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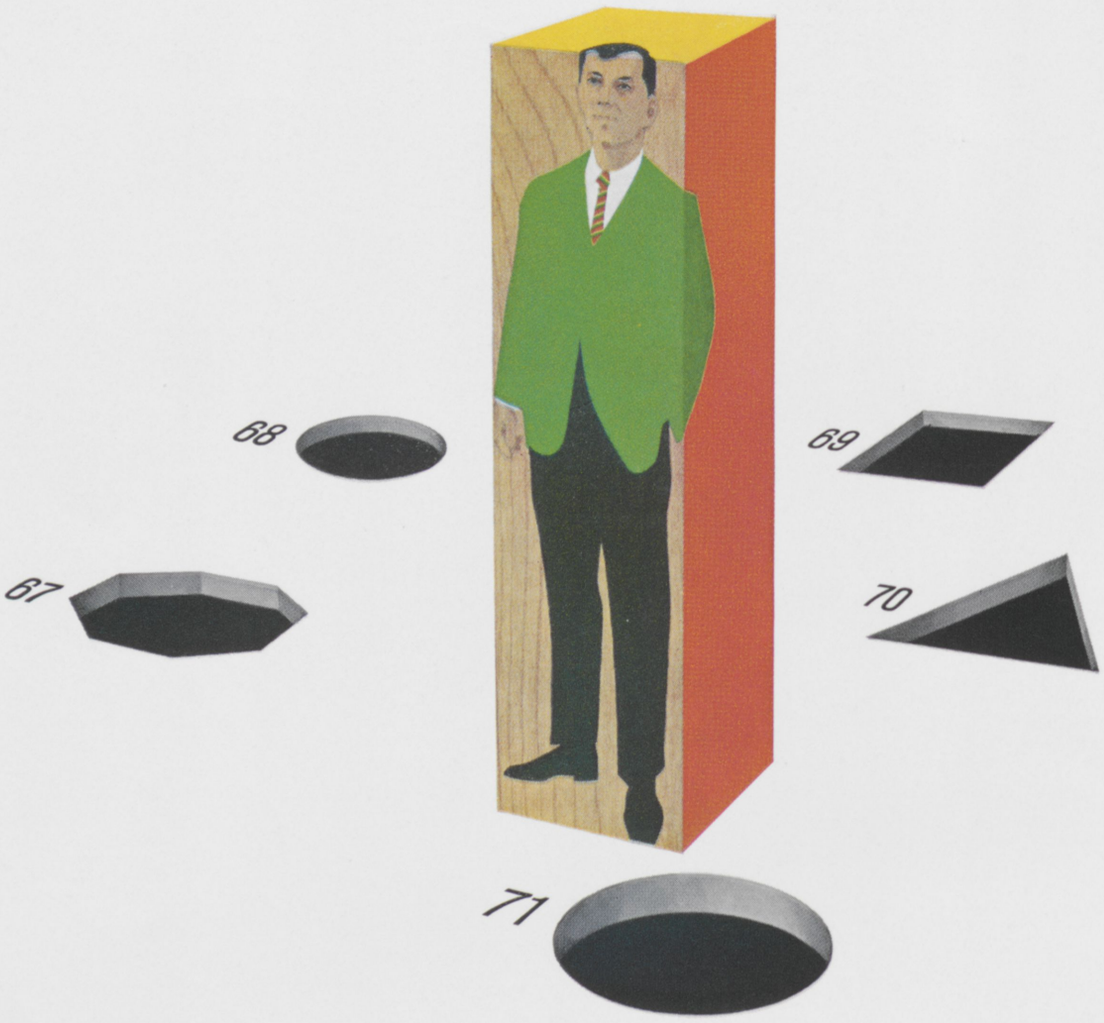
Rose Technic Staff
Rose-Hulman Institute of Technology

Rose Technic

May 1967

Lasers & Masers
Water Polution
Computers



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IN THIS ISSUE

Masers and lasers, what are they and how and why do they work? Charles Divine starts an interesting background on page 8.

Water pollution, how great and growing problem is it? On page 6 Carl E. Smith presents some of the known causes, their results, and what is and is not being done to combat this increasing problem.

In the winning Tau Beta Pi Essay on page 10, Denny Porter criticizes current religious practices.

Simulation and Computers: Their Value to Management is a short article on page 12 by Ken Culp of how computers are helping businessmen and industry today by actually simulating processes and considering and analyzing solutions to problems that can develop.

COVER NOTE

Pete Doenges' illustration of a laser beam's tremendous power is our cover for May.

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May 1967

Rose Technic

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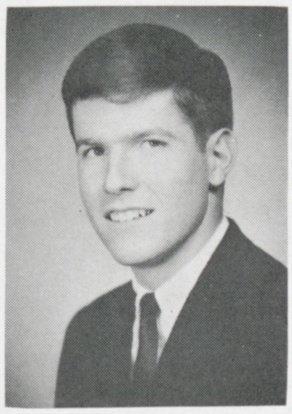
Impact: Leader's Analysis



Charles Morgan is a senior E.E. from Carmel, Indiana. As the present Student Congress President, he has conceived the Impact Program. Besides the ltadership of the Student Congress, Chuck is a member of Blue Key, Tau Beta Pi, and Eta Kappa Nu, Sigma Nu and Who's Who on American College Campuses.

Project Impact was the first symposium of its kind ever presented on the Rose campus by the Student Government. Impact brought before the student body prominent speakers who presented challenging ideas for thought and action. Our purpose was to create an atmosphere of debate, discussion, and response within the Institute—and this it did.

Phase I was marked by an attendance three times the number usually present for a convocation. Phase II with parents and guests recorded nearly 2,000 people. So, certainly both phases were welcomed enthusiastically by the students and their response to the speakers met the goal as defined.

Impact also helped a growing Rose to meet the problems which it now faces. In addition it proved that our Student Government is stronger and more energetic than here-to-fore was recognized and known.

Impact 1967 has set a precedent for succeeding years. Its worth has been proven and Impact 1968 will be even greater than Impact 1967.

CHARLES P. MORGAN

President of the Student Body

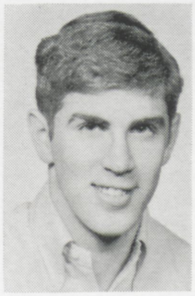
In the years past, there had always been much talk about the attitude of the Rose student towards his Student Government. Conversations and discussions along these lines invariably included such words as apathy and disrespect. Once in Student Government, it became obvious that these feelings were more truth than rumor. However, another fact became obvious — that up until this year, the Student Government itself could also be accused of lethargy. It would be very candid and outspoken in its condemnation of student attitudes, but when challenged for a solution, the Student Government responded with thundering silence.

IMPACT was this year's response to the challenge. The challenge that a Student Government should not only be a forum of criticism and evaluation, but a mechanism through which solutions to problems will be tackled and hopefully solved. We all know the details of the IMPACT program itself, so let us consider the results. Did IMPACT work?

It did show that the Rose Student Government is a workable mechanism when properly managed. It demonstrated that the Student Government could work with faculty and administration on matters of concern to Rose.

But what of the student apathy about which we hear or have heard so much? Certainly IMPACT did not clear this up, as recent lack of response to the Rose Riots indicates. However, we must be aware of the fact that apathy is a personality flaw and a single event such as IMPACT is not going to eradicate it (apathy).

IMPACT did not fail though. Phase I, that part of the program that would suffer most from the Rose apathy was viewed by 150 people. (This, of course, is far less than the crowd that listened to Gov. Wallace; but comparison of the two



John Elzupfon is a junior Chem. Eng. from Newark, New York. He has been responsible for developing this year's program. John is president-elect of the Student Congress and member of Blue Key, Theta Xi, and A.I.Ch.E.

is invalid due to the national stature of Gov. Wallace.) Although 150 people does not represent the number of people hoped for, it does show a three-fold increase in attendance when compared to convos. Equally encouraging is the overwhelming favorable reaction to the program—especially the Friday session. In addition, many have openly regretted that they missed the Friday program —something rather unusual. The most heartening of all though is the steady stream of questions and comments concerning another IMPACT program next year. This is far from the apathetic attitude that was supposedly so ingrained in the Rose student.

Through past inactions, the Student Government made it possible for an apathetic attitude to become an ugly reality. This year, the Student Government accepted the responsibility and challenge of this problem and came up with IMPACT as a solution. Next year's Student Government will not stagnate and merely point to this year's successes. Major problems that effect the entire Rose community are going to be tackled. As for IMPACT, it too, will remain with us and every effort will be made to make IMPACT '68 even better than IMPACT '67.

John A. Elzufon

Water Pollution

by Carl Smith

Carl E. Smith is a senior civil engineering student from Hammond, Indiana. He is currently a major in the Advanced ROTC program and a member of ASCE. Carl has been a Student Congress Representative for two years.

Layout by Marty Goodwine

Four-fifths of the world's area is covered with water. Therefore it would seem that water is the world's most abundant natural resource. However, most of this water can not be used for man's purposes unless it has undergone some special treatment. This treatment may be only filtering through a screen or it may be desalting by distillation.

There is a huge demand for water. At present the average annual stream flow is 1,100 billion g.p.d. It has been estimated that by the year 2000 the total withdrawals will be 888 billion gpd, or 21% of the present stream flow.[1] Therefore it is fairly evident that certain waters will be used many times over and it will be more necessary than ever to make sure that the people upstream do not make the water unfit for those downstream.

