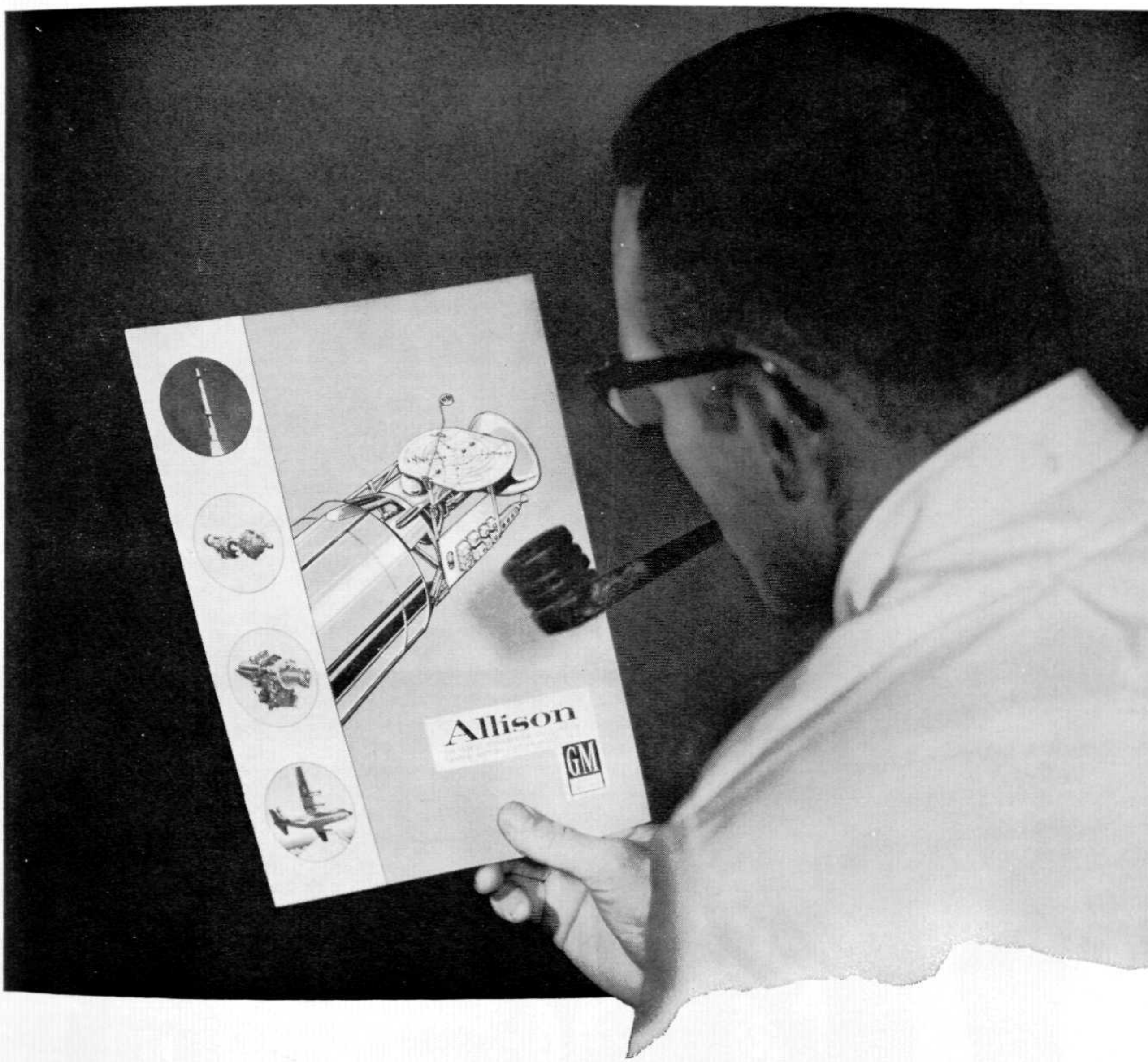
ACROSS

1. An alloy containing copper and zinc that is harder and stronger than brass.
5. Bonnet monkey
9. The university (abbr.)
12. Football (slang)
14. Metal with atomic number 26
15. "Have an ___ to grind."
17. Dark, lacking brilliance
19. Chemical symbol for terbium
21. and 26. Name of this magazine
23. Type of cloth used for wrapping the dead
25. A cereal grass
29. Turn aside
33. Institute of Electrical Engineers (abbr.)
34. Doze
35. Surpass
36. Chemical symbol for bromine
37. Doctor (abbr.)
38. Girls' dorm rooms
39. Go astray
40. Alabama (abbr.)
41. Not narrow
42. Ensnaring
44. Do wrong
45. Rub out
46. Reddish
50. Water vessels
52. Set in order
53. Irritate
54. Morsels
55. Partner of Wells in famous express company
57. Rajah's wife
58. Thaw
59. The Beehive State
60. Damp
61. Small gifts
62. For fear that
63. Loafs

DOWN

1. Scale of hardness used in mineralogy
2. University of Virginia (abbr.)
3. Hero of romance
4. Chemical symbol for thallium
5. Heavenly city of God
6. Arnold (abbr.)
7. Preposition
8. Whole number
10. Mid-terms ___ the engineers
11. Uranium-x (abbr.)
16. Ethyl (abbr.)
17. ___ Major: staff of army
18. Spree (slang)
20. Soft cheese made in France
22. A sporty gay character (slang)
23. Sea needle
24. Chief priest of shrine
27. To mitigate
28. Revolutions per second
29. Encourage
30. Actress Zorina
31. Seriously
32. Large wading bird
36. Supremely happy
38. "Make ___ Mink."
40. Fellow's name
41. "A word to the ___ is sufficient."
43. Grains to be ground
44. Alone
46. Ninety-degree angle
47. Benefit
48. Taut
49. Departures
50. Explosive device
51. Scope
52. Religious brothers

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SOCIETY PAGE

The Engineering Council

The Engineering Council is the student government of the engineering college. It is made up of representatives from the following organizations in the engineering college:

I. Professional Societies
AIChE, ASAE, ASCE, ASME, IEEE, and SAE
II. Engineering Honoraries
Chi Epsilon, Eta Kappa Nu, Phi Lambda Tau, Pi Tau Sigma, Tau Beta Pi
III. Other Organizations
Engineer's Wives, Knights of Saint Patrick, Sigma Phi Delta, and Triangle

The Engineering Council operating in conjunction with the Dean of the Engineering College and the engineering department heads, helps to direct and coordinate the activities of the engineering students.

