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With atomic power, it is possible for rockets to carry bigger loads farther than with conventional fuels. The first full power test of the reactor for NERVA (Nuclear Engine for Rocket Vehicle Application) promises a new United States capability for voyages into deep space and to the planets.

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For more information, write J. H. Strange, American Oil Company, P.O. Box 431, Whiting, Indiana.
In April of 1964 the TECHNIC published its first special Bioengineering issue. Interest in this rapidly-growing field and in Rose's increasing number of bioengineering courses has resulted in this, our second Special Bioengineering Issue.

Larry Rose discusses the development and present status of the artificial kidney in "The Kidney Machine," starting on page 8.

The electroencephalogram, or EEG, is the subject of Tom Sprouse's article. To learn the meaning of your brainwaves, turn to page 12.

Do you like your algae fried or broiled? Jerry Massa outlines the possibilities for food from the sea in "Marine Biology—A Source of Food." Begins on page 22.

COVER NOTE

This month's cover is by Dave Honey, a Sophomore Chemical Engineering Major, and is entitled "EEG."
The Kidney Machine ................................. Larry Rose
Measuring the Electrical Power of the Brain .......... Tom Sprouse
The Engineering Summer Work Program ................. Jeff Keeler
Waste Utilization in a Closed Ecological System ...... Jim Phelps
Marine Biology—A Source of Food? ...................... Jerry Massa

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ROSE POLYTECHNIC INSTITUTE
Terre Haute, Indiana

HIGH SCHOOL GRADUATES OF 1965
You are cordially invited to visit Rose Polytechnic Institute where you can earn a degree in:

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ELECTRICAL ENGINEERING
MECHANICAL ENGINEERING
CIVIL ENGINEERING
MATHEMATICS
PHYSICS
CHEMISTRY
The Rose

Admissions Program

Ed. Note—This is the third of a series designed to acquaint students and alumni with the functions of the various departments of the administration of Rose Polytechnic Institute.

The Rose admissions program is designed to attract and enroll qualified students motivated toward careers in science and engineering.

Professor Paul Headdy is Director of Admissions and Placement. He has been at Rose for 19 years, first as a teacher and since 1960, as admissions director. His years of teaching have defined for him the qualities he looks for in future Rose men. Working with him as counselors are Bill Brown, a 1962 Rose graduate, who majored in Mathematics, and Duncan Murdoch, who was graduated from Hanover College in 1961; worked in the Admissions Office there for two years, and came to Rose in September, 1963.

Student recruiting is done nationally, even internationally, mostly through specially designed pamphlets and brochures mailed to interested students, high school guidance counselors and libraries. In the past two years personal recruiting has been intensified in Louisville, St. Louis, Cincinnati, Dayton, Cleveland, Detroit, Chicago and Indianapolis as well as lesser cities in Indiana, Illinois and Ohio. The result is a geographically diversified student body, a feature we will preserve and expand.

From these contacts come applications for admission. We receive an average of two applications for every student ultimately admitted. So far this year we’ve received approximately 3,000 inquiries and applications to increase markedly in succeeding years.

Not every inquiry results in an application. An initial screening of interested students weeds out the obviously unqualified. Later, after application has been made, students are screened again on the basis of high school record, College Entrance Examination Board (C.E.E.B.) scores, extra-curricular activities and recommendations. We want the best qualified young men — men equal to the demands and challenge of the Rose program; men who will benefit most from the unique and outstanding opportunities at Rose.

Once admitted, each student becomes a member of our recruiting team. When he is home on vacation, he is “selling” Rose to everyone he meets. When high school students visit the campus, often the Rose students’ attitude and appearance have a decisive influence on the visitors.

Your cooperation as hosts, making special contacts for the admissions office and stopping back to see your high school guidance counselor and teachers is of great value and assistance. Together we can and are attracting the best men to Rose.
CAN WE ABOLISH THE DRAFT?

“Let’s not look at it—maybe it will go away.” This seems to have been the attitude of Congress for the past two decades, and continues to be the prevailing attitude, toward the problem of military conscription. In the shuffle to deal with what some regard a more pressing issue, “the draft” has repeatedly been pigeonholed for later action. Yet this is a matter which strongly affects the future of a vast majority of the young men of this country.

The military obligation is not the central issue involved in the question of having or not having conscription. Any patriotic American should feel compelled to serve his country if he is needed for military duty. The question at hand is, rather, a question of need. Do we need the draft in order to maintain the large standing military force necessary in the Cold War? Without claiming to be an expert, and admittedly having only limited knowledge of facts, I still submit that there is a good possibility that we do not need the draft.

To determine why the extensive recruitment program of the Army does not meet the demand for men, one must ask, “Why not join the Army?” The answer to this boils down to these two deficiencies, in a great many cases: (1) insufficient pay and (2) a lack of prestige.

Without elaborating on the meaning of these two points, let us examine how military service might be made more attractive to young men.

First, higher pay is necessary. A professional army, in which a man receives a salary comparable to what he could make as a civilian, and in which his ability and training would result in commensurate financial reward, is the thing which should be sought. Higher pay would result in more career men, which would produce a slower turnover of manpower, which in turn would result in much-reduced costs for individual training and equipping. By making army service as lucrative as, say, selling shoes or growing corn, and with the added attraction of travel opportunities, many more high school graduates would be interested in “joining up” rather than “dodging the draft.”

The problem of prestige, unfortunately, is not one which is easily legislated away. When one considers the relative amounts of prestige accorded an officer in the British army and an American army officer, one can see the difference. This is a problem attached more to officer recruitment than enlistment.

If the draft is abolished, the ROTC program will receive a heavy blow which must be offset. The best solution here, though, still hinges on the question of better pay. Better pay will attract more and better men, and because of this the level of prestige should increase.

The fringe benefits of abolishing the draft by raising pay, and in other ways making military service more desirable as a profession, are large enough to be considered as compensatory. As previously mentioned, the reduced turnover in manpower will result in great savings, obviously. The increased level of proficiency gained from experience might well permit a cut-back in necessary manpower. The abolishment of the local Selective Service boards and their expensive registration and call-up apparatus, would be yet another saving.

The social consequences are worth consideration, also. How many marriages have been entered into prematurely, largely because of the hurry to “beat the draft?” How many young men are standing on street corners, unable to find jobs, because they have not yet fulfilled their military obligation? How many young bachelors hesitate to put down roots in the community where they live and work, to become involved in civic affairs, because they know their numbers are coming up, and they must soon leave for the army?

These social consequences are the things not being measured by the Pentagon’s all-knowing planners. Perhaps an army of the sort described here would be more costly to the taxpayers, but what proportion of these taxpayers have faced a peacetime draft as an inevitability to be reckoned with as surely as death? The draft is just such an inevitability for many young men. In the light of these things, the problem of the military draft takes on more urgency than it has been accorded in the past. It is imperative, from the viewpoint of one who is eligible for the draft, that Congress act on this problem this year, and that it weigh the large social gains against any alleged financial impracticality put forth by the dollars-and-cents men from that five-sided fortress of efficiency run by Secretary McNamara.
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For more information, contact the Professor of Advanced research in nuclear weapons.

U. S. Air Force

If your campus has no AFROTC, see your Air Force recruiter.
Larry Rose is a freshman who commutes from St. Mary-of-the-Woods, Indiana. He plans to major in chemical engineering. He played football first semester, and is a pledge of Sigma Nu Fraternity.

Illustrations by LEE MORROW, jr. chem.

The kidney machine is a machine to simulate the functions of a natural kidney and to be used in place of the natural kidney. Before the kidney machine is discussed in detail it would be wise to first understand what are the natural kidneys' purpose, location, expendability, etc., so as to be able to see actually what the kidney machine will have to do or to what extent it can be used.

The human kidneys are bean-shaped glands, approximately four and one-half inches long. There is one kidney lying on each side of the body in the upper region of the abdomen outside the peritoneum. There are three main purposes of the kidneys; 1) extraction and excretion of wastes from the blood, 2) control of the body's pH of the blood by excretion of Na ions and H ions, 3) performs in physiological processes, formation of erythrocytes and regulation of blood pressure. These functions are carried out by the kidney by the processes of filtration and reabsorption. Blood pressure supplies the force necessary for filtration. Only two blood constituents normally can not pass through the filters, blood cells and plasma proteins. The kidneys seen as a crosssection (fig. 1) revea an outer region, the cortex and the inner region, the medulla, which is striated and divided into eight to eighteen cone-shaped pyrimids and then is connected to the expanded end of the ureter. A renal artery comes directly from the aorta into the kidney and then branches off into many smaller arteries and finally vein connected to the inferior venae cavae. Part of these capillaries extend into the Bowmen's capsule (fig. 2). These capillaries are termed as the glomerulus and it is here where the wastes are filtered into the collecting tubule. This waste plus other materials, which are filtered out, passes down the collecting tubule to a loop in the tubule called the Henle loop. At this loop is where the second process occurs, reabsorption. This is done by specialized cells in the nephric tubule which secretes substances, most abundant is water, on their outer surfaces which is then reabsorbed into the blood stream. Of the 150 quarts of liquid filtered per day by the kidney, 99% of the water is reabsorbed and all of the
How much do we depend on our kidneys? The kidneys are more expendable than most people believe. It has been estimated that man can survive without mechanical aid on one-twentieth of one functioning kidney. Many people today live happily and safely on one natural kidney. The statisticians even give a person with one kidney the same life expectancy as a person with two. The only normal exception to this is for a pregnant woman and she needs both kidneys.