Natural waters are classified into three main groups: meteorological, surface, and ground waters, Meteorological waters are precipitation in the form of rain, hail, snow, etc. These waters are usually potable without treatment if the cathment area and storage facilities are properly protected. Surface waters are those found in rivers, lakes, and oceans, and are the most common source of large municipal water supplies. Ground waters are found in the underground rivers and streams and are made available for use by wells. In this paper the discussion will be mainly concerned with the surface waters.

A definition of polluted water is now in order. It is water which was rendered offensive to sight, smell, or made unsatisfactory for drinking, domestic, or industrial purposes. This may be caused by sewage, toxic materials, bacteria, or suspensions or various other materials. There are at least three reasons for controlling pollution. These are the prevention of transmission of enteric diseases, the protection of water supplies against taste and odor, and the protection of fish and other water life.

During the past four years an abnormal amount of fish and shrimp have died in the lower Mississippi and Gulf regions in the early winter. With the development of a new technique it has finally been shown that these fish had minute quantities of the insecticides endrin and dieldrin. There is no evidence of large accidental spillings of these chemicals into the river, but it is believed that this is the result of four years of normal use of these insecticides. It is known thaa the fish can store a certain amount of poison in its fatty tissues. However, when the winter comes, the fat is burned for fuel releasing the poisons into the bloodstream. Also noted was that the first year endrin was used on crops was also the first year that the fish mysteriously died. Endrin and dieldrin were found in the mud far out into the Gulf. If this can happen to the Mississippi which dumps 300 billion gallons per day, what could happen where there is less water to dilute the poisons?

Another problem that will become more serious in the future is pollution due to radioactive materials. At present there is already some con-

(Continued on Page 23)

How about a glass of Atlantic Ocean on the rocks?

By 1980, we may need 85 billion gallons more fresh water per day than we have. We're going to have to make up a lot of that shortage by taking the salt out of the sea.

There's no trick to desalting salt water. All you have to do is boil it and condense the vapor. The problem lies in boiling enough of it while keeping costs from soaring out of sight.

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Lasers and

by Charles Divine

In 1960 the word LASER was added to the popular and scientific vocabulary of the world. Standing for Light Amplification by Stimulated Emission of Radiation, the term immediately stirred the imagination of countless scientists, engineers, and laymen. The intense excitement generated by the laser can best be understood by comparing it with other electronic and light devices.

The most commonly known and spectacular property of the laser is its space coherence. An "ordinary" light beam diverges as it travels through a medium. A laser beam when properly focused through a 20″ telescope can be formed into a beam of only 10^{-5} radian divergence and can be sent 235,000 miles to a target on the moon only two miles in diameter. (1) Another result of the space coherence is that intense power densities can be generated. Lasers can develop localized power densities of 1,000,000 watts/cm^2 with electric fields of 1,000,000 volts/cm . (2)

A second outstanding characteristic of the laser is its time coherence or monochromaticity. Spectral line widths as narrow as a few cycles have been predicted and observed in the frequency range of laser light. This performance is far superior to other monochromatic light sources.

HISTORY

In the early 1950's the MASER (M standing for microwave or molecular) was predicted and later developed. This device achieved amplification by stimulated emission at microwave frequencies ($\Xi 10^9$ Hz). In 1958 Schawlow and Townes predicted that maser action could be observed at optical frequencies, and 1½ years later the ruby laser was developed. So the laser has basically extended the properties and concepts known at microwave and radio frequencies to the optical range.

THEORY

I. Resonant Cavity

The laser, as envisioned by Shawlow and Townes, consisted of a Fabry-Perot interferometer cavity enclosing an amplifying medium. (Figure I)

Figure I

Fabry-Perot interferometer

The setup included two accurately plane-parallel mirrors (one is partially transmitting), separated by a length l, containing an excited gas as the amplifying medium. It is at once obvious that this is just a resonant cavity (like a short-circuited transmission line or a closed organ pipe) when there are an integral number n of half wavelengths in the cavity.

$$(1) \qquad l = \frac{n\lambda}{2} = \frac{nc}{2v}$$

Where c is the velocity of light and v is the frequency of oscillation. The reflected wave adds in phase, creating a standing wave that starts from some noise level and grows to a steady-state value.

THEORY

II. Stimulated Emission

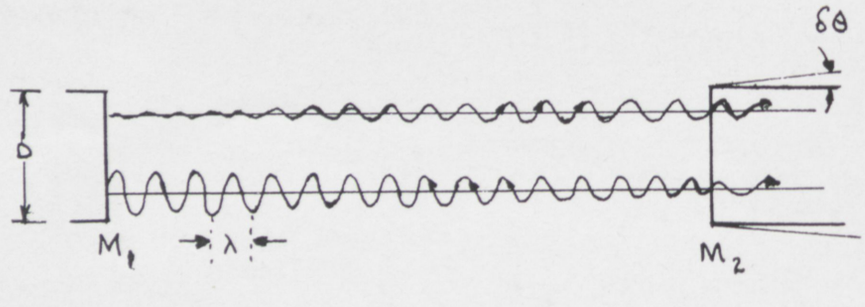

Figure I: Fabry-Perot Inteferometer

Masers

The anthor is Charles Divine from South Bend, Ind. Chuck is a Senior E.E. and a member of Eta Kappa Nu and Tau Beta Pi honor fraternities.

Layout by Skip Douglas

Light amplification is what the laser does — stimulated emission is how this is accomplished. Spontaneous emission is a familiar process in which an atom in an excited state E_i can drop to a lower energy level E_j, emitting radiation of frequency U_{ij} according to the familiar

(2) $E_i - E_j = hUij$

where h is Planck's constant. These jumps occur at a rate Aij with a spatially isotropic power of NiAij hUij where Ni is the population of atoms in the excited state. This process can be artificially induced by irradiating the atom with radiation of frequency Uij. This stimulated emission which results has the same properties as the spontaneous variety. In 1917 Einstein wrote the emission relation as

(3)

$$p(\nu_{ij}) = h\nu_{ij}\left[n_i A_{ij} + (n_i - n_j) B_{ij}\, u(\nu_{ij})\right]$$

Where P(Uij) is the total power radiated per unit volume, u(Uij is the stimulating energy density, n_i and n_j are the populations of the upper and lower states, and Aij and Bij are the Einstein coefficients of spontaneous and induced emission, respectively. So, 37 years before the first operating maser was built this relation concerning stimulated emission was known.

In earlier absorption spectroscopy studies Ej was the ground state, n_j was much greater than n_i, so (n_i-n_j) was negative, hence absorption. In emission spectroscopy u(Vij) was so small that spontaneous emission was dominant.

At thermal equilibrium the atom is in its lowest energy state and $n_j > n_i$. So for gain to be achieved, i.e., (n_i-n_j) to be positive, n_i must be made larger than n_j. This condition in which $n_j > n_i$ is known as population inversion. If a method could be found to disrupt the equilibrium condition, i.e., to invert the population, one would expect to observe gain instead of absorption at the frequency Vij.

Immediately the dependency of the gain on frequency is noted. If population inversion between two states is accomplished, (n_i-n_j) will be positive only near the frequency Vij. Hence we have a gain bandpass instead of an absorption spectrum.

Actual population inversion is carried out by pumping to an initially empty state Ei and then allowing the system to decay to another lower empty state Ej. Most lasers are this 3-level (or 4-level) type. Given the three energy levels in Figure II, a simple analysis of a 3-level laser can be given.

Figure II

3-level Laser Schematic

Now if the substance is irradiated at frequency V_{13}, this populates the 3rd level by drawing from level1. Hence stimulated emission and gain occur between levels 3 and 2 at a frequency of V_{32}

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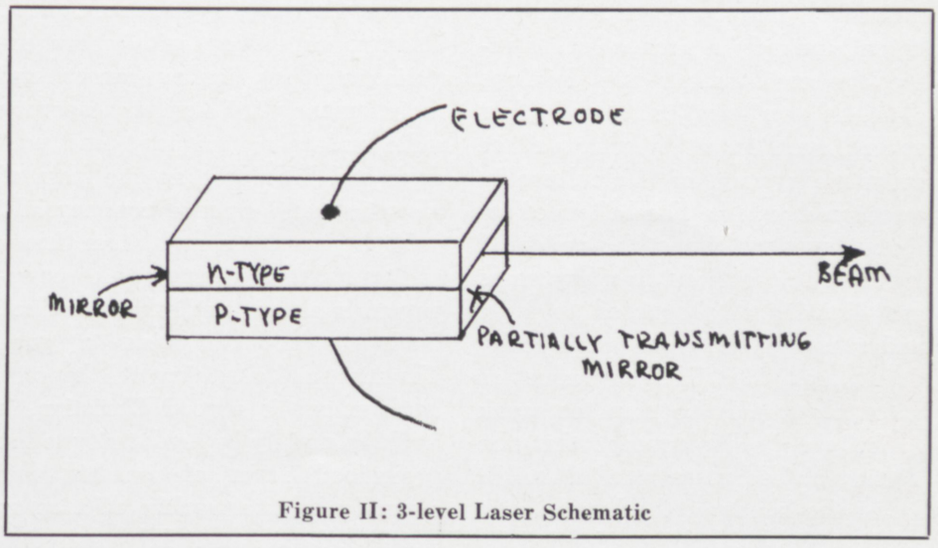
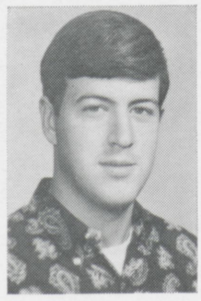


Figure II: 3-level Laser Schematic

Contemporary Religion In The U.S.

by Denny Porter



Denny Porter is a junior mechanical engineer from Connersville, Indiana. He is on the Dean's List, a pledge of Tau Beta Pi, and recipient of the Chrysler Award. Denny is a member of ASME, Lambda Chi Alpha, and captain of the tennis team.

