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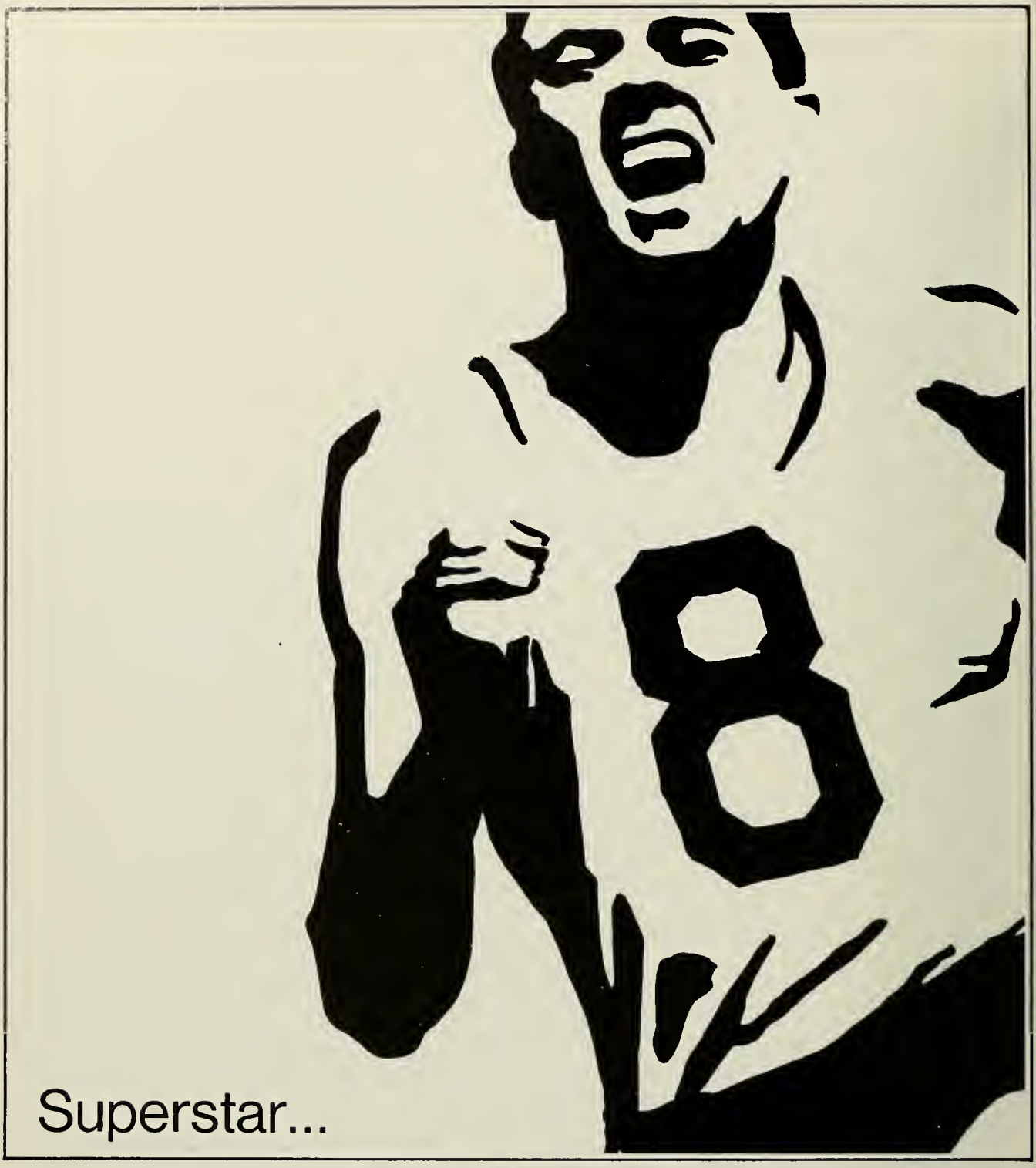

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IN THIS ISSUE

On the cover: Electron micrograph of double viral DNA rings synthesized in the test tube at Stanford University School of Medicine. Actual length across is 2 microns (one micron equalling one-millionth of a meter). Photo by California Institute of Technology.

EDITOR'S NOTE

As we go to press, we have just learned that *Science and Public Affairs* (formerly known as *The Bulletin of the Atomic Scientists*) is going to reprint the genetic engineering material from this issue of the *WPI Journal* in their November issue.

How Dare You Change My Magazine!

by Walter B. Dennen, Jr., '51
Chairman, Alumni Publications Committee

THE JOURNAL these days just isn't the magazine it used to be. The articles are different from those that have traditionally appeared in the *Journal.* Even the look is different.

"Why?" you may be asking. Why the changes, and where is the *Journal* headed?

For more than a year the Alumni Publications Committee has been working with the editor, and under the guidance of the Alumni Council, to evaluate the *Journal.* We have asked ourselves questions: What have been the goals and purpose of the *Journal* in the past, and how well were they achieved? What should those goals and purposes be for the present and future? How can the *Journal,* or any other kind of publication, best serve the alumni, the Alumni Association, and WPI itself?

The questions are difficult and sensitive. We are still searching for some of the answers. But the broad outlines of the *Journal's* aims and future direction have been worked out and given the endorsement of the Alumni Council and its Executive Committee.

Alumni Interest and Continuing Education

As we see it, the *WPI Journal,* like any alumni publication, has two reasons for being. First, it is the primary link between WPI and most of the alumni. The *Journal,* therefore, is an essential element in maintaining alumni interest and involvement in the Institute.