More than one-half of all the deaths in the United States are classified technically as due to cardiovascular renal diseases. What are the causes of renal shut-down? Kidney shut-down may be due to mechanical or pathologic of renal, extrarenal or mixed origin. These include the nephritides of acute toxemias, infection, pregnancy, shock with blood loss, mismatched transfusions, sever burns, trauma (physical injury) to kidney or ureters causing anuria (lack of urination) and poisoning by barbiturates (aspirin), sulfonamides and certain compounds such as carbon tetra-chloride. If kidney shut-down occurs extrarenal routes are taken for excretion such as through the skin, the peritoneal lavage, the gastrointestinal tract, kidney transplants (very unsuccessful as of yet), crossed blood transfusions (exsanguinatransfusion), perfusion through an isolated loop of intestine and through vivodialysis or vividiffusion which is the use of the kidney machine. This last method is the most effective and practical.

The actual practical experimentation with the kidney machine began with Abel, Rowntree and Turner in...
1913 but actual credit is given to Dr. Willem J. Kolff as father of the kidney machine. Essentially there are two main types of kidney machines, the horizontal (fig. 3) and the vertical (fig. 4).

The horizontal kidney machine was the first type of kidney machine successfully put into use, approximately 1945. The first model was almost as large as a commercial laundry machine and cost up to $7,000. Today the horizontal kidney machine consists of a stainless steel tub, twenty-four inches across and seventeen inches deep, a revolving drum, with rotating couplings, tubes caring blood from and to the patient, 115 feet of dialyzing tubing, sterile cellophane which is usually sausage casing, wound around the drum between two layers of screen, an air pump, plastic valves, a temperature control device and a blood clot and air bubble trap. This is the basic make up of the horizontal kidney machine. The principle on which it works is dialysis, which is the migration of substances through a semi-permeable membrane to a lower concentration. Operational procedure of the machine is rather simple. Banked blood, approximately 400 ml, is initially introduced into the machine along with some physiological saline and herparin, to prevent the blood from clotting. The bath solution, which covers half of the drum, varies in composition, depending on the reason for the use of the machine, but it generally consists of 100 l. of solution containing the major electrolytes of plasma, such as sodium, potassium, calcium, magnesium, bicarbonate and chlorine. These electrolytes are put in as concentrations normal to plasma. A mixture of 5% carbon dioxide and 95% oxygen is passed steadily between the fluid and the plastic cover of the machine. Carbon dioxide enables the calcium to remain in the solution with the bicarbonate. These electrolytes can be made up to 100 l. with ordinary tap water but deionized distilled water is preferred. Glucose may be added to the bath and is required in some cases where movement of the fluid of the bath into the blood occurs. This causes hydration which would lead to pulmonary edema if not corrected or regulated by adding glucose to the bath, about 0.7% is satisfactory. This glucose causes the fugacity of the bath fluid less that of the plasma. This solution is warmed to and maintained at the temperature of the body. This rinsing solution is the only thing connected with the kidney which does not have to be sterilized. This is because microorganisms do not and viruses apparently do not penetrate the cellophane. After the rinsing solution is prepared and the machine is readied for use, a surgeon places cannulas in the patient’s body. These sometimes vary from place to place but the most common place is to place the incoming tube, that is the one going into the machine, into the radial (wrist) artery and the one coming from the machine into vein on the inner aspect of the same arm at the elbow. Still another way which is good for patients which must be subjects of the kidney machine for many different periods, a period lasts about six hours, is to use just the artery and to put in a “plug-in” in the patient’s arm so that surgery is not required each time. The patient is just plugged in to the machine. When the patient is ready to be hooked up, the banked blood is introduced into the machine and extracorporeal circulation is started.

(Continued on page 34)
Work for a bearing and steel company? What’s exciting about that?

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Tom Sprouse is a Junior Civil Engineering major who commutes from Staunton, Indiana. Active in extra-curriculars, Tom is Ritualist for Lambda Chi Alpha Fraternity, Recorder of the ASCE, a student Congress representative, Inter-Fraternity Council representative, and a letterman on the baseball team.

Measuring the Electrical Power of the Brain

Where does the brain get its power to perform its many functions of everyday life? This is a question that is yet not completely answered. The common theory involves the idea of an electrical potential set up within the brain itself. It is with this subject of activity that this paper will deal. To limit the subject further, since the whole of electrical activity of the brain could not be fully discussed in a normal sized book, this article will deal mainly with the device which measures the electrical activity of the brain. That device is the electroencephalogram or EEG.

As early as 1875 electrical currents were measured in the brain by an M.D. in Liverpool, Richard Caton. To measure these currents he used one of the few electrical instruments of the day, the galvonometer. Caton’s work was followed by Adolph Beck, from Poland; Fleische von Marxow, from Vienna; and Vasnilo Yakolevich Danilevski, from Russia, who all claimed to improve his experiment at about the same time.

Twenty-five years ago Hans Berger, a German psychiatrist working in Jena, began to publish some strange little pictures consisting of nothing but wavy lines. They should have caused great excitement among his colleagues, because he claimed that they showed the electrical activity of a human brain. But in fact no one even bothered to repeat his experiments.

Today several hundred laboratories in the U. S. and a similar number in Europe are recording and interpreting charts of the electrical discharges of human brains. Their total annual output of charts would girdle the earth. Hospitals all over the world have accumulated thousands upon thousands of brainprints of their patients, for these recordings have proved to be great
help in the diagnosis and treatment of brain diseases.

Brain diseases leave prints as distinctive as a criminal's fingerprints, and the brainprints have been useful in medical practice for precisely the same purpose — to identify the culprit. A brainprint may be put to use for identifying a brain disorder even though we do not understand what it may have to tell about what is going on in the brain. The detective work involved in tracking down the clues to brain diseases is so exciting that at first scientists were content to exploit this aspect of electroencephalography and to postpone more fundamental investigations. During the last few years, however, interest has been swinging around to use of the tool to study the workings of the living brain itself.

By a fortunate coincidence — or perhaps it is not a coincidence — the designers of the new electronic computers have, at the same time, become more and more impressed with the similarities between their machines and the mechanisms of the brain. Physiologists have had the satisfaction of seeing engineers develop, with great labor and expense, systems which evolved naturally in living creatures millions of years ago. This convergence of interest — the cross-fertilization between communication engineering and biology — has been given the name cybernetics, originally used by the French physicist Andre Marie Ampere over a hundred years ago. The task now that faces the engineering student, physicist, and doctors is that of finding how the brain works.

The machines that record the electrical rhythms in the brain have become elaborate and expensive. They contain dozens or even hundreds of radio tubes. A really elaborate research apparatus may have several hundred controls, set and adjusted by a team of highly skilled operators before and during each experiment. The cost of the equipment is usually defrayed by the fees earned in medical applications; the gigantic scale of this work could never have been achieved with the funds available for academic research. The astonishing thing is that with all this time and material we still do not understand even one part in a thousand of the frantic scribblings of our fine machines.

The standard electroencephalographic chart shows a set of eight or more wavy lines, each line being a graph of the electric signals from one region of the head. We may suppose — and it is only a supposition — that these signals are code messages from the brain, and our task may be defined as a search for clues that will help us to break the cipher and read the messages. The usefulness of the brainprints in diagnosing disease lies in the fact that we have established that serious emergencies in the brain usually yield certain simple code messages in our machines.

The signals are usually classified by the frequency of the electrical pulsations in them. Berger's original oscillations, which he named alpha rhythms, are in the frequency band between 8 and 13 cycles per second — that is, about as fast as you can move a finger. Their size, or amplitude, is around 30 millionths of a volt. Neither the frequency nor the amplitude is constant. Each individual has his own characteristic pattern of shifts in frequency and size; thus his brainprint is as distinctive as his signature. The alpha rhythms also can be identified by the part of the brain they come from; they are nearly always largest at the back of the head, where the nerve signals from the eyes reach the brain. They are usually larger and more regular when a person has his eyes shut and is not thinking. From this the inference has been drawn that activity of the visual imagination may suppress the alpha rhythms. One person in five shows no alpha rhythm at all — only small, complex, irregular pulsations from all parts of the brain, with no fixed frequency. In one in five also the alpha rhythms go on even when the eyes are open. Upon the basis of such personal differences we have established a tentative classification of brain types in human beings. This system indicates differences in ways of thinking, rather than the relative success of people's thinking, as "intelligence tests" do.