Webster, considered by most people to be the leading authority of the English language, defines religion as the service and adoration of God or a god as expressed in forms of worship and as one of the systems of faith. Anthropologists deem it necessary to divide the gamut of human relations into three, sometimes overlapping, areas, man to nature, man to man, and man to unknown. Traditionally, in answering the "Why?" questions in the third category of human relations, philosophy employs logic and reason while religion bases itself upon faith and belief.

Before an adequate presentation of contemporary religion in our country can be proffered, it is felt by the author of this paper that his views on the subject of religion in general should be introduced. The author maintains that any particular religion is merely a product of its respective environment and develops along its own lines just as any other aspect, such as a governmental or economic system, of the culture in question develops. The beliefs of religious systems cannot be validated by scientific fact and in many cases are diametrically opposed to logic and reason based upon empiracally determined data. Religion serves as a crutch to aid the man too weak to believe in the concept that the destiny of the human race just might lie in the hands of the human race itself. Answers, often clouded by symbolism, to scientifically unanswerable questions are provided very neatly and compactly by various religious beliefs. A very common trend, the assurance of personal well-being in either this life or some hereafter in most religious faiths is easily achieved upon one's acceptance of the basic tenets of the faith. Disbelief or non-acceptance of the precepts quite naturally results in a situation at the opposite pole of punishment or ill-being.

The major religion in the United States is Christianity, separated into the two camps of Catholicism and Protestantism. It is admitted that there are other faiths prominent in the country, but for the sake of a fairly normative representation of religion, the *practices* of Christianity will be attacked. To begin, the author is of the opinion that the church of today is a highly commercialized business competing with other organizations for its customers and their money. Churches sponsor radio and television programs, post signs and billboards as one form of advertisement, finance commercials, publish pamphlets and other forms of literature, and advertise in newspapers in order to sell their product. Such a product, being a good Christian and receiving the benefits because one is a good Christian, is financed mainly by conformity to the prescribed form of worship and secondly by the weekly offering at services. As in most large corporations there very definitely is a hierarchy of command in the church system. This hierarchy is exceptionally prominent at a national level, and each church leader possesses his title and relative position of status and power similar to the structural framework of a large business concern.

The church has also assumed the position of an important social organization. There are church basketball and softball teams playing in organized leagues, church fish fries, and even church bridge clubs. Frequently the social gossip after Sunday services is much longer than the sermon. People sometimes attend church in order to talk to their friends or conduct business rather than to be enlightened spiritually.

The majority of worshipers of contemporary religion in the United States are very hypocritical. A very large percentage of people maintain the religion, whether Methodist or Baptist for example, of their parents. In most of the cases, these people accept the faith with little question as to its worth relative to the other common faiths. Such people do not realize that if nature had started them from a different background or environment, their faith would probably be different. Thus, people are hypocritical as to why they think they believe. Another very prominent hypocrisy is that a Christian of today believes he can repeatedly sin

(*Continued on Page* 25)

Last year, thousands of lawyers, bankers, accountants, engineers, doctors and businessmen went back to college.

And not just for the football games.

We'd like to clear up what appears to be a misunderstanding. It is somewhat popular on campus to decry a business career on the grounds that you stop learning once you start working for Cliché Nuts & Bolts.

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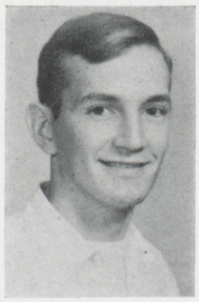
Simulation and Computers: Their Value To Management



Ken Culp is a junior mechanical engineer from Martinsville, Indiana. He is a member of ASME, Lambda Chi Alpha, and the track team. Ken is secretary-treasurer of the Junior class.

by Ken Culp

Layout by Scott Stephan

Computers have been used in the technical industrial world for over two decades—their importance as quick "mathematicians" can hardly be disputed. But only in the last 10 to 12 years has management noticed the value of the computer and subsidized it. It is true that management still uses the computer for its original function: the super-quick adding (multiplying, squaring, etc.) machine. Even as late as 1959, 90 percent of all industrial computer time was spent on data processing.[1] Only recently has the computer's vast potential been realized. One of these new uses is that of process simulator.

There are two main types of simulation, competitive and system. An example of competitive simulation is the marketing management decisions made by IBM Corporation and of system simulation, distribution inventory made by Westinghouse Electric.[2]

Management has always had a need to know the end result of present actions or policies. The computer can give accurate and complete analyses of alternate courses of action for the decision makers. Simulation is also needed because "the number of variables, the probabilistic aspects, and the servo aspects of systems under study often defy the use of strictly analytical or mathematical methods of analysis."[3] Simulating the actual process considers almost all of the problems that would be faced by the businessman. Now that industry has an instrument that is capable of processing enormous qualities of data in relatively short time, management is able to feasibly simulate long-term operations that include intricate time-related processes.

The need for simulation has been observed and the instrument by which to conduct it has been developed. What, then, are the particular uses of simulation in management? The largest area is undoubtedly data processing. As a data-processing tool, the combination simulator-computer makes out payrolls, positions and controls the plant's inventory, advises product releases, etc. Another use is as a controlling device in which the computer decides by optimization the appropriate personal reqquirements, inventory pricing, and production schedules. All of the pertinent data relating to sales, production changes, etc., must be read into the machine to get a dependable solution. A third use is as a problem-solving tool. In general, the simulation projects dealing with the computer as a problem-solver fall into these three main groups: system design and evaluation, system research and planning, and training (appreciation, procedural, or study displays).[4] There are now computers which are both problem-solving tools and controlling devices. The most appreciated quality of this machine is that it may be working for a better solution of the very problem it is presently controlling.

Perhaps the phase of the problem-solving computerized simulation that is most used by the personnel manager is the training procedure. There are several reasons for this. Foremost, the cause and effect are immediately seen for each solution or decision. Secondly, the "personal experience" aids the young businessman in evaluating the available evidence. Simulation also familiarizes the individual with the amount and type of data that is needed. Involvement in this simulated management seems to motivate the student and causes him to be much more alert and interested in the results. Finally, the necessary work with computers familiarizes the student with Electronic Data Processing.

The system design and evaluation phase has had great success in simulation and promises to prove even more helpful with further development. As of now, simulation in this area has been quite useful for equipment design, the size determination of maintenance and operating crews, and the actual organization of the operating crew procedures.

Fluctuations of operating costs plague simulation in the area of system research and planning because this phase is more oriented towards equipment that is to be designed and built in the future.

Although simulation has much to offer by its ability to condense and predict the workings of large-scale operations, there are also several problems that accompany this benefit. One of these problems is that most large simulations require the use of a computer. Not only is this expensive, but sometimes it takes considerable time before the more

(*Continued on Page* 25)

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MISS TECHNIC

Sue Ridgely

Miss Technic for May is Sue Ridgely. Sue is a freshman at Indiana State University from Gary, Indiana. At the present she plans to major in elementary education. Sue is a member of Zeta Tau Alpha sorority and was president of her pledge class. She is on the hall council and is chairman of the Campus Carnival Dance. Sue is 5′ 6″, has brown hair, and blue eyes.

LASERS AND MASERS

(*Continued from Page* 9)

LASER CLASSIFICATAION

There are three basic types of lasers in operation today—gas, crystal, and semiconductor. Each operates on the same principle—a substance which exhibits gain due to population inversion, housed in a resonant cavity. The method of pumping, the type of cavity employed, and the gain characteristics of the medium are all different and worth comparing.

CRYSTALLINE

The crystal laser consists of a Fabry-Perot cavity containing a crystalline host imbedded with impurity ions. These impurities may be substitutional or interstitial, i.e., they may replace one of the ions in the lattice, or they may be "squeezed" into the structure. It is these impurity ions which carry out the lasing action of stimulated emission.

Population inversion is accomplished through optical pumping, i.e., the crystal is illuminated by a lamp of the proper frequency. However, a real optical pump source is not perfectly monochromatic but emits in a broad band. Therefore, only a fraction of the energy it emits is usable as pump power. This means that large pump inputs are then required to meet the absorption energy threshold of the laser material.

Lasers can be operated by continuous wave or pulsed pumping. Many more crystal materials can be operated pulsed than CW. This is the result of a number of factors. One major problem is heat dissipation. The crystal host may not be able to satisfactorily dissipate the heat generated by continuous operation. Also, pulsed pumps can supply higher peak powers during the lms fluorescent lifetime during which the laser integrates population in its upper state. For 4-level lasers the terminal state may not be able to depopulate fast enough to provide continuous output.

Presently crystal lasers hold some advantages over other types. Their excited metastable states have longer lifetimes than most gas or semiconductor varieties. This property makes them more amenable to J-switching and energy storage, and the generation of high peak powers. So the crystal laser lies as a good compromise for high CW powers; it is dilute enough to avoid the heat problem of the semiconductor, yet requires smaller volumes per unit power output than for the gas type.

GAS

Although it was the ruby laser that came first, probably the most common laser in use today is the gas laser. As the name implies, an excited gas provides the amplifying medium. This plasma may be composed of neutral atoms, ions, or molecules. All of these substances can be pumped into an excited state and become useful as laser mediums.