The major activity of the council is the annual engineering exposition held during spring term. The exposition features student exhibits and displays along with exhibits by private industry and branches of the government.

Topping the social activities sponsored by the Engineering Council is the Engineers' Ball -- an annual dinner dance which is held at the end of the exposition. The engineering queen reigns over the exposition, the dance and the intermission activities which include recognition of the outstanding engineering seniors, presentation of the exposition awards and trophies and the tapping of new Knights of Saint Patrick.

A third major activity undertaken by the council this year is the distribution of the Spartan Engineer magazine.

The Engineering Council also has additional activities and services for engineering students in the planning stages.

All members of the engineering student body are welcome to attend the meetings of the council which are held every other Monday night and are encouraged to voice their opinions on matters of concern to engineering students.

TRIANGLE FRATERNITY

The Michigan State Chapter of Triangle Fraternity is a social-professional fraternity. It is a social fraternity, but it is also professional because its members are engineers and scientists, only. Triangle Fraternity is established on a national scale with chapters at twenty-one colleges and universities across the country. An extensive expansion program is under way in the national organization.

At the present time, Triangle is sponsoring a program in cooperation with the Michigan State University Placement Bureau called "Tomorrow the World." This program is designed to aid fraternity and sorority members in their interviewing for jobs. The first presentation of the program took place on October 24, 1963. Mr. John Singleton, Michigan State University Placement Bureau Director, spoke on "How to Get a Job." There are five more presentations planned for this year with representatives of major companies as speakers. These representatives are from Dow Chemical, General Electric, General Motors, Ford, and the Michigan Education Association.

ASCE

The purpose of the M.S.U. Chapter is to help the student prepare himself for entry into the civil engineering profession and the present branch of the Society.