To complete the panorama of the strange dark world within our heads, let us look at the brainprint itself. Learning to understand brainprints is rather like learning a foreign language from a number of acquaintances with different accents and dialects. Now there are two things which often astonish a visitor to a foreign land: (1) the ease with which young children speak the tongue, and (2) the similarity of baby talk in all countries. We are called mammals because "ma" is one of the first syllables human babies everywhere fix upon, and they seem to apply it to the maternal organ which first regularly attracts their attention. There are similar characters in brainprints. At birth the brainprints of infants are generalized, but at an early age, around three or four, the child's brainprint acquires the individualistic features of an adult's. In a newborn babe there are slow, rhythmic swings of electric change in all areas of the brain, the different parts acting in the same way electrically but without much coordination. During sleep the brainprints of babies are very like those of sleeping adults: mainly large, slow, regular oscillations, called delta rhythms. Some time during the first few months of life an important mechanism appears — a transient outburst of fast and slow rhythms when the sleeping baby is half awakened by a noise or movement. Most parents are only too familiar with the transition from an infant who will sleep through almost any racket to one which stirs at the creak of a floor board. The same electrical response to stimuli when asleep is seen in adults. In most cases it seems to be connected with the brain mechanism that prevents a sleeper from being awakened too easily by trivial noises; it has been called the "K" complex. In later life these safety mechanisms are usually very sharply tuned, as it were, so that a mother may sleep through a thunderstorm but wake when her baby whimpers.

(Continued on page 26)
THE ENGINEERING SUMMER WORK PROGRAM

by JEFF KEELER

The author, Jeff Keeler, is a junior majoring in Electrical Engineering. Besides being a member of the track team, he also is active in the Radio Club, serving now as secretary. In addition to his extracurricular activities, Jeff maintains a high grade point average and is a member of Tau Beta Pi. Jeff has worked for Public Service Company of Indiana for two summers under a program similar in many respects to the one he describes here.

In recent years industry has become aware that summer work programs can be quiet beneficial to both themselves and to the student engineer working in the summer program. The company provides the student with an application for his technical knowledge and introduces him to problems associated with even the simplest job. In return the student is better trained to enter industry upon graduation. He provides an important liaison between the company and his school for if the company provides a good summer work program, the student will carry this information to his classmates.

In industry the student has his first chance to really apply what he has learned at school. However, he not only applies technical knowledge during the summer, but he probably will learn more about how to efficiently apply than could ever be gleaned from a textbook. If the summer is to be meaningful, the budding engineer should be given an engineering project, the completion for which he is fully responsible, with the proper guidance, of course, this project should be a challenge. The engineer should have to use his technical skills, his decision making ability, his specific job training, and his methods of application in completing a successful project. While this primary project should be of a challenging nature, one or two routine duties could be assigned to the student. This not only keeps him busy, but makes him feel more useful. At times the primary project might entail lengthy hours of busy work and these secondary matters would tend to relieve the monotony. After all, an engineering student is quite accustomed to carrying out several assignments simultaneously.

A variation which gives the student a chance to break the boredom of an office job is going to a work site itself to gather data. In industries with several students on a summer work program, meetings are usually held to evaluate the company’s program. For optimum benefits these meetings should be of three types. Group meetings of company representatives and all the summer students should be held perhaps twice during the summer in order to discuss general problems of the summer programs, to see the similarities of one’s own departmental problems to other department's problems, and to offer suggestions for improving the overall program. Local meetings of students and company personnel held perhaps once a month could be used for discussion of specific problem concerning the student’s satisfaction with the work assigned to him, the student’s feelings about his supervisor, or registration of any complaints he may have at the time. An important topic not to be overlooked at this meeting is union policy. Unions forbid certain jobs by part-time employees. This information should be made available to the student so he will know what is not expected of him. Lastly, the student engineer’s part in departmental meetings can be very valuable. The student is probably capable of delivering a small talk on a topic related to his department. His education allows him to present topics that industrial workers (particularly “blue collar”) may have never heard. A striking example would be explaining how to use Laplace transforms to solve network problems to a group of radio technicians. These meetings provide an ideal time for the student to report on his summer project also.

One fact must be faced. The company is trying its best to attract these summer workers to permanent employment after graduation. It can describe the company’s predicted future at group meetings and show the student where he would stand in this development. The company should let the student learn all he can about the major departments in the industry. In particular he should be given a chance to work with both “white collar” and “blue collar” workers. This allows him to hear and to understand problems of management and human relations from both groups of personnel. The student will probably find that the company will be quite liberal with

(continued on page 29)
Young engineers find challenging opportunities at Allison where “Energy Conversion Is Our Business.”

For instance, here’s Warren Neil Holcomb who came to Allison following his graduation from Purdue University last year with a BS Degree in Mechanical Engineering.

He first entered Allison’s Accelerated Experience Program . . . a program designed to help the young engineer gain on-the-job experience in the shortest possible time. Holcomb’s eight-month work tour included assignments in: Stress Analysis, Experimental Test Operations, Production Engineering, Aerothermo Design, Product Design, Field Service, Product Reliability and Materials Laboratories.

Upon completion of the program, Holcomb started with the new T78 Regenerative Turboprop Engine Mechanical Design Group. He is currently assisting in design and development of the gear section.

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THE ENERGY CONVERSION DIVISION OF GENERAL MOTORS. INDIANAPOLIS, INDIANA
WASTE UTILIZATION
In A Closed Ecological System

by JIM PHELPS

The launching of the first earth satellites and the rapid development of space technology emphasize the need to prepare for the day when man embarks on extended voyages into space. The design and engineering of the manned spacecraft, space platform, moon shelter, and moon base must provide a comfortable environment suitable for the function and existence of space crews. It is obvious that one of the essential conditions for survival in space ships or stations is the rigid control and constant renewal of the environment within the ship. On extended trips this control and renewal will involve not only the disposal of the crew's solid, liquid, and gaseous wastes, but also the reconversion of these wastes into usable products. Such reconversion is necessary to minimize the load which must be launched from earth.

This article summarizes the research work done in liquid and solid waste management and reconversion of these to water. These wastes that result from closed space occupancy may be classified to include feces, urine, perspiration, and washings. All human wastes contain an appreciable amount of water. Urine contains approximately 90 to 95%, feces 75%, expired air and flatus 4%, and perspiration, saliva, nasal discharge, and phlegm are approximately 99% water.

Feces is mentioned as a source only because it is one of the water-containing wastes. The extremely minor quantity of water that is actually available does not justify the equipment that would be required for extraction. Until there is some demonstrated value attached to utilization of feces solids, it is suggested that feces be removed from all waste treatment processes, handled separately by the simplest possible methods.

Freezing will suffice to inactivate the material and permit its storage at -20°C. The amount of cubage that might be required for equipment to inactivate and freeze the material is still a matter of conjecture.

Water that will be recovered as a condensate from the air conditioning system in space cabins will be pure but may have a slight odor. It can be used for washing and even drinking. In the latter case it would have to be percolated through activated carbon.

The amount of wastewater resulting from the handling and preparation of food will not be great. One-half liter per day per man has been estimated as a minimum if the principle of tube feeding is used. Water for preparation will be nil and the amount used for cleansing will be minimal. The wastes in whatever quantity, will contain small amounts of organics.

Personal hygiene wastes will include hand washings, face washings, bath waters, and oral washings. Skin excretions, clothing lint, and bacteria will be the main pollutants of the bath, face, and hand washings. Oral washings will contain additional substances such as dentifrice, food particles only partially broken down, bacteria, and saliva.

Clothes washing wastes will consist predominantly of the skin excretions from the sweat and seba-
aceous glands. Also present will be lint, hair, dust, and bacteria. The use of detergents in closed space operations should be minimal yet effective in emulsifying the soil contained on the person and his clothes.

Many of the water recovery systems that could be used for space flight are listed in table 1. The simplest form of water recovery is atmospheric distillation. This produces an ammonia odor and a high pH but no coliform bacteria in the reconversion of urine. Ammonia can be removed from the distillate by a cation exchange resin. Although the equipment for atmospheric distillation weighs little, it has a high power requirement of 40 watts daily for recovery of water from three men. For zero gravity conditions the still and condenser must revolve in order to provide a centrifugal force for separating liquid from vapor and gasses. Before distillation urine can be treated with: 1) sulfuric acid, 2) sulfuric acid.