The resonant cavity may take any of several configurations, from the basic Fabry-Perot to systems employing concave, convex, and plane mirrors. The design of the resonator determines the modes of operation, efficiency, gain, etc., of the system.

Population inversion is accomplished in most cases by gaseous discharge. The main reason that optical pumping is not satisfactory is that most of the decays in a gas are radiative, so a desired decay chain may be bypassed as the system acquires its ground state. This type of decay prohibits laser action.

Most gas lasers are operated in the CW mode because they can dissipate the excess heat generated, owing to their dilute particle concentrations. However, in an effort to extend the higher frequency limits of the laser and improve the peak and average power capabilities, some work has been done with pulsed discharge.

The gas laser is probably the best behaved of the lasers. Its lower density makes it an optically homogeneous medium with a low refractive index. This characteristic makes it very amenable to simple mathematical resonator theory applications. Its behavior is well understood and quite predictable.

Because of its ease in packaging the gas laser has become commercially popular, and presently it seems to dominate the field. But new materials are constantly being investigated.

Semiconductor

In 1962 the first observations of stimulated emission in semiconductor materials were made. Since that time there has been much investigation in this area, and devices have been produced which operate from the far infrared to the near ultraviolet. Much interest has been generated by the semi-conductor laser, largely because of its miniaturization potential.

Figure III

Energy vs. Density States of Intrinsic Semiconductor

In Figure III (a) the highest filled band is the valence band, and the next higher band is the conduction band. The two are separated by an

(*Continued on Page* 22)

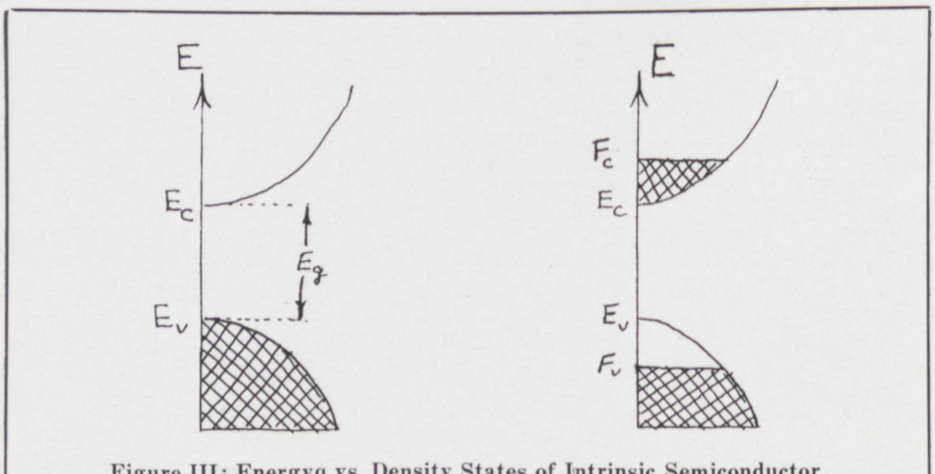


Figure III: Energyq vs. Density States of Intrinsic Semiconductor

SANDIA*

edited by Jack Uhlenbrock

Layout by Andy Spence

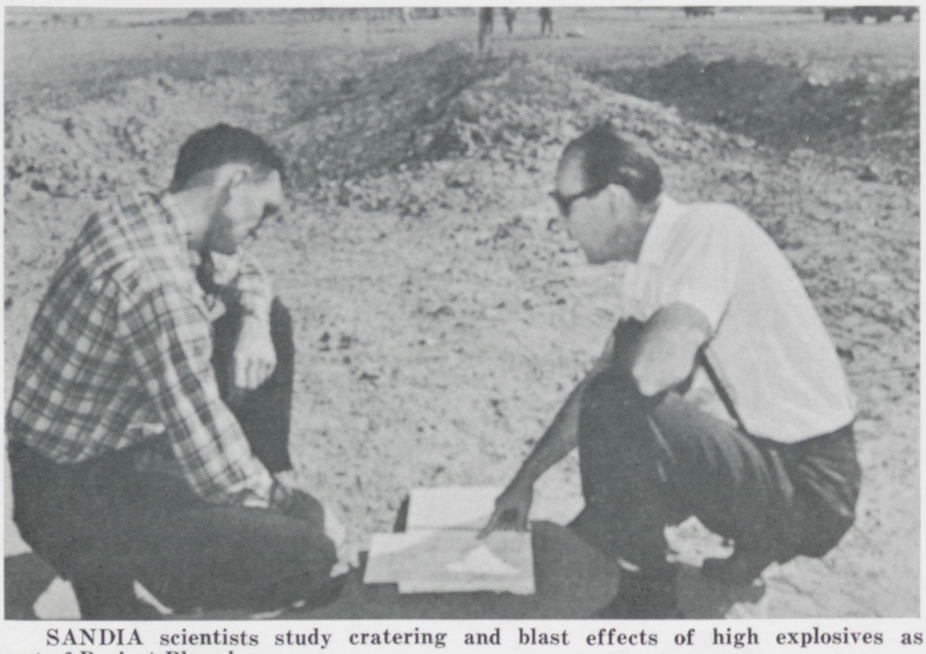
*Condensed from Bell News, Indiana Bell

Out on the edge of the desert in New Mexico, the Bell System's Sandia Corporation is making atomic history in a new way. It is charting a course for exciting new scientific explorations that will take it into the realm of peaceful uses for the most powerful source of energy in the world . . . the atomic power that revolutionized the concepts of warfare and diplomacy.

Sandia Corporation is located at Sandia Base near Albuquerque, N. M.; a description brief and vague—but Sandia deals in highly classified work. It designs and develops non-atomic components for nuclear weapons. The work is performed under a no-fee public service contract with the Atomic Energy Commission.

On November 1, 1949, the Bell System moved into the field of national defense . . . one month after President Harry S. Truman announced that the Soviets had exploded their first atomic bomb. On that date, operations began at the Sandia Corporation. Created and operated by Western Electric, Sandia traces its history to the closing days of World War II. The original laboratory was managed by the University of California, but when the university asked to be relieved of the responsibility, President Truman urged the Bell System to take over.

There are about 8,000 skilled men and women applying their creative talent to the discovery of non-weapon application for nuclear energy; 7,000 in Albuquerque, and about 1,000 at Sandia Livermore Laboratories in California. Several hundred of them, according to Sandia sources, are former Hoosiers serving in a variety of capacities at Sandia.



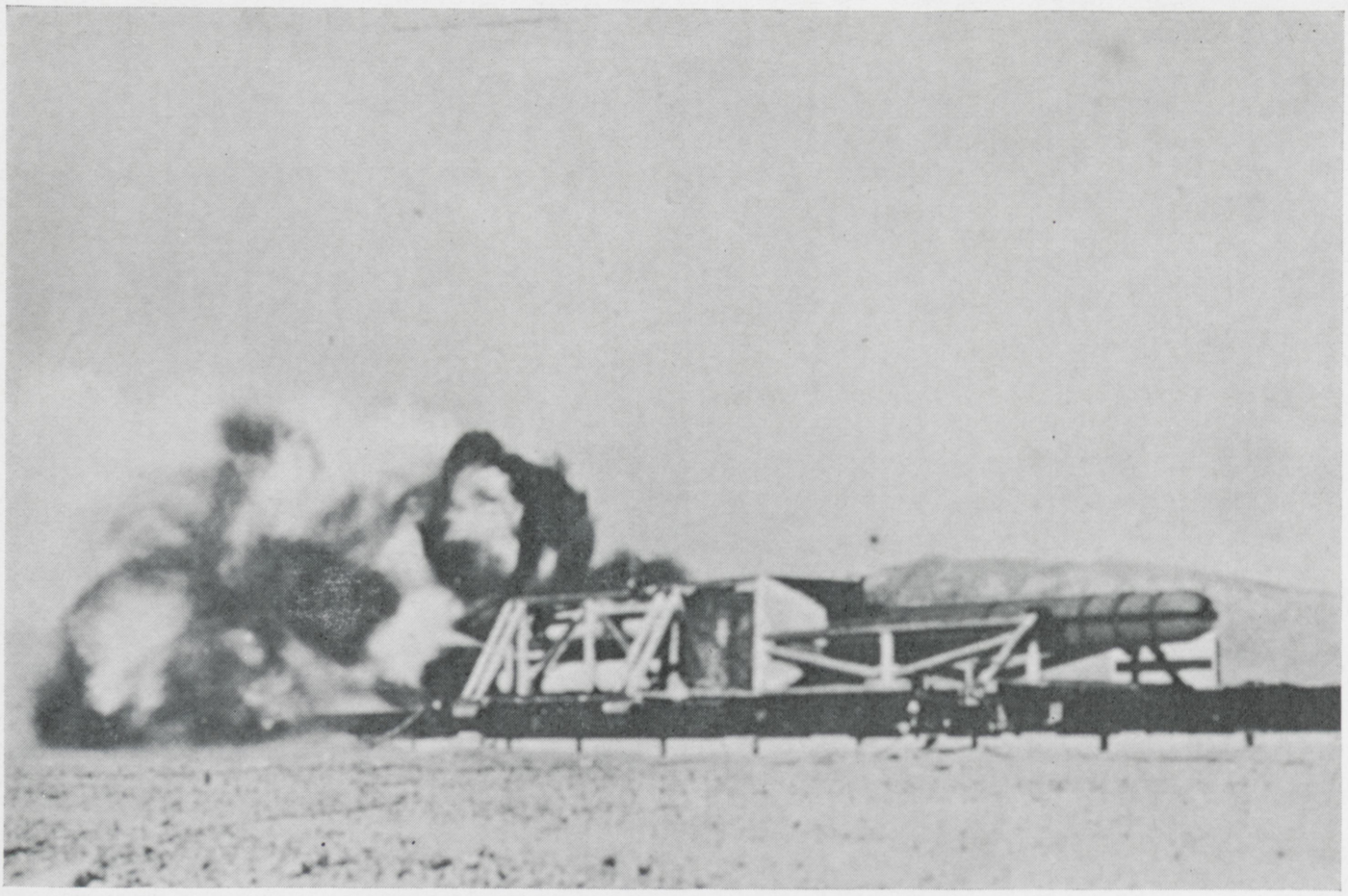
SANDIA scientists study cratering and blast effects of high explosives as part of Project Plowshare.