The chapter is a good medium for exercising principles of personal and public relations. Meetings, which are held biweekly allow the student to obtain information about his future role in the profession. Speakers at these meetings normally represent a good cross section of the civil engineering field.

In addition to regular meetings, the agenda usually includes a joint meeting with the Lansing-Jackson branch of the parent society, and an informal faculty student social meeting. Also available are opportunities to attend meetings at other schools when district conventions are held. Near the end of spring term a faculty-student picnic is held annually.

The M.S.U. Chapter extends a personal invitation to visit with us at all the meetings listed below. Meetings are usually held in room 146 E.B. at 7:00 p.m.

ASCE TERM CALENDAR

OCTOBER 3
Speaker: Mr. W. A. Jeltma, representing the Michigan Section of Associated General Contractors of American. Topic -- "The Role of the Civil Engineer in Construction."

OCTOBER 17
Speaker: Mr. Kenneth Cook, representing Delenw Cather & Co. Topic -- "The Role of the Civil Engineer in Consulting Engineering."

OCTOBER 31
New York Central Railways

NOVEMBER 6
Joint ASCE Banquet between the M.S.U. Chapter and the Lansing-Jackson branch of the Senior Chapter. Speaker: Dr. Miller. Topic -- His recent trip on the Mt. Everest Expedition.

NOVEMBER 21
Speaker: John Shingleton representing the M.S.U. Placement Bureau.

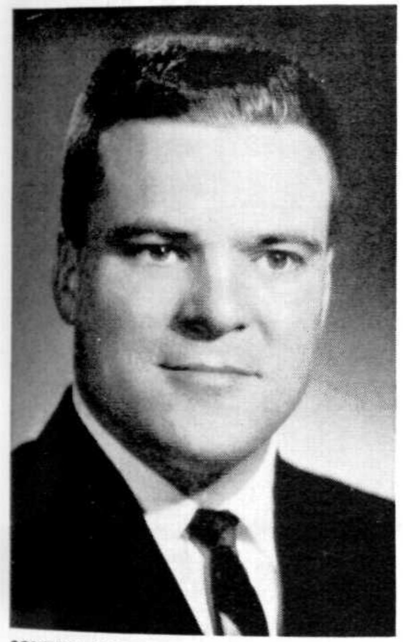
DECEMBER 5
Speaker: Dr. C. E. Cutts, chairman of the M.S.U. Civil Engineering Department. Topic --"Technician vs. Engineer."

THESE GRADUATES THRIVE ON CREATIVE CHALLENGES...THE AUTOMATION PROBLEM SOLVERS

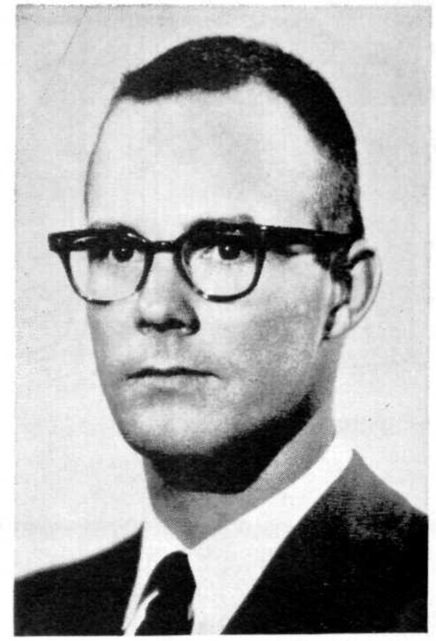
PROJECT MANAGEMENT
V. H. Simson
Iowa State University—BSEE—1948

MANUFACTURING ENGINEERING
R. A. Busby
University of Michigan—BSME—1952

DEVELOPMENT ENGINEERING
R. P. Potter
University of Illinois—BSME—1959



CONTROL ENGINEERING
B. O. Rae
University of Wisconsin—BSEE—1957



SALES ENGINEERING
J. B. Hewitt
University of Colorado—BSME—1957

ANALYTICAL ACCOUNTING
D. R. King
University of Wisconsin—BBA—1957

There's an exciting challenge ahead for you too, on a Cutler-Hammer automation team

K. M. Nelson, Manager—Industrial Control Sales, discusses the functioning of Cutler-Hammer's automation teams, and how creative graduates contribute to pioneering developments.