### Table 1. Water Recovery Process

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Atmospheric distillation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal distillation</td>
<td>85 212</td>
<td>H SO with</td>
<td>act C</td>
<td>H</td>
<td>H O not potable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or without</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>K Cr O or</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>K SO</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vacuum distillation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sponge system</td>
<td>90 80</td>
<td>none</td>
<td>act C</td>
<td>L</td>
<td>Sponges with slush residue have to be stored.</td>
</tr>
<tr>
<td>Simple distillation</td>
<td>68 100</td>
<td>H SO</td>
<td>act C</td>
<td>H</td>
<td>Poor recovery. Much residue left.</td>
</tr>
<tr>
<td>Catalysis of vapors</td>
<td>87 100</td>
<td>none</td>
<td>act C</td>
<td>H</td>
<td>Slushy residue.</td>
</tr>
<tr>
<td>Vapor compression</td>
<td>85 90</td>
<td>Hyamine 1622</td>
<td>filtered by ion exchange resin, act C</td>
<td>H</td>
<td>Rc. for flights 14 days, and 3 men. Leaves much slush to be cleaned.</td>
</tr>
<tr>
<td>Recovery of insensible water</td>
<td>100 80</td>
<td>none</td>
<td>none</td>
<td>L</td>
<td>Can be used for cooling of air by evaporation to space.</td>
</tr>
<tr>
<td>Membrane permeation*</td>
<td>95 212</td>
<td>none</td>
<td>none</td>
<td>H</td>
<td>Leaves slushy residue. Recovered water may not be sterile.</td>
</tr>
<tr>
<td>Electrodialysis*</td>
<td>60 room temp.</td>
<td>urease</td>
<td>bacterial filter, act C</td>
<td>H</td>
<td>Potability after long period of use not proved.</td>
</tr>
<tr>
<td>Electolytic systems</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Two-bed deionization*</td>
<td>80 80</td>
<td>none</td>
<td>none</td>
<td>H</td>
<td>Requires grt. amt. of ion-exchange resin. Much residue is rejected.</td>
</tr>
<tr>
<td>Single-bed deionization</td>
<td>80 80</td>
<td>none</td>
<td>none</td>
<td>H</td>
<td>As above.</td>
</tr>
<tr>
<td>Electrolysis*</td>
<td>90 80</td>
<td>none</td>
<td>none</td>
<td>H</td>
<td>Produces large quantities of concentrated wastes.</td>
</tr>
<tr>
<td>Closed ecological systems*</td>
<td>100 100</td>
<td>not deter.</td>
<td>not deter.</td>
<td>not deter.</td>
<td>Preliminary investigation shows algae can’t use urine as nutrient. Development to be expected in future.</td>
</tr>
</tbody>
</table>

*Hasn’t been developed yet
acid and potassium dichromate, or 3) potassium persulfate. Any of these three processes plus preliminary treatment with carbon yield 85% of the original water content and eliminate the odor and color and reduce the amount of impurities in the distillate to a safe drinking form. Because of the requirements for so many elements, the still is far from being practical.

It has been established that vacuum distillation offers a good potential in water recovery. Vacuum distillation lowers the distillation temperature, reducing the amount of urea decomposition. Distillation below 98°F does not decompose urea, and hence the distillate does not contain ammonia. However, the presence of coliform bacteria increases as the distillation temperature is lowered. An additional sterilization process is required to kill the bacteria. This can be accomplished by filtration of the distillate through a bacteriological filter.

The present work in vacuum distillation is directed toward finding conditions for optimum efficiency of water production and acceptable water quality.

Figures 1 and 2 demonstrate the cumulative yield at 20 mm of Hg for urine, wash water, urine, and wash water using the vacuum still.

Ammonia could cause problems in this vacuum distillation. At the end of distillation when the residue of materials dissolved in the ammonia becomes concentrated, ammonia concentration increases. A point is reached where ammonia distilling from the residue as ammonia gas is carried to the condenser and re-dissolved in the recovered product. At this point water is considered to be non-potable for drinking purposes, but satisfactory for other uses.

It has been indicated that a still having a maximum capacity of 2 liters of substrate could convert a one-man day supply of drinking water from urine in 3.2 hours, or provide water needed for drinking,

(Continued on page 20)
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A method devised by Bambeneck and Zeff for vacuum distillation is described below. The general principle of this method is illustrated in figure 3.

The evaporator is maintained at cabin temperature and the condenser at a lower temperature by radiating the heat into space. Waste water is held in a manifold in the door, and water is evaporated at reduce pressure at 80°F. Vapor passes from the manifold through a sponge entrain separator to the condenser section, where it is directed into bellows-shaped drinking receptacles and condensed. The heat of condensation is conducted to the radiation panel by the metal bottom of the receptacles, and the condensed water at 60° to 70°F is removed from the condensing surface by the capillary action of a doughnut-shaped sponge within the receptacle. After the cycle is completed, the drinking receptacles are removed, and covers with purification cartridges are attached. The receptacle is squeezed to displace positively the water for drinking and food preparation.

There has been proposed a membrane permeation technique to reclaim water. Membranes that permit water but not urea to pass are available. Specially treated forms of cellophane, acrylic sheets, or copolymers of polyvinyl alcohol have been used for similar distillations. The proposed plan by Ionics Inc. is shown in figure 4.

Urine is forced under slight pressure into a “boiler” where the urine is heated to a suitable temperature. At this temperature water permeates the membrane, whereas urea and other solutions do not. On the other side of the membrane is a condenser compartment filled with sponges and kept under a vacuum. Hot water evaporates from the membrane into this compartment and condenses on the cooling surfaces.

Although this has not been developed yet, it is hoped that it will require a small volume and little weight. It will, however, require a lot of power.

A membrane electrodialysis process as shown in figure 5 uses synthetic ion-exchange membranes. These membranes are thin sheets of cation- or anion-exchange resins and are therefore selective as to the migration of cations or anions, respectively. They exhibit high electrical conductivity and low permeability to the passage of water. Upon the application of an electromotive force, the positive ions (such as Na+) pass through the cation-permeable membrane, whereas the negative ions (such as Cl−) move in the opposite direction and pass the anion membrane. Thus, the water passing between alternate membrane pairs is depleted of salt, whereas that passing through the intervening pairs is enriched.

Electrodialysis will remove only ions and not urea. For this reason, urine has to be treated first with the enzyme urease which converts all of the urea into ionic ammonium carbonate, which then can be removed by the electrodialysis. A supply of 300 grams of urease will be sufficient for six astronauts for six weeks. The power requirement is only a few watts per man.

Electrodialysis adapts itself very well to weightless conditions. If the amount of residual effluent can be made small and the desalted water can be made potable over a long period, then this method would have considerable merit.

A method not yet discussed is the biological system of environmental control. This system serves as a complete control of environment. It would accomplish the necessary gas exchange of oxygen for carbon dioxide and reclaim water from human wastes.

This system would be similar to the earth’s biological system. It involves the use of single cell green algae to carry out the reactions of the green plants in the plant kingdom. A schematic diagram of this plan is shown in figure 5.

There are many problems to be overcome before a biological system

---

Fig. 4. Membrane permeation technique of reclaiming water proposed by Ionics, Inc.
can be put into operation. The light requirement and the weight of the system are its biggest drawbacks now. Electrical light is not efficient enough to make the algae culture system worthwhile. The system at its present efficiency would require about 6.8 gallons of algae, and an equivalent volume of activated sludge, or a total weight of 114 pounds to handle the fecal wastes of one man.

It is obvious that this system would not be worthwhile in a 60-day, two-man trip, but for a spaceship on a three year trip to Mars carrying three men a biological system would be an important factor.

This system also has great potential terrestrially. If palatable dishes can be prepared from algae for spacemen, there is no reason why the process could not also be used to reduce the world's food shortage.

---

Fig. 5
Environmental control by the use of single cell green algae.

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*Asphalt surface on Asphalt base
The earth was wrongly named. It should have been called Oceanus. Seventy per cent of the surface area of the earth is covered with water; most of it is saline in nature. The ocean and its inhabitants combined are man's nearest frontier.

The population of the earth in the last 200 years has grown tremendously and even though technology and science have lifted agriculture to a much higher plateau, more people are starving throughout the world each year. Science must look for an answer to this problem, and one natural course science takes is toward the sea.

Plants, in general, are divided into two categories. One division is that of the thallophytes or plants which are dependent on water for reproduction. The other section is the embryophytes-plants which have become attached to the land, and usually posses roots or tendrils. Two subdivisions of the thallophytes which have been given much recent consideration as food sources are: 1) rhodophyta, consisting of marine algae and closely related to 2) chlorophyta, which are the fresh water algae most abundant in the form of plankton. Plankton is a collective term used for floating flora and fauna on a body of water, and it consists mainly of microscopic organisms.

It has been estimated that 500 billion tons of solid plant matter are made each year by green plants through photosynthesis. Man has, up to now, used only a very small fraction of this amount. Land plants produce only one-tenth of this photosynthized food, while ninety per cent is produced by fresh-water and marine algae.

A new concept has appeared within the last ten years called "mariculture". This is defined as the utilization of the food resources of the sea by using the techniques worked out in modern scientific agriculture.

Scientists picture oceans in the future to be a vast hydroponic farm. Gilbert B. Levin, of Resources Research Inc., at the International Symposium on Saline Water (1958) aired the theory that both food and water for future generations can come from marine algae. This is what he suggested: Certain algae take up large quantities of salt when sun shines on them. When sunlight is stopped, the algae lose salt. Mr. Levin envision sea-water being made drinkable by the above desalting process. Later the algae provides food if it is again desalted. This, however, is only theory at present.

The yield of food from fresh water algae has been found to be fantastic, and there's no reason to consider marine algae to be any less valuable. Chlorella, a one-celled plant (which incidentally is a fresh water plant) can, depending on the sunlight, produce 15 times more food per acre than soy beans! A large part of this food is protein, about 15 tons per acre, and about 2 tons of fat is produced per acre. Algae increases protein content by 20 per cent and fat content by 75 per cent. (Diet watchers might want to avoid algae.) One tablespoon of algae equals the nutritional value of one ounce of steak.

Edith K. Schuelle, a 15-year-old high school girl, made cookies, French bread and cheese swirls from algae. She said that fresh, powdered algae tasted like broccoli. Other scientists say that if you age algae for a while it will taste like prunes.