Discovering and improving peaceful uses of nuclear energy is one of the most fascinating challenges ever to face this group of scientists, engineers and technicians. Under Project Plowshare, for example, they are conducting studies with high explosives that will help clear the way for the use of atomic explosions to build canals, form earth dams and aid mining operations.

If the men and women at Sandia can find a way to convert heat to energy using radio isotope-powered generators, America's spacecraft will have a new and continuous source of auxiliary power. This is another of the atom-taming projects on the boards at the New Mexico site.

For the Vela satellite program, Sandia contributed complex logistics systems. These twin satellites have been monitoring outer space for signs of illegal nuclear testing since shortly afater the limited test ban treaty was signed in 1963. Sandia recently developed a prototype Unmanned Seismic Observatory. The USO is designed for possible use by the Defense Department to detect underground nuclear explosions.

(*Continued on Page* 20)



Rocket sled carrying test components blasts off.

SANDIA

(*Continued from Page* 18)

Sandians see these non-weapons applications as a hopeful sign of an approaching era in which all scientific knowledge can be put to peace uses. But until the day arrives when science can devote all its energies to embellishing a peaceful world with devices to promote health ,safety and prosperity, there is work to be done for defense.

A major effort in developing weapons is testing. Much of Sandia's testing is conducted at a location about six miles from Sandia Base. Components and systems are exposed to a wide spectrum of stress, shock, speed and temperature that they might encounter in actual use.

Testing devices include two giant centrifuges. One is the largest in the free world, and can develop 100 times the force of gravity on an eight-ton object.

Late last year a new 5,000-foot-long track for a rocket sled was completed. The purpose is to subject components to the same punishment they would withstand in missile launching or jet take-off. Ultimately, systems may be catapulted at speeds up to 7,000 feet a second (there are 5,280 feet in a mile).

A radiant heat facility tests ability of systems to withstand rapid changes caused by the shattering reentry from outer space. Temperatures can be raised to 5,000 degrees Fahrenheit in seconds. Climatic test chambers alternate temperature extremes to simulate thermal shock conditions. Two nuclear reactors next to the test site gauge effects of atomic radiation on components and systems.

The reason behind Sandia's emphasis on testing is clear to all of us —the weapons, if needed, must work the first time. There won't be a second chance.

Sandia's assignment from the AEC extends beyond design and development. It monitors the work of contractors who manufacture weapons parts, and it trains military instructors in weapons use and maintenance. Sandia's interest in a nuclear weapon ends only when that weapon is retired from the stockpile.

As these weapons are stored, distributed or used, safety and reliability must be built in. Sandia must insure none are detonated accidentally or without proper authorization. This reliability was demonstrated—though not mentioned in the headlines—when a B-52 armed with thermonuclear bombs crashed in Spain. Three bombs plummeted to earth without exploding. The fourth, which landed in the sea, was brought up from within the impact area pinpointed by Sandia experts.

The men and women at Sandia who develop these weapons hope they will never be used. Their job is to help give our country such a powerful arsenal that other countries will be deterred from starting a global conflict. And at Sandia, the chill winds of weapon technology blow in a great many beneficial changes in scientific concept that will stand in readiness to serve us in a world of peace.

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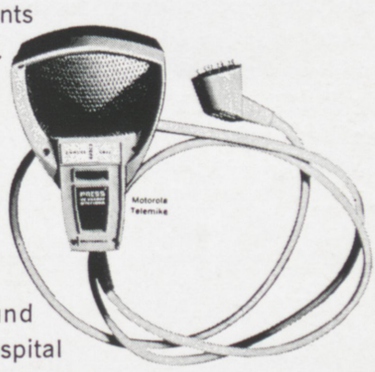

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MOTOROLA

LASERS AND MASERS

(*Continued from Page* 16)

energy gap Eg in which other bands are forbidden. If radiation of energy hv>Eg strikes the semiconductor, it will be absorbed, causing electrons to leave the lower valence band and populate the higher conduction band.

The most important of the semiconductor lasers is the injection laser. Figure IV shows a p-n junction (energy vs. distance). As before, Ec is the conduction band edge, Ev is the valence band edge. The left side (n-type material) has been doped with donor impurities which provide enough electrons to fill the conduction band to the Fermi level F. The right side (p-type material) has been doped with acceptor impurities which deplete electrons in the valence band to the Fermi level. For zero biasing voltage across the junction (Fig. IVa) electrons had flowed from the n-type to the p-type till an equilibrium barrier voltageVb was established which prevents further current. If this barrier voltage is lowered by an external biasing voltage V, i.e., the n-side is raised in energy (Fig. IVb), then electrons can "spill" over (are injected) into the p-side. Here they can make a transition down to the unfilled valence band, emitting at the same time radiation of energy is nearly equal to Eg. In other words, the lowering of the barrier created a population inversion in the p-type material.

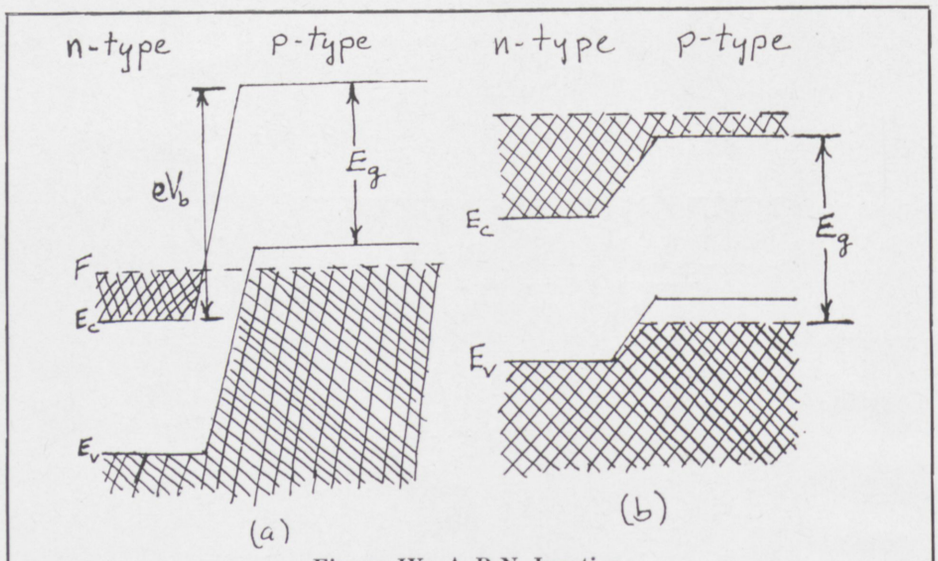

Figure IV: A P-N Junction

Figure V shows the Fabry-Perot arrangement of an injection laser. The electrodes on top and bottom provide the biasing voltage. Very high currents at low voltages are required to effect sufficient population inversion.

Although injection lasers are normally low-temperature, low-power devices and are therefore limited in application, the field is developing rapidly. Injection lasers have been used as optical amplifiers, with gains of 2000 reported. (14) The area of quenching, i.e., turning off one laser with the output of another, is also a promising field.

APPPLICATIONS

Applications of the laser have already become as wide as the frequency range it opened up. One of the first applications was the study of non-linear effects in the interaction of light with matter. The crystal lasers have been significant in this field. Recently laser light has been used experimentally to break down the bonds in granite in preparation for drilling. The laser has been used as an ultra-sensitive guidance system for a tunnel borer. Its monochromatic quality lends it to spectroscopy work. The destruction of malignant tissue in medical work is being investigated, and the initial tracking of missiles is a fertile field. The laser is still so young that it is not at all clear what it will be when it "grows up." Its most important application may very well not yet have been conceived!

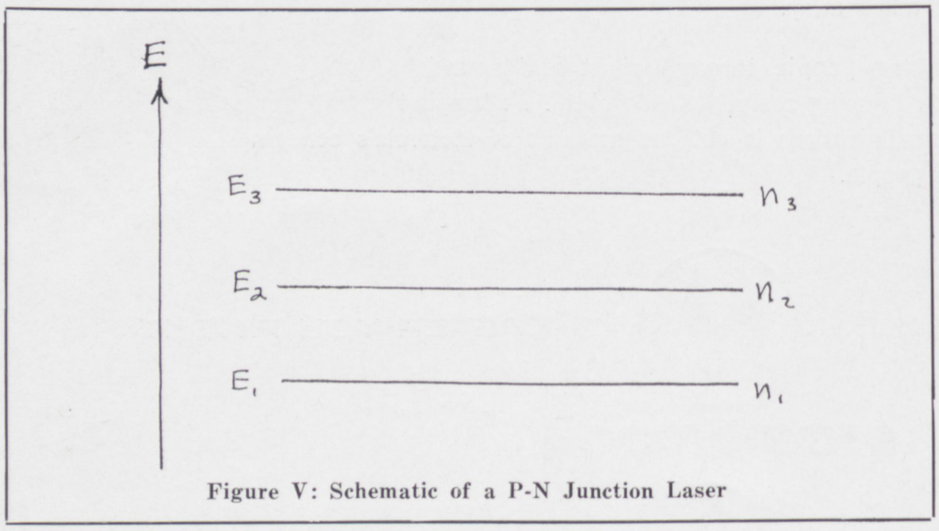

Figure V: Schematic of a P-N Junction Laser

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WATER POLLUTION

(*Continued from Page 6*)

cern for certain waters located near nuclear energy plants. As time moves on there will be more nuclear powered plants and their waste waters will have a very definite effect on the public health unless they are treated in such a manner as to reduce the threat of radioactivity.