For over sixty years Cutl Hammer has been a key c tributor in planning automa systems—now called automation.

To meet the pressing challenge rapidly expanding industrial au mation, we have formed a number automation project teams. The teams combine the technical manufacturing talents of versat seasoned specialists and young, c tive-minded engineering and busi administration graduates.

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How do they meet this challen By working with customer engin and consultants to isolate cost p lems in manufacturing and w housing operations. Then, by app ing their individual disciplines creative ingenuity to build comm sense automation proposals that can be justified economically.

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This approach has paid off! Though industry has barely scratched the surface of the automation potential, our credentials already are quite impressive. Jobs such as the U.S. Post Office mail handling systems in 14 major cities; a pallet handling system for a mail-order firm; data accumulation systems for large steel producers; a number of automobile body-line systems; bundle-handling systems for 30 major newspaper mail rooms; and a package-handling system for a prominent publisher are just a few examples of our automation planning skill at work.

What are the advantages to the young, creative-minded graduate? Short range, it's an exceptional opportunity for the man who responds to the challenge of finding new solutions to tough manufacturing problems. Long range, being a key member of a Cutler-Hammer automation team is an excellent way to get the diversified experience so essential to steady career development and future advancement.

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WHAT'S NEW? ASK...

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CONTROL

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An E.E. professor eyed the class as he prepared to return a batch of exam papers "You will remain seated while they are passed out," he commanded. "If you were to stand, it is conceivable that you might accidently form a circle. That would make me liable for arrest."

"Why?" the EE's wanted to know.

"I could be arrested for maintaining a dope ring."

* * *

They moved apart as Frank lit their cigarettes; then she snuggled close to him again.

"Darling," she cooed, "how many others were there before me?"

After a few minutes of silence, she said, with a slight pout: "Well, I'm still waiting?"

"Well," he replied, puffing thoughtfully, "I'm still counting."

* * *

Math Prof: "If there are fifty states in the Union, and superheated steam equals the distance from Bombay to Paris, what is my age?"

Frosh: "Forty-four, sir."

Math Prof: "That's correct. How did you prove it?"

Frosh: "I have a brother who is twenty-two and he is only half nuts."

"Who ever told that guy that he was a prof? He might know it but he can't teach it. The trouble is that he is too far advanced. Every time he tries to explain something, he gets so far off the subject that no one understands anything about it. He outghta go back to the farm, or try teaching a more advanced course."

"Yeah, I flunked the course, too."

* * *

Statistics show that Vassar graduates have 1.7 children, while Yale graduates have 1.4 children on the average. This proves that women have more children than men.

* * *

Army doctor: "You have any physical defects?"

Recruit: "Yes sir, no guts!"

In a shack on Wake Island, four Marines were playing bridge when another leatherneck rushed in shouting: Two hundred Japs have just landed on the beach."

The four Marines looked at each other, and finally one said: "I'll go -- I'm dummy this hand."

* * *

A modern country is one which can ban fireworks and produce H-bombs.

* * *

The roadster slid around the corner on two wheels, glanced off a lamp-post, took the front porch off a house, hit two parked cars, bounced through an excavation, and come to a shuddering halt against a stone fence.

A dreamy-eyed girl stepped happily from the wreck.

"Oh, darling," she exclaimed, "That's what I call a KISS!"

* * *

Chemical Analysis of a Kiss

Properties: color; colorless to deep red. Is not affected by water, but reacts strongly to alcohol.

Occurance: Cars, porches, parlors, and parks. In most cases the compound has only a transitory existence, but it may exist for a considerable period of time.

Chemical Behavor: It quickly breaks up when exposed to a bright light, but it seems more stable by moonlight. It frequently plays the part of catalyst producing bonds of a more permanent nature. The appearance of the parent compound produces a quick and violent displacement of the individual members of the compound.

Future Developments: Although it is not new, it is constantly being rediscovered. Very little is known about the nature of the compound, in spite of the fact that many heads are busily engaged on the problem until late every night.

THE ADVERTISER'S INDEX