Algae is not only a probable source of food for alleviation of world-wide starvation, but researchers are looking at it in a different aspect. One-celled algae is scheduled for use in space, not only as a source of food, but also as an oxygen restorer. The tiny plant converts carbon dioxide to oxygen and converts light energy into protein. An

(Continued on page 31)
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In this hypothetical geographical area, communications could be supplied with one large telephone switching office and a network of cables (left), or with three smaller offices and a different network (right). Many other combinations of offices and cable networks might be possible. This situation, although hypothetical, is typical of the complex telephone engineering problems that are being solved with the aid of computer programs designed at Bell Laboratories.
Habla Espanol? No, our Miss Technic for this month isn’t a Spanish major. She is a full-blooded, Spanish-speaking Nicaraguan, Miss Aida Marah Ley.

Miss Ley comes from the capital of Nicaragua, Managua. She has attended American schools for the past four years. This year she is a freshman at Saint Mary-of-the-Woods College, where she is majoring in foods and nutrition. After graduation, Miss Ley hopes to return to Nicaragua to work as a dietitian.

This pretty Latin is 5’ 4” tall and weighs 115 lb. She has very lovely brown eyes and black hair. Sorry fellows, that’s all the information available at this time. But, as you can see from the pictures, everything is fine.
Alpha Rhythms are recorded. Each curve except the bottom one represents the fluctuations of current from electrodes attached to the head as indicated by the drawing at the left. The bottom curve is drawn by a wave analyzer which periodically dissects the frequencies of which the fifth curve from the top is composed. The tallest spike on this page, for example, records the average amplitude of a frequency of 10 cycles per second; the spikes to the left of it represent the amplitude of nine cycles, eight cycles, seven cycles and so on. To the left of the left vertical line the subject's eyes were open and the alpha waves are small; to the right, his eyes were closed and the waves are larger. When he was given a problem in arithmetic, waves were damped until he gave the answer.

BRAIN POWER

(Continued from page 13)

During the first few years of life the slow rhythms get steadily smaller as the nerve fibers in the brain complete their growth. At about the end of the first year another sort of rhythm appears. It has a frequency of five or six per second and is largest at the sides of the head. It seems to be connected in some way with what we call emotion, particularly with feelings of annoyance and frustration. In children of about three years old it can be evoked very easily by teasing — by offering a piece of candy and then snatching it away. Another similar rhythm can easily be evoked by simple physical pleasure. These rhythms have been called theta rhythms, because they seem to be connected in some way with the functioning of the thalamus, the midbrain where signals from the body are relayed to the brain roof. The theta rhythms usually appear at that phase of development when children start to acquire self-control. The age at which this happens varies, and so do the size and character of the theta rhythms.

An adult whose brain becomes diseased or injured, or who has a childish personality, may revert to the slow delta and theta rhythms of infancy and childhood. In certain conditions of strain unusually fast rhythms appear. In certain types of epilepsy there is a characteristic combination of enormous slow waves and fast spikes. Naturally the exact location of these abnormal features is a very important part of electroencephalography, for it can pinpoint a disturbance for an operation by a brain surgeon.

This catalogue of the signals received from the living brain may give a misleading impression of simplicity. Only in very severe or advanced stages of a brain disease are the brainprints so clear that their features can be designated with complete confidence. Far more often all these slow and fast components appear together intermittently or continuously in various parts of the brain, all of them varying with the state of the person being studied. The record is usually more like the score of a symphony or the transcript of conversations at a cocktail party than a simple code message. When ever it takes on the character of a solo or a monologue, one knows that something has gone seriously wrong, either with the brain or with the recording machine.

Using the analogy of cipher breaking, the difficulty with electroencephalography is not to pick up a message but that inevitably a great
many different messages are received at the same time. This situation has demanded several refinements of technique. The human eye is ill-adapted to sorting out the components of a complex curve. Sometimes different rhythms combine in such a way as to give a completely false impression. For example, during an examination in which a person becomes annoyed by something, the curve may change in a way which seems to indicate that the frequency of his alpha rhythm has dropped by one or two cycles per second. Actually the true change may be the breaking out of an entirely separate theta rhythm which is imposed on the alpha.

To unravel the situation many laboratories now employ special wave analyzers. These instruments deal with the complex electrical oscillations from the brain in rather the same way as a prism separates the colors in a beam of light. The components of the complex wave are isolated by electronic circuits tuned to the several frequencies. A moving pen automatically records the amount of activity at each frequency during a fixed interval, usually 10 seconds. The result is a set of curves giving the frequency spectrum of the brainprint. This process is repeated over and over, and other electronic circuits write out the statistical average of the spectrum readings every minute or so, so that the experimenter can measure not only the composition of the brain signals from time to time but also their variability over a longer period. From this can be assessed the versatility of the brain under investigation—an important measure of its repertoire of adaptive stratagems.

Frequency analysis by this means has proved a valuable tool, but like all tools it has its limitations. It cannot easily be applied to more than one part of the brain at once. Few laboratories can afford more than two analyzers, for they cost upward of $5,000 apiece. Furthermore, frequency analysis can be quite misleading unless it is used imaginatively; it can only suggest possible solution to a problem, and the experimenter must then make further studies to decide which of the possible solutions is correct. Since the state of the brain is always changing, the fresh tactics suggested by frequency analysis may come too late to be of immediate value. Again, using the cipher comparison, frequency analysis will not give information about how the rapidly changing signals from different parts of the brain are related to one another, or which of the suggested meanings is the most likely one.

Yet the sort of insight that frequency analysis is capable of providing is vividly illustrated by a recent laboratory experience. The investigator had just taken delivery of a new analyzer and had spent a Saturday morning tuning and calibrating his new treasure. By afternoon he was ready to try it, but the only test subject left in the laboratory was a technical assistant who had, by ordinary standards, rather a dull record. (Electroencephalographers mean no (Continued on page 30)
There is nothing better fitted to delight the reader than change of circumstances and varieties of fortune.

Cicero, Epistolae ad Atticum. Bk. v, epis. 12.

The lead quotation might very well be advocating that readers have a 'change of pace' occasionally in the form of fiction books. Recent articles in this space have been slanted in the direction of the 'better' reading such as biography, history, literature, etc., and it just might be that now is the time to give equal time to reading for pleasure and nothing more.


The darkness of wonder and terror, of forgotten things, impossible things that have no names and faces, gray and formless in the darkness of your mind — that is the sort of imaginative fiction you will find in these tales. It is the realm of fantasy. Not the fantasy of Peter Rabbit but the fantasy which follows the rule that the author is allowed only fantastic assumption; thereafter his story must be developed logically, consistently, and without violating known facts. Except for their themes, the stories in this book are more like science fiction than like fantasy. In fact, some of science fiction's greatest authors provide many of the most unusual situations ever conceived these strikingly different incident.


This is the story of a policewoman, Susan Carstairs, of the Los Angeles Police Department. She is assigned to help in the investigation of the disappearance of a teen-age girl. Then came other cases: an elderly woman disappeared, a youngish man was found dead in his parked car, and then there was a series of killings — in a candy store, a gas station—holdups, with unresisting victims killed senselessly. Were these pleasure killings? Policewomen Carstairs, Sergeant Maddox and Detective D'Archer had almost more than they could handle. This report of their activities will delight its readers.


In this new and moving novel, Lew Archer, the author's celebrated California investigator is hired by the principal of a private reform school, to trace a missing boy. What appears to be an ordinary matter of juvenile delinquency is suddenly magnified, as Archer plunges into a web of murder and extortion. He ranges all over the Far West, tracking down men and women who are pursuing the fast buck, and hating to be reminded of what is waiting on the far side of the last dollar. This is the story. Kidnappers ask twenty-five thousand dollars for a man's son. Lew Archer, the private investigator, suspects the victim of being a willing partner in the extortion attempt against his parents. Archer follows his hint and becomes personally involved in the case when a woman he once considered marrying is implicated. In solving the mystery Archer finds it necessary to dig into his past and open old wounds. If you like a hard-boiled story of violence and death you will want to read this one.


"You killed my brother", the voice on the line said, "and since the law won't punish you I will." When he accidentally ran down and killed a pedestrian, Barry Sanford was found innocent by the law. But the dead man's brother did not. At first Sanford shrugged off the threats. But couldn't shrug off being pushed from a subway platform in front of an oncoming train. Consumed with fear he ran from New York and from his job. From New York he traveled south to Florida, and then to Belize on the coast of British Honduras. His new business was beginning to prosper. He was invited to discuss land values with a new resident who lived on a houseboat in the harbor. He had one foot in the doorway before he came to a sudden and involuntary stop. The man sitting in the room was the brother of the man he had killed. In this exotic mystery money, a tropical sun, expensive yacht, and a beautiful woman, lead not to escape but to entrapment and capital crime.


A good man not only cuckold but defrauded of his future, a foster betrayed, a samaritan dubiously rewarded for his instinctive kindness
— all these are met in Aristide Michal, the hawk-nosed Greek restauranteur who had found his way to a French mountain village. The agony of Aristide Michal is great, but his soul is greater. As he flounders in a sea of troubles the reader will pity him because he never for a moment pities himself.