A number of infant deaths is being attributed to excessive nitrate in drinking water and formulas. Cows whose diet includes excessive nitrate will give milk which will contain an abnormal amount of nitrate. A condition called nitrate cyanosis causes the blood to lose its ability to absorb oxygen. However these deaths were needless since there are at the present means to remove the nitrate from water.

A few years ago one could see pictures in newspapers of rivers which were covered with foam and soap suds. The cause for this problem was the new synthetic detergent classed as the "hard" type (non-biodegradable). With the present sewage treatment plants the detergents could slip through and into the streams without any change. D. C. Melnicoff, president of the Soap and Detergent Association announced that by the year of 1965 all household detergents will be made so that the foaming in the rivers will cease. However, facts have shown that this was causing only a very small and non-toxic part of the water pollution.

A bacteria, sphaerotilus natans, creates slime formations that rot nets of commercial fishermen, kill fish and destroy the recreational and scenic value of rivers. This slime is colorless and it may attach itself to an object or float independently. The slime traps organic matter and the combination reduces the oxygen content of the water making it unhealthy for fish.

Oil and tar products are also very detrimental to a water supply. Two of the more outstanding characteristics are the disagreeable taste and odor. These wastes also cause damage to the gills of fish and reduce the amount of plant life on which the fish feed. There also is a reduction in the recreational value of the surrounding waters.

Domestic sewage in a water supply is a dangerous health hazard. Typhoid fever and many intestinal diseases could be spread through this sewage. Since it is a threat to the public health, sewage treatment is a problem which must be solved if we as a nation want to remain healthy. As well as creating a noticeable odor, raw sewage as it decomposes in the river decreases the oxygen content of the water.

We now know what can be a few causes of pollution. In order to correct or prevent this contamination of the water supplies certain tests must be devised to analyze the water in a scientific manner. Four important quantities which may be used in discussing the pollution of water the the dissolved oxygen concentration, the coliform count, the pH and the specific conductance.

In surface waters the concentration of dissolved oxygen should be close to the saturation point. When the concentration is less there is a good chance something is contaminating the water. However, underground waters may be deficient in oxygen due to the oxidation of the dissolved minerals without necessarily indicating contamination. Also a certain concentration is needed to support the fish and other forms of water life. Closely connected is the biochemical oxygen demand which is an indicator of the metabolism of living organism as they utilize organic material for food. Unpolluted water should have a value of less than 5 ppm for BOD (boichemical oxygen demand). When BOD has a high value, it indicates organic pollution. However, the BOD will show only organic pollution and not give any idea concerning inorganic pollution.

The coliform count is an index of the concentration of the domestic sewage in the water. Along with this sewage is the potential hazards from intestinal disease germs and viruses.

Specific conductance is the reciprocal of the resistance of a column of water 1 cm. long and having a cross section of 1 sq. cm. usually at 25 degrees centigrade. This is a measure of the concentration of ions in that water being tested. An increase in ion concentration will cause the conductance to increase. The purest rainwater will have a specific conductance of 128×10^{-6} mho.

The pH is a measure of the acidity of the water. This acidity is due to carbon dioxide, mineral acids and salts dissolved in the water. Usually natural waters are slightly alkaline.

At present, main attention is being focused on the area of sewage disposal. There are two steps. The primary step is sedimentation or screening to remove solids. By using a group of screens up to 25% of the suspended solids may be removed. The standard primary sedimentation treatment will take 2-4 hours and will remove 40%-55% of the settleable solids. This process may be greatly aided by chemical precipitation. The secondary steps use trickling filters, sand filters or the activated sludge method to remove dissolved and colloidal organic matter and is oxidized to remove odor and nuisance.

We have seen that water is a natural resource which is very necessary to life. It has also been pointed out that there are various ways of polluting water and there are methods for analyzing the conditions of the water. With this we can take corrective following steps:

1. Analyze the water in the stream — find out what is polluting the water supply.
2. Evaluate different treatment methods for maintaining water quality.
3. Take legal action

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College Dissension

Today so much of the news is concerned with the current student craze of condemning everything. Literally nothing escapes the wrath of some student group or another.

Do these soap box oratorial groups deserve the attention they receive? As supposed college students they are supposed to display the eloquence of college training and contribute to the expression of academic freedom.

If this writer were a school administrator, he would expel them all and write an uncomplimentary letter to each boy's (emphasizing the word boy) draft board recommending his unwillingness to obedience and hard work. Since the boys could not look and act like Vietcong refugees, the girls would not either.

Before the writer gets a mail box full of ugly innuendos, he asks only that you finish the editorial. He does not condemn the freedom of speech, assembly, and press or the need of the college student to become aware of the social conditions of the times. But how effective are these protests? It seems that these rebels are only seeking glory or social recognition and none of the hard work that might callous their baby soft hands and sharpen their utopian minds to what really makes the world turn.

Do these groups do any thing but protest? Anybody can disclaim, but the better man seeks solution while condemning the present conditions.

Definitely the protesters are right in arousing the concern of the public, but they have taken the wrong approach for progress. Most people are wise enough to realize that they are not going to receive help by biting the hand that feeds them. How willing would you be to support needed reform when the reformer is not willing to support the rudimentary institutions that make his protest possible.

A counter example is the former Governor of Alabama, George Wallace. His views are not important to this editorial. What is significant is that this man has used the tools of democracy open to all of us including the protesters to build himself a publicly recognized dais from which to issue his criticism.

F.M.N.

It is indeed heartening after the last student body elections to see that approximately four-fifths of the student body voted. Often important affairs of this nature are passed over lightly by eligible voters.

Seemingly, a main issue in this election was the fact that the Student Congress needs to do more for the student, make the student aware of the activities of the Congress, and make the Congress aware of the student's needs. In that there was a large voter turn out, it is apparent that the new Student Congress officers should strive to communicate with the student today. THIS IS A DIFFICULT JOB! The lack of interest in passing the Bookstore amendment is an example that the student body can be just the opposite as they were in the Student Body elections.

I believe the Student Congress should take the initiative to poll the students through the Campus Mail, as to what they would want in programs such as big name talent on campus and speaker's topics for Impact, etc. Most important the Congress should publish, not just post, minutes and any recorded Student activities in one of the campus publications.

It is only through the extensive use of Campus Mail and publications, a suggestion box and other campus facilities that a good representative student government can be attained.

D.E.M.

COMPUTER MANAGEMENT

(*Continued from Page* 12)

complex programs are operational. In large problems, the number of parameters and factors is often great and their interactions very complex. Also, large quantities of data, for present and future processes, are required in new developments. This new data is occasionally revealing enough without having to perform the simulation. Analysts have also noticed that there are often much simpler methods than simulation available for predicting or "trying" these processes. Naturally these other methods should be sought first. Yet, even with the consideration of these problems, the insights that simulation provide assure it a place in the realm of future management.

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CONTEMPORARY RELIGION

(*Continued from Page* 10)

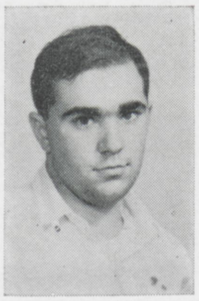
six days a week and be redeemed on the seventh. Many of those who attend services do so not because they really desire to, but because it is an accepted form of behavior in our society, just as exchanging presents at Christmas. Such a philosophy is especially applicable with the younger generation. Many Americans suffer under the delusion that attending church, an outward profession of faith, is a necessary and sufficient condition for being a good Christian and going to heaven.

The Christian church today is extremely ethnocentric in its outlook. Anyone who is not of the Christian faith is almost automatically assumed to be wrong with his faith by the pious devout Christian. Imagine the weekly worshiper of some Christian sect condemning the Buddhist monk who has spent his entire life in the study of his religion. In the United States there are even present petit rivalries among the various denominations of the Christian religion. An ethnocentric religious outlook precludes the possibility of one possessing a broad and open mind when challenged with an opposing view.

In summary, the author would like to emphasize that he is *not* adverse to the moral and ethical code of the Christian religion, but is opposed to its practices in the United States today and to the organization and activities of the modern day church. The church has become a commercialized business and a large scale social organization. In reality most churchgoers of today attend because "it is the thing to do." The Christian religion is a very ethnocentric one which denies the possibility or correctness of conflicting ideas institutional in our religions. Our modern religion, as formulated earlier, is a product of The Great Society and consequently is becoming more complex in structure and more impersonal in its secular relations among individuals. It is the author's opinion that religion should be more individualistic and less rigid and binding.

Spring Sports Review

by Don Riley



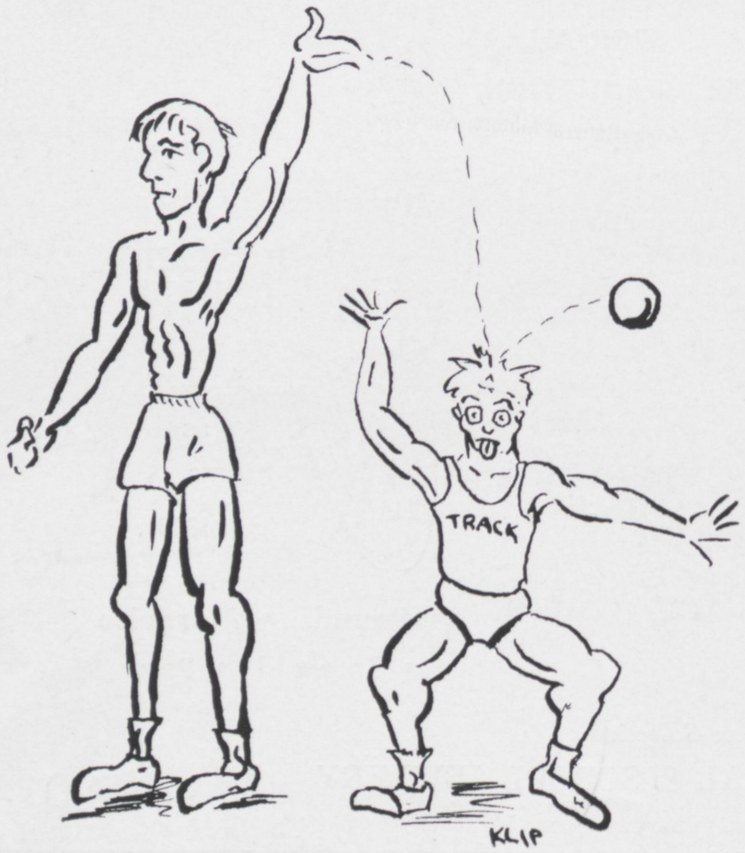
The author is Don R. Riley, a junior majoring in electrical engineering from Akron, Ohio. Don is a member of Lambda Chi Alpha fraternity, and is also active in the Glee Club.

After recovering from the effects of last month's terribly late editorial, I've almost sworn off editorializing. I must add, however, that I did appreciate the artists conception of, I suppose, an ISU football player. Ah, but to spring sports, as I promised.

The tennis team began slowly, but have won their last two matches, and now stand at 2-1 for the season. Wabash, meeting Rose on their own courts, smashed our men 7-0. Only three of the seven matches went the full distance of three sets. But, the Rose netters bounced back against Marian and Blackburn. The match of the season was to be held today, April 22, but due to rain, the match was cancelled.

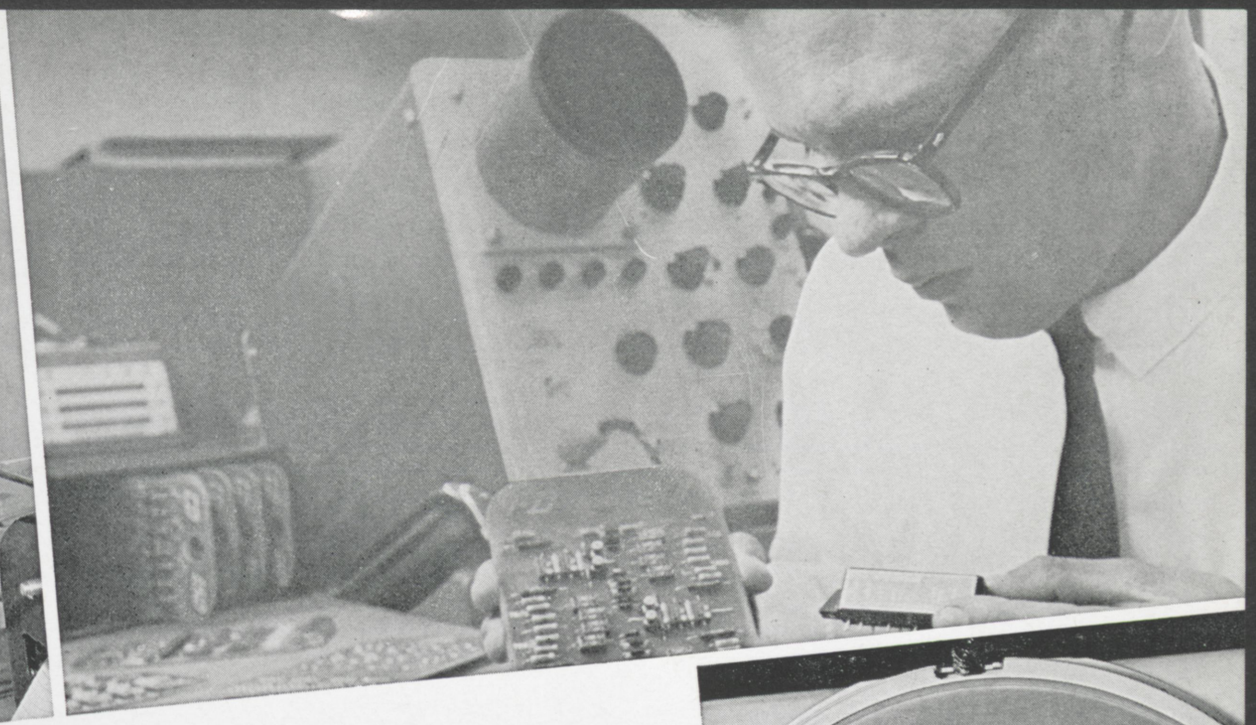
The golf team has a record identical to that of the tennis team, as of this writing. Opening the season in Indianapolis, they stroked the ball for a 12-6 win over Indiana Central. Then, the linksmen lost a tight one to DePauw and came back against Wabash, edging our arch rivals 9½-8½. Tom McLeish has been leading the team thus far this season. He shot an excellent 74 in the recent win over Wabash.

The track squad has been running and jumping into some good meets this season. They defeated Hanover in the season's second meet 94-51 on the Hanover track. When the sun set that Wednesday night, Rose had captured twelve first places. Although the entire team didn't participate in the Wabash Relays, Coach Martin entered thirteen men. None of the thirteen captured any honors, but I must point out that they were competing against the best track men in the area and we should be proud of the representation those men gave. In the next meet, a triangular one held on the Rose track, Rose met Wabash and Greenville, two very respected teams. Rose came out on the low end with Wabash walking away with the top spot. However, Tom Johnson captured firsts in the shot put and the discus. As of the writing of this article, the results of the Marian-Franklin Rose triangular meet were not available.



Finally, the baseball team has been keeping its head barely above the .500 mark with a 5-4 record at present. They began slow, but won four in a row and were 4-1 at that point. Then, on April 15, Rose traveled to Earlham to meet probably the best pitcher in the league. In the first game of a twin bill, Rose got two hits and one run, losing 6-1. In the second game, things were going well until the fifth inning, and that's when the roof fell in. Final score on that one was 6-5. In their last outing, Greenville handed Rose a shellacking, this loss bringing their season mark to 5-4.

So ends another year of Sports from the rear pages of the Technic. See you next year, and maybe a little closer to the front.



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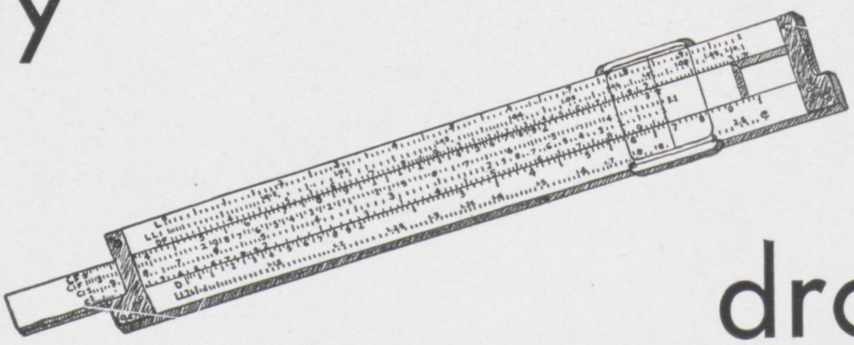


droolings

Stolen by GARY KELM, Fr.

LIFE OF A JOKE

One minute: Freshman thinks of a joke and tells it to his girl friend.

One day: Joke circulates through girl's dorm and then is told to senior engineer by his date.

One week: Senior sends joke to campus magazine (us), claiming origination for himself. Joke page writer thinks joke is miserable, but since deadline is overdue and he is desperate for five lines, he decides to use it.

One month: Joke appears at bottom of joke page. Joke page writer is forced into exile.

One year: Joke circulates through every engineering college magazine from Alabama to Canada, and from New York to Oregon.

Two years: Gag writer for radio program finds local college magazine on bus and sees joke. Joke appears on Disc Jockey program. Gag writer loses union card.

2½ years: Reader's Digest prints joke from radio program.

4 years: College professor finally gets around to reading the issue of Reader's Digest and laughs heartily at joke.

5-30 years: College prof uses joke to start off his lectures at beginning of each term.

35 years: Joke passes on, as does college professor.

Chemical Engineer (moaning at the bar): "It's terrible, the cost of living has gone up to $4.18 a fifth.

* * *

A number of showgirls were entertaining the troops at a remote Army camp. They had been at it all afternoon and were not only tired but very hungry. Finally at the close of their performance the major asked, "would you girls like to mess with the enlisted men or the officers this evening?

"It really doesn't make any difference," spoke up a shapely blond. "But we've just got to have something to eat first."