Aristide operates a restaurant-hotel in the village. A robust ironic man from the Eastern Mediterranean, he is an artist in the kitchen, and something of a poet as well. He glows with love for the "wife" whom he rescued thirty years before from poverty and worse on the streets of Marseilles. He is devoted to their adopted "son" a wartime waif now grown into a young man of classical beauty irresistible to women young and not so young.

Everything that he finds good seemingly awaits Aristide — the restaurant-hotel he is at last in a position to buy, the years ahead with his wife and son. Utopia is just around the corner, but that is where it stays, which is the way of this imperfect world. Just how Aristide's little world cave in upon him, and what he does when he must look disaster in the fact is a story you will enjoy.


SUMMER WORK
(Continued from page 14)

him, allowing him freedom of movement, perhaps an expense account, and other benefits. The young engineer should not take advantage of the company by using these benefits indiscriminately. The company is treating the man the best it can, and the student should appreciate and respect these privileges.

If a summer engineering work program is incorporated successfully in an industry, both the company and the young engineer can derive considerable benefit. The company employs the student as a recruiting aid and advertising media and material for the future. The student employs the company's program as an outlet for his technical and creative ability. And during the process he learns and applies decision-making policy. A well designed summer program is a goal in which each able company should strive to incorporate and a goal in which each engineering student should strive to become involved.

DODGE DRUGS

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H. H. OLDHAM, Mgr.
offense when they call a record 'dull'—in fact, the best companions often give the dullest records. The reference is only to the lack of larger regular oscillations.) On this Saturday afternoon an international football game happened to be going on, and the subjects listened to the radio while the test proceeded. After a few minutes the experimenter, who was not listening to the radio but was busily adjusting the settings of his new instrument and checking the consistency of its analysis, began to realize that he was unconsciously game as it affected his subject. At first, when the home team was in the lead and the play was relatively uninteresting, the subject's alpha rhythm droned on at nine cycles per second, and there was only a trace of theta activity. Then the game livened up; the analyzer promptly showed an alpha rise to 10 cycles per second. When the visiting team scored a goal, the theta rhythms suddenly increased to the size of the alpha rhythms. This complex spectrum of theta and rapid alpha activity persisted with only minor fluctuations until the game ended with the defeat of the home team. One may say that, knowing the score, one could tell the nationality of the subject from his brainprint, of knowing the subject, one could infer the state of the game. Testing a roomful of people, the instrument could show which of them were interested in football and whether an individual's interest was mainly in the niceties of play or in which side won.

In the future there are sure to be many new discoveries of the human brain. I believe the electroencephalograph is sure to hasten these discoveries. In the twenty-five or so years it has been around we have learned at least how to recognize a few of the brain diseases. Also in this past quarter of a century this machine has helped to show us that the engineer, scientist, and doctor can help each other.
attempt to speed up the life cycle is in the research stage now directed by Professor William E. Fontaine, at Purdue University. The optimum day and night sequence for algae for algae — plankton. Principle among these organisms are the single-celled diatoms, housed in "snowflakes" of silica, and whirling dinoflagellates, whose perpetual motion keeps them from sinking out of reach of sunlight. These simple algae conduct a major portion of photosynthesis in the ocean and are called "grasses" of the sea. From sea water, carbon dioxide, and certain other nutrients, the algae synthesize carbohydrates, fats, and proteins. Optimally, they may multiply to hundreds of thousands of cells per liter of water, clouding the water with a red, brown, green, or yellow color depending on which species is dominant.

The smallest of the animals which consumes plant plankton is the single-celled protozoa. The largest are wriggling crustaceans, resembling small shrimp. The largest of the plankton animals are devoured by birds, seals, fish, and some whales.

Man can use this plant plankton in the next step of the food chain by eating these birds, seals, fish, and whales; but one is not surprised to learn that a large part of the organic matter is lost in each link of the chain. In general, about 80 to 90 percent of organic matter is lost in each step. Starting with 1/2 ton of plant plankton, man might only get one pound of organic matter in the final step.

It is logical to conclude that one can get a much higher degree of efficiency if he harvests the plant; however, except for a few regions, the plant plankton is much too dispersed in the water. What man needs, therefore, is a means of concentrating this substance. The answer may be a plankton animal named Euphausia Superba and known to whales as whale food or krill. It is a bright red, shrimplike crustacean; and it is herbivorous, bringing the whale, and possibly man, to within one step.

It is interesting to note that the annual production of krill must be at least 1,350 million tons which has been calculated to average 1,000 per acre.

Another point is the edibility of krill. Mistaking them for lobsters, some employees took some krills from a deep freeze and prepared them. After eating them, there seemed to be no ill effects, at least not caused by the krills.

It is evident from the preceding paragraphs that fauna of the ocean are also a probable source of food. Fish, of course, always come to mind when seafood is mentioned. Fisheries are the commercial means for fish supply. However, fisheries are at present only a means of harvesting. Fishermen harvest a random crop, which is limited by the natural characteristics of the sea. Fisheries depend on the return of nutrient chemicals to the near-surface, well illuminated layer where plants synthesize organic matter and deplete the water of essential elements. In order to get a return of nutrient chemicals to the surface, a stirring effect is necessary. In shallow water, tidal stirring, aided by winds is usually sufficient. Winter is the best season for stirring because of winter storm. In latitudes near the equator, winter stirring extends 200-300 meters deep. In the tropics offshore winds cause stirring. The waters surrounding Antarctica are stirred very well by deep winter convections and strong westerly winds. The deeper and better a portion of the ocean is stirred, the more biologically productive it is. A great percentage of the ocean is unfortunately a biological desert.

To develop "mariculture" into something as scientific as agriculture has become, fisheries must find a way to stir the water in places where the wind, tide, and convections are not adequate. The power needed to overturn water is very small compared to that needed to overturn soil. A quarter horsepower motor could keep even the largest salt water pond from coming to a state of equilibrium. Pumping systems might be used along the shore, pumping air through the water causing agitation. In the open ocean, radioactive heat sources may possibly cause convection currents. The future holds much promise.

There is an increasing amount of stress being placed on marine biology, not only for the sake of knowledge, but for the good of humanity. The governments of the world are beginning to realize the increasing urgency of farming the seas.
Hairpins, nails, tacks, safety pins (open and closed), keys, and other iron objects swallowed accidentally by children and adults can now be retrieved without surgery by two new medical instruments developed recently at the General Electric Research Laboratory.

The new medical "tools," designed around powerful Alnico magnets, may facilitate the recovery of iron objects from the food tracts of the human body. The devices are being tested by Dr. Arthur Q. Penta, director of the department of Bronchoesophagology at St. Clare's and Ellis hospitals in Schenectady, New York.

Most of the foreign bodies that become lodged in the upper intestinal tract normally make an uneventful exist from the body. But when the foreign body is long, sharp, or jagged, its passage may perforate the stomach and intestine. In such cases, it is desirable to remove the swallowed objects as quickly as possible.

For a number of year, physicians have used simple permanent magnets to retrieve swallowed iron objects. In a typical case, a flexible cable — with a magnet at its tip — is inserted down the patient's throat until the magnet comes in contact with the swallowed object. Magnet and object then are withdrawn. The entire procedure is followed on a fluoroscope, and can be carried out quickly.

Switchable medical magnet can be turned "on" or "off" at will, and can retrieve swallowed sharp objects at greatly reduced hazard to the patient. Inserted gently down patient's throat (left), device is steered under fluoroscopic guidance to the spring of open safety pin, and switched "on." Safety pin is then turned around and removed blunt end first (right). If the safety pin had been grasped with the sharp point projecting up, as a simple permanent magnet would have done, delicate tissues might have been scratched or punctured during withdrawal. The new medical "tool" was developed at the General Electric Research Laboratory in Schenectady, N.Y. These X-ray photographs were taken by Dr. Arthur Q. Penta, a local specialist who is testing the new device.
The new magnetic medical “tools” grew out of a visit to the Research Laboratory by Dr. Penta, one of the pioneers in this field. Using Alnico magnets, he has designed and used a number of devices for retrieving foreign objects from the esophagus, stomach, and duodenal regions. Among the objects removed have been a padlock, a coffee can key, foreign coins, pins, dental burrs, hypodermic needles, and metal toys.

During his visit, Dr. Penta pointed out that simple permanent magnets could not be used in certain cases, such as the removal of an open safety pin from a patient’s stomach. The magnet might grasp the open safety pin with the sharp point projecting up, making it impossible to withdraw the safety pin without some danger of puncturing the delicate tissues of the stomach and esophagus. Dr. Penta’s challenge: Could a magnet which could more easily be controlled be developed?

Indeed, they could. Within a few months, a “switchable” permanent magnet device, that could be turned “off” or “on” at will, was developed.

Before this device is switched on, contact can be made on the spring of an open safety pin. The safety pin can then be turned around and removed blunt end first.