* * *

Connect 20,000 volts across a pint. If the current jumps it, the product is poor. If the current caused a precipitation of lye, tin. arsenic, iron, slag, and alum, the whiskey is fair.

If the liquor chases the current back into the generator, you've got good whiskey.

* * *

Reader: "So you made up these jokes yourself."

Editor: "Yep, out of my head."

Reader: "You must be."

* * *

A chaperone is a force acting on a couple to maintain it in a state of equilibrium.

Finals, finals everywhere
with drops and drops of ink,
And never a prof who'll leave the room
And leave a guy to think.

* * *

"May I have this dance?"

"I'm sorry, I never dance with a child," said she, with an amused smile.

"Oh, a thousand pardons," said he. "I didn't know about your condition."

* * *

A couple of gobs laying over for a day or two in Sweden decided to go to church. Knowing no Swedish, they figured to play safe by picking out a dignified looking gentleman sitting in front of them and doing whatever he did.

During the service the pastor made a special announcement of some kind, and the man in front of them started to rise, at which the two sailors quickly got to their feet, to be met by roars of laughter from the whole congregation.

When the service was over and they were greeted by the pastor at the door, they discovered he spoke English and naturally asked what the cause of the merriment had been.

"Oh," said the pastor, "I was announcing a baptism, and asked the father of the child to stand."

The Air Force doesn't want to waste your Bachelor of Science Degree any more than you do.

B. Sc. Those letters have an impressive sound.

But they won't be so impressive if you get shunted off into some obscure corner of industry after you leave college. A forgotten man.

You want activity. You want to get in there and show your stuff.

All right. How do you propose to do it?

If you join the United States Air Force you'll become an expert fast. The Air Force is like that. They hand you a lot of responsibility fast. Through Officer Training School you get a chance to specialize where you want... in the forefront of modern science and technology.

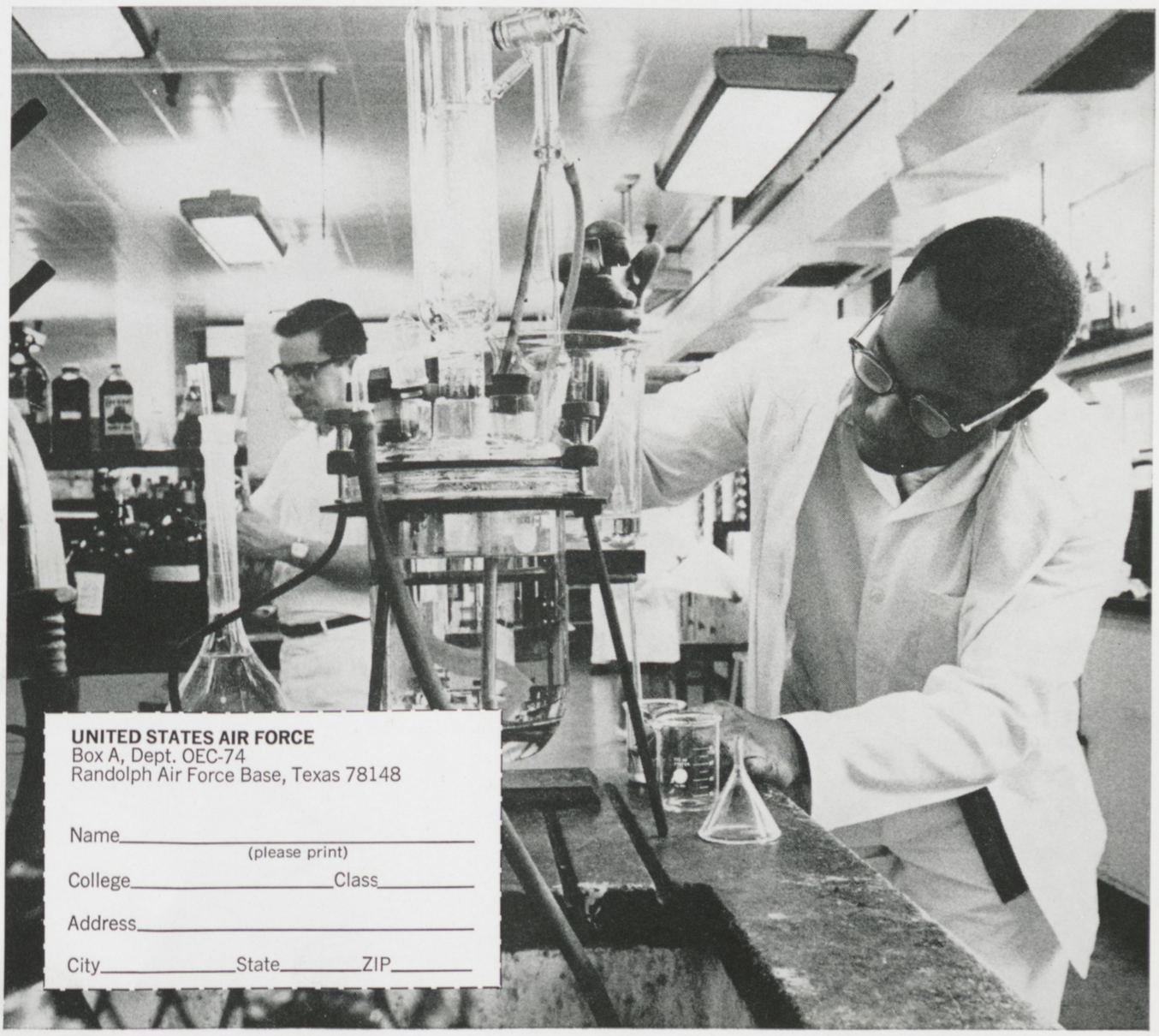
Suppose, for example, you wanted to become a pilot and serve as aircraft commander on airplane crews. You'd plan missions and insure that the aircraft is pre-flighted, inspected, loaded and equipped for the assigned mission. You'll be trained to fly exciting aircraft.

Just examples. There are so many more.

Wouldn't it be pretty nice to enjoy officers' pay and privileges? And serve your country, as well? Also, you get retirement benefits, 30 days' paid vacation, medical and dental care.

B. Sc. Very impressive letters.

Now, *do* something with them.



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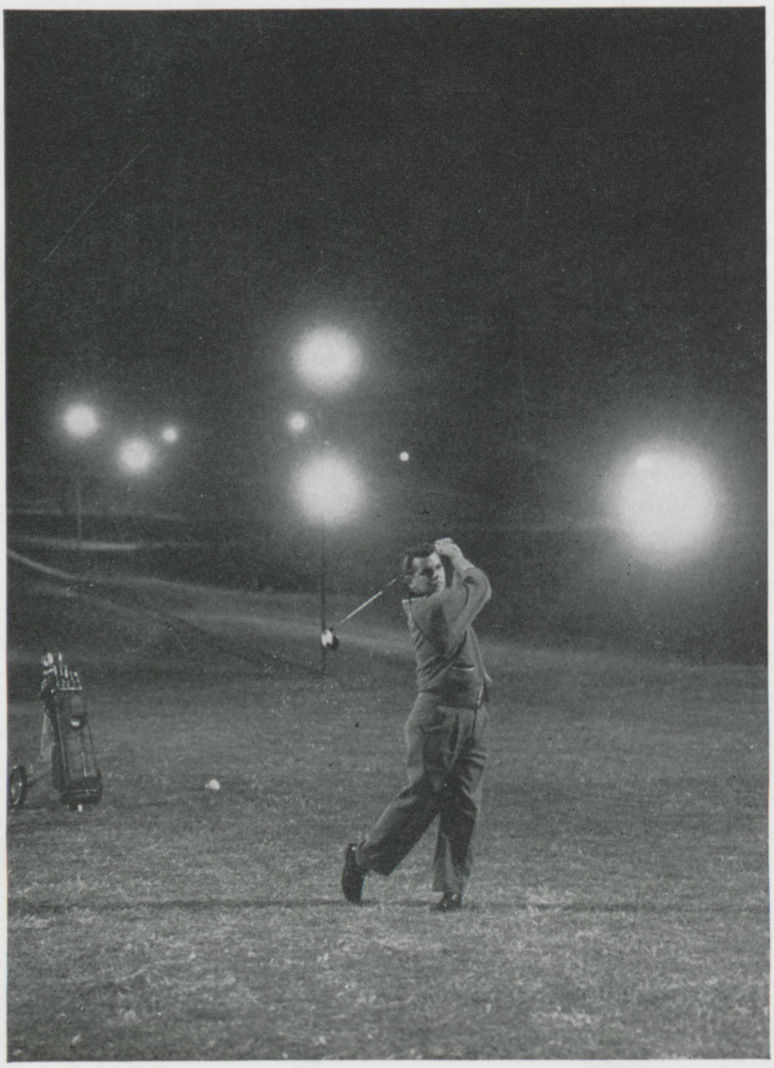
like longer days



Turning night into day with outdoor lighting is one of the many challenges you may face in your technical career at General Electric.

For example, inquisitive minds in research and advanced design at General Electric are evolving many concepts to make our recreation areas available day and night. Design engineers are developing concepts into specifications, while manufacturing engineers are developing the techniques and processes that translate designs into outdoor lighting systems.

In addition, technical marketing specialists are working with electric utilities and city planners, applying night-lighting to athletic stadiums, city parks, or outdoor pavilions.

You can help develop new products and concepts, new facilities, processes and manufacturing systems, or new applications and markets in your technical career with General Electric. For more information write: D. E. Irwin, Section 699-21, Schenectady, New York 12305.

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