The new medical “tool” is about 30 inches long by one-quarter inch in diameter. It consists basically of a stainless steel cable enclosed in a plastic tube, which end in an iron tip. When the permanent magnet at the end of the control cable is slid forward until it touches the iron tip, the tip becomes magnetized. When the permanent magnet is retracted into a magnetic shield, the tip loses its magnetism.

At the time of his visit to the Research Laboratory, Dr. Penta also had pointed out that certain regions of the stomach are inaccessible to a magnet on the end of a flexible cable — because of the angular shape of the esophagus as it enters the stomach. This led to the development of a second device — a “steerable” magnet.

The “steerable” magnet also consists basically of a stainless steel control cable enclosed in a plastic tube. However, a spring hinge is located near a permanent magnet at the tip of the device. After the device has been placed in a patient’s stomach, a physician can maneuver the magnet upward simply by pushing down on the control cable. The magnet can then be rotated to any desired position, reaching previously inaccessible regions of the stomach.

“These new medical instruments are an important breakthrough in this field,” Dr. Penta commented today. “For example, the complete procedure — from insertion of one of these devices to its removal — takes only two or three minutes. No anesthesia or hospitalization is required, and the patient may be discharged immediately.” Another advantage is that no special training is required in the use of these new devices. Thus, in smaller communities that do not have a specialist available, the general practitioner — under fluoroscopic guidance — should be able to use these instruments successfully.”
KIDNEY
(Continued from page 10)
by the revolving of the drum, 25 revolutions per minute, which rolls the blood through the dialyzing cellophane submerged in the rinsing solution. After being cleaned the blood is pumped through plastic valves, which minimize the injury to the blood cells. This pumping raises the blood several feet above the bed of the patient. It is led into a beret which drains it through a clot catching funnel containing glass beads. Air bubbles are also removed here. The blood is then returned to the patient. The disadvantages of the horizontal kidney machine are that it is larger, more bulky, thus harder to sterilize, and takes more initial blood. It is probably the most popular because it was the first type and is also very reliable.

The vertical kidney machine is of two types. In the first type the blood is "sprayed" over coils of tubing containing the dialyzing fluids (fig. 4) and the second type has coils of tubing carrying the blood wound around something stationary in the center of the dialyzing fluid bath (fig. 6). The vertical machine differs in design but it employs essentially the function and processes as does the other kidney machine. This is the use of a semipermeable membrane and a rinsing fluid.

The first type of the vertical kidney machine consists of a silicone-coated glass chamber detachable upper portion, twenty-three feet of three-quarters inch cellophane tubing in the chamber in concentrated layers and all other miscellaneous equipment as needed such as a pump, blood clot and air bubble trap, temperature regulator, conduits, etc. The tubes in the chamber require no supports and are placed in the chamber with the free ends connected to the reservoir containing the rinsing solution. Circulation of the rinsing solution can be accomplished by gravity but a pump is usually used to get the sufficient pressure and also the pump is able to move the solution through the coils faster, 300 ml. per minute. Oxygen and carbon dioxide are entered into the reservoir as it was in the horizontal machine to control the pH of the fluid. Hydrostatic pressure of the perfusion or rinsing fluid is maintained; throughout the use of the machine, equal to or slightly above hydrostatic pressure of the blood. This machine is put into operation by first preparing the rinsing fluid, same make up as the horizontal machine but in different quantity of solution, and warming it to body temperature. A continuous circulation of the rinsing fluid is established and then, the patient is prepared for hook up to the machine. This hook up is usually the artery to artery hook up so as to prevent a arteriovenous shunt (fig. 5). The initial blood introduced into the machine is less than that of the horizontal machine. The blood flows from the patient into the top of the machine and rides down to the bottom of the chamber on a layer of air. By controlling the pressure, the volume of the chamber is controlled. Thus negligible loss of blood pressure is obtained.

The second type of the vertical kidney machine (fig. 6) consists of a stationary coil of cellophane tubing, approximately twenty yards long, separated by fiberglass screens put in an inner container. This whole apparatus sets in the middle of the dialyzing bath. The fluid for rinsing goes up through the middle of the inner container, up and around the coils of cellophane containing the blood, and flowing over the top of the inner container into the outer tank. This fluid is warmed to body temperature and is recirculated by a pump. Blood is pumped through the cellophane coils by pumps and is filtered to remove blood clots and air bubbles before returning to the patient. This particular kidney machine is considered to be a disposable kidney because the inner core comes premanufactured. This throw-away kidney consists of cellophane tubing, eleven yards long, sandwiched between two strips of fiberglass screen. This is put in a roll in a four inch diameter fruit can. This fruit can is then put into a larger can equipped with a garden hose connection for the rinsing fluid at the bottom. The larger can is then sterilized and sealed for shipping. It can be opened with an ordinary can opener. Pumps for the blood and the rinsing fluid and the tank are still needed. Cost of this core is approximately $800. Travenol Division of Baxter Lab makes a vertical kidney machine with a disposable core for $1,300, the pre-sterilized core costs $59. The operation of the second type of vertical kidney machine is much the same as the first type but it is initially primed with two pints of blood. This throw-away kidney eliminates time in re-cleaning up, sterilizing and setting

Fig. 5. Artery-to-artery hookup used to prevent arteriovenous shunt.
Fig. 6. Second type of vertical kidney machine.

up older and larger kidney machines. Another type of kidney "machine", which is in the experimental state but has been used successfully in Arbor, Michigan on four patients and in the Peter Bent Brigham Hospital, Boston on five other patients, consists of a plastic tube which works like a conduit. Through a surgical operation, a silicon rubber, or teflon plastic conduit is sewn into the patient's abdomen. Once a week a special fluid is poured through the tube into the abdomen surrounding the intestines. For twelve to seventy-two hours fluid is drained and poured through the plastic porthole. This process is called "peritoneal dialysis" and works by the process of osmosis. The kidney is separated from the abdominal cavity by the peritoneum membrane. The peritoneum lies in contact with the kidneys and thus by osmosis the wastes from the kidney are extracted to the fluid. Drs. Harold McDonald, John Weller and Robert Stevens are still experimenting with this plastic tube.

Plastic is starting to replace most parts in most kidney machines. This is because of the greater ease of sterilization of plastic and the lightness of it. A plastic kidney machine has been designed and developed by George Jernotted and Harry Baker of the Westinghouse Special Products Engineering Department, Pittsburgh.

The uses of the kidney machine all revolve around removal of wastes after kidney shut-down but they are also used when the kidney is functioning normally because they can remove some harmful substances faster than the natural kidney can. The kidney machine is used more often, though, when the natural kidney shuts down and is unable to excrete waste materials, uremia. The second important use would be for the removal of poisons and barbiturates from the blood stream. In one particular case it saved a 57 year old woman from permanent brain damage. She had been receiving potassium thiocyanate to reduce her high blood pressure. Somehow the drug accumulated in her blood stream and caused her to become mentally deranged and violent. For a week she was this way even after the stopping of the use of the drug. She was then treated for a six hour period with the kidney machine. Twenty-four hours later a distinct improvement was noticed and at the end of the month she was completely recovered. The kidney machine removed the thiocyanate from her body fast and in large amounts which her own kidney could not do. The kidney machine, in this case, proved to be 73.6% more efficient than the normal kidney. The kidney machine is also used in the removal of excess water in edematous. With the use of the kidney machine for a six hour period, one and one-half quarts of water were removed. Constant weighing of the patient showed loss of weight correlated with the weight of the water removed. Hydrostatic pressure of 200 to 300 mm of mercury is usually put on the dialyzing membrane when using the kidney machine to remove water because the pressure will enable the removal of more water per time, ten ounces per hour.

What are some of the problems in
the use of the kidney machine? Some of these are the problems of blood clotting, sterility, hemolysis, pyrogen reactions, blood flow, blood viscosity, hemorrhage in the tubes and requirements of large amounts of heparin, become major problems and increases the operational risks. Constant blood sampling and testing throughout the dialyzing period and use of chemicals to neutralize the heparin, after use, help to reduce the problems. Another big problem is the large size of the machine thus needs large quantities of initial blood. Some say this could be corrected if some special device was used to put pressure on the dialyzing tube to use the full value of their surface area. Another employs the use of a series of “kidney units”, each consisting of a single layer of cellophane between corrugated rubber pads. A problem which some believe exists is the limit of the use of the kidney machine but according to the father of the machine, “Patients age or severity of the illness will not limit the kidney machine.” It has been used on a two year old boy who had eaten aspirins. The vessels in his arms were too small to fit the cannules of the machine so the surgeon had to work them up through his thighs to the great veins entering the heart. The cannules were kept far enough apart that the same blood was not circulated.

The previous uses which were discussed were for the temporary use of the kidney machine but what about permanent damage to the natural kidneys? In Seattle they use the method of installing a plug-in permanently in the patients arm. Nine patients were on this program and kept alive, in 1962, but the use of the $3,000 machines is limited because of lack of skilled manpower. Due to this limiting factor some people needing the machines are turned down. A laymen group was set up to decide who is worth saving. These members were nominated by King County (Seattle) Medical Society. They are anonymous, and include: a bank president, a labor leader, a minister, two doctors (not involved in the kidney program), a housewife and a lawyer. The purpose, stated Dr. Scribner, “To represent the community and to assure that choices are made objective and without outside pressure.”

The requirements of a patient for this program are: under forty, self-supporting, resident of Washington since last August, 1962. The committee considers the social factors and not the medical factors. One such patient under this program is Ben A., twenty-four years old. Ben A. spends Wednesdays, all twenty-four hours, at University Hospital with a kidney machine, which without he would be dead in less than a month. Ben is probably the only man kept alive as such and is still to do a day’s work.

So it seems that a prediction of Dr. Kolff’s may yet come true. He stated he might see a patient, “who is doing his work in the daytime and who is dialyzing himself through his intestinal loop during the night and in whom both kidneys will have been removed as useless, superfluous and even dangerous organs.”

 Reserve these Dates

April 30 - May 1

PARENTS WEEKEND

1. Great Centennial Convocation featuring six nationally famous speakers

2. Rose Drama Club production “Inherit The Wind”

3. Military review

4. Rose home baseball game
The Rose basketball team should end the season with a fine 10-10 record, the best since 1958. Included among their victories is a 65-62 win over Wabash. This is the first time that any Rose athletic team has defeated Wabash since World War II. Prospects are good for next season with only one starter being lost through graduation. Coach Mutchner hopes to find a 6-5 center and a tall guard for next year's team. Something new, a road trip to the New York area, has been added to next year's schedule. The team will play Rensselaer Poly, Brooklyn Poly, and Merchant Marine Academy.

During the basketball season, Coach Mutchner has obtained fine halftime shows. They are: 1) Rose Rifles, 2) Indiana State Rockettes, 3) Indiana State gymnasts and 4) high school marching units.

The tennis team is looking toward a winning season this year. The team lost two men through graduation, but it is hoped that freshmen will take their places.

New uniforms, yankee pin stripes have been purchased for this year's baseball team. The 1965 football team will also have new uniforms.

Due to the coming of the spring term, the fieldhouse is being prepared for indoor track and baseball practice. The new floor will be taken up to make room for running. The long jump, high jump, and pole vault pits have been put inside the fieldhouse. Indoor track meets have been planned for this spring. Later on, the batting practice cage and machine will be set up. Also for use by the sport enthusiast is a practice cage for golfers and a dirt tennis floor.

The weight lifting area is in the process of being enlarged. Parallel bars are being installed.

Rose has a fine intramural program. Competition takes place in the major sports, touch football, basketball, and softball. There are also: 1) cross country meet, 2) volleyball team play, 3) badminton tournament, 4) tetherball, 5) ping pong, 6) billiards, 7) free throw tournament, 8) track meet, 9) tennis tournament and 10) golf tournament.

Rose also has an intramural bowling league. This year, members were chosen from the league to represent Rose in a tournament held at Indiana University. The team turned in a fine effort, finishing ahead of Purdue.
Originally, this earthmover wheel hub was not a forging. Now it is forged in steel. Here's why . . .

While reviewing costs of the original part, the earthmover manufacturer discovered that: (1) Cost of the hub was too high; (2) rejection rates during machining were high because of voids and inclusions; and (3) hidden flaws required costly salvage operation.

By converting to forged steel hubs, the manufacturer has saved 16%, has completely eliminated rejects and repairs of parts in process, has achieved 100% reliability of the part.

Forgings have greater inherent reliability and strength because they:

1. Are solid, void-free metal
2. Have higher resistance to fatigue
3. Are strongest in withstanding impact and sudden load
4. Have high modulus of elasticity
5. Have low mechanical hysteresis
6. Have unique stress-oriented fiber structure

Memo to future engineers:

"Make it lighter and make it stronger" is the demand today. No other metalworking process meets these two requirements so well as the forging process. Be sure you know all about forgings, their design and production. Write for Case History No. 104, with engineering data on the earthmover hub forging shown above.
Dewey Nelson came to Delco Radio Division of General Motors in 1958 with a BSEE from Iowa State University. Today, as a project engineer at Delco, Dewey helps design the building blocks for digital control systems—such as the logic cards and modules pictured above. He also assists in designing complete digital systems using these parts.

Like other talented young engineers at Delco, Dewey can enjoy the prospects of a longtime, satisfying career with this stable electronics division of General Motors. He can look forward to a happy future for his family in the friendly, growing environment of Kokomo, Indiana where schooling is tops . . . desirable new homes and apartments plentiful . . . cultural and recreational attractions nearly endless. And both Purdue and Indiana Universities offer undergraduate and graduate work locally.

As a young graduate engineer you, too, might soon be on your way to a challenging and rewarding career with Delco Radio. You'll find abundant opportunities in such areas as silicon and germanium device development, ferrites, solid state diffusion, creative packaging of semiconductor products, development of laboratory equipment, reliability techniques, and applications and manufacturing engineering.

Our brochure detailing the opportunities to share in forging the future of electronics with this outstanding Delco-GM team is yours for the asking. Watch for Delco Radio interview dates on your campus, or write to Mr. C. D. Longshore, Dept. CR, Delco Radio Division, General Motors Corporation, Kokomo, Indiana.
What are chemists doing at NCR?

Plenty. Fundamental and Applied Research—Process and Product Development. All of which are of continuing importance to the growth of NCR. Our Research results have practical applications: the process of microencapsulation permits the "lock-up" of a substance in minute capsules for subsequent release; a "Photochromic Micro-Image" process permits a book to be recorded on a two inch square film; a solution-spraying technique for the deposition of inorganic thin films for solar cells and memory devices; self-erecting polyurethane foam structures for space programs. And in Development? Improvements in NCR paper products and other supplies; determination of new materials or processes for printed circuit boards; improvement of tapes and mylar cards used as magnetic recording media; new processes and applications for plastic materials used in business equipment; increased utilization of analytical tools for research and production.

These examples indicate that the talents of chemists at all levels in every major chemistry field—physical, organic, polymer, analytical, engineering, electrochemistry, and paper chemistry—are utilized in NCR's research and development programs. Many of these are related to business systems which are normally associated with NCR; there are also other programs that have considerably broader applications.

What would you do at NCR? Send us an outline of your interests and qualifications to determine if a career position currently exists. All correspondence will be given confidential consideration. T. F. Wade, Technical Placement, The National Cash Register Company, Dayton 9, Ohio. AN EQUAL OPPORTUNITY EMPLOYER
Should You Work for a Big Company?

An interview with General Electric’s S. W. Corbin, Vice President and General Manager, Industrial Sales Division.

S. W. CORBIN

Wells Corbin heads what is probably the world’s largest industrial sales organization, employing more than 8000 persons and selling hundreds of thousands of diverse products. He joined General Electric in 1930 as a student engineer after graduation from Union College with a BSEE. After moving through several assignments in industrial engineering and sales management, he assumed his present position in 1960. He was elected a General Electric vice president in 1963.

Q. Mr. Corbin, why should I work for a big company? Are there some special advantages?

A. Just for a minute, consider what the scope of product mix often found in a big company means to you. A broad range of products and services gives you a variety of starting places now. It widens tremendously your opportunity for growth. Engineers and scientists at General Electric research, design, manufacture and sell thousands of products from micro-miniature electronic components and computer-controlled steel-mill systems for industry; to the world’s largest turbine-generators for utilities; to radios, TV sets and appliances for consumers; to satellites and other complex systems for aerospace and defense.

Q. How about attaining positions of responsibility?

A. How much responsibility do you want? If you’d like to contribute to the design of tomorrow’s atomic reactors—or work on the installation of complex industrial systems—or take part in supervising the manufacture of exotic machine-tool controls—or design new hardware or software for G-E computers—or direct a million dollars in annual sales through distributors—you can do it, in a big company like General Electric, if you show you have the ability. There’s no limit to responsibility... except your own talent and desire.

Q. Can big companies offer advantages in training and career development programs?

A. Yes. We employ large numbers of people each year so we can often set up specialized training programs that are hard to duplicate elsewhere. Our Technical Marketing Program, for example, has specialized assignments both for initial training and career development that vary depending on whether you want a future in sales, application engineering or installation and service engineering. In the Manufacturing Program, assignments are given in manufacturing engineering, factory supervision, quality control, materials management or plant engineering. Other specialized programs exist, like the Product Engineering Program for you prospective creative design engineers, and the highly selective Research Training Program.

Q. Doesn’t that mean there will be more competition for the top jobs?

A. You’ll always find competition for a good job, no matter where you go! But in a company like G.E. where there are 150 product operations, with broad research and sales organizations to back them up, you’ll have less chance for your ambition to be stalemated. Why? Simply because there are more top jobs to compete for.

Q. How can a big company help me fight technological obsolescence?

A. Wherever you are in General Electric, you’ll be helping create a rapid pace of product development to serve highly competitive markets. As a member of the G-E team, you’ll be on the leading edge of the wave of advancement—by adapting new research findings to product designs, by keeping your customers informed of new product developments that can improve or even revolutionize their operations, and by developing new machines, processes and methods to manufacture these new products. And there will be class-work too. There’s too much to be done to let you get out of date!

FOR MORE INFORMATION on careers for engineers and scientists at General Electric, write Personalized Career Planning, General Electric, Section 699-12, Schenectady, N. Y. 12305

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