Second, the *Journal* is a prime — and perhaps sometimes overlooked — vehicle for the continuing education of alumni. WPI exists to educate people to deal with science and technology. That education need not, and should not, stop with the granting of a degree — especially in today's dynamic environment. In achieving the goal of contributing to alumni's continuing education, the Journal automatically contributes to the first goal, that is, stimulation of alumni concern for and identification with WPI.

The Alumni Publications Committee has adopted a "theme issue" concept as a means of strengthening the *Journal's* role as an educational tool. In general, each issue will deal with a single subject, usually in several articles. Subjects are chosen with two criteria in mind: they should be interesting and meaningful to alumni, and they should relate directly to WPI.

We hope to deal with significant issues of the day, showing how the issues relate to WPI people. The *Journal* will depict, moreover, how WPI is responding to current problems in terms of institutional structure, educational methods and concepts, research projects, the WPI physical plant, or whatever approach may be most appropriate to the subject.

Of course, many fine articles do not fit the theme concept, yet warrant presentation. Therefore, we will periodically break the theme mold with a catch-all (or perhaps we mean "catch-up") issue containing a potpourri of articles and features.

We haven't said anything about specific alumni information, the class notes section. And the reason is that we don't plan any major changes in the section, except to spotlight some of the more interesting stories about individual alumni.

Increased Distribution

Beginning with the October issue, the *Journal* will be distributed on campus during the academic year to all WPI students. This move is long overdue and should afford students a better understanding of what the Alumni Association is and does. In other words, we begin to develop alumni identification at the earliest possible stage.

Genetic Engineering

This issue of the *Journal* is very special in many ways. It has a theme that dramatically demonstrates how the *Journal* can contribute to our continuing education. The topic, genetic engineering, may disturb us. But we cannot ignore it merely because of its implications. And the information presented on the accompanying pages deals with implications and consequences, not with the mechanics of the subject.

The articles represent a somewhat condensed publication of a symposium held on campus on May 2, 1972. The symposium was in conjunction with the traditional Honors Day Convocation, with honors extended to include the four participants, who were given honorary Doctor of Humane Science degrees. (One result of this changed format was that honorary degrees were not awarded at Commencement this year. However, Dr. James Danielli, a seminar participant, returned to deliver the Commencement address.)

Simply stated, genetic engineering is man's ability to alter hereditary processes by chemical and surgical means. It is here now, in laboratories throughout the world, in experimentation with microscopic animals and, to a certain extent, with human egg cells. The inherent moral and legal questions are profound, and questions cannot be overlooked. In the *Journal's* April issue, Ben Bova said: "The power is there, when we can begin to tinker with our own heredity, to produce the kinds of people we want in the colors, sizes, and shapes that we want. This may be more power than any political system that we can think of today has a right to own. Many of the world's leading biochemists and geneticists are already asking themselves, their colleagues, and the public: What should we do? Should we continue these lines of investigation? How do we handle this power once we have it? A very basic question arises. . . . how are we going to deal with the science and technology that we have developed?"

In a recent issue of its journal, which appeared just prior to the May symposium, the American Medical Association stated that the ethical implications of experiments that would seek to implant a "test-tube baby" into the womb of a woman, and other experiments in genetic engineering, should be thoroughly explored before such work is applied to man.

It is interesting to note that the April issue of the *Journal,* built on a theme of the 1972 Intersession program on campus, offered a natural introduction to this theme issue. Such was not our intent. But perhaps it clearly shows the interrelations that exist among diverse topics.

WPI has recognized and anticipated evolutionary changes. The Institute is becoming increasingly involved with the life sciences. Curricula are relating technical studies to social needs and problems. At the same time a surprising number of students are using the WPI bachelor's degree as a springboard to medical school.

It is therefore fitting that WPI should be among the first educational institutions to publicly address the questions and problems inherent in genetic engineering.

Readership Survey

We anticipate that alumni will benefit from the "new look" in the *Journal.* But the Publications Committee is a relatively small group of people. And we want to be certain. That is why we will soon be conducting a readership survey. We hope that most alumni will respond and make their wishes and opinions known to us. We will publish our findings in a future issue of the *Journal* and will be guided in our decisions by alumni sentiment. ■

feedback

To the Editor:

The April issue is outstanding. Intersession '72 is just fantastic!

From a layman's standpoint I'm involved in our local education activities. (I'm president of the Hatboro-Horsham (Pa.) Senior High School Home and School Council.) As a parent I have four boys in school. One of my boys will enter our new open space design middle school. I met the new principal last week (he's from Fitchburg High School and Fitchburg State College). Some of the ideas of Intersession '72 would fit into his planned program. I'd like to get a copy of the April Journal for him. Would you kindly forward it to me?

I enjoyed "The Next 100 Years" too. Keep up the good work!

R. W. Nikander, '48

To the Editor:

The February issue of the Journal offered interesting and valuable information on environmental problems.

But, perhaps the most significant aspect is that it was printed on 100% recycled paper. As greater amounts of recycled paper are used, it will be economically competitive with virgin fibers, and even hopefully, less expensive.

David J. Gumbley, '68

Editor's Note:

Mr. Gumbley appears to have been misled by the note which appeared on page 1 of the February issue. Only the cover was printed on recycled paper; the remainder of the issue was on a nonrecycled paper.

To the Editor:

Congratulations on your last two Journals. In the last one the paper was excellent and so was the subject matter. Also I found that the typography could not be improved upon. You should be proud of this issue.

I was also deeply concerned with the *Tech News.* It was the most horrible example of subject matter, and no effort was made to have the printing anywhere near correct. Someone ought to straighten out the matter. The mourning of a drug addict's death was a far cry from news of student activities.

But this latest Journal really shows that Tech is trying to bring forth students of real responsibility.

Dana S. Greenlaw, '24
St. Petersburg, Florida

Genetic Engineering

Man's Responsibility to His Future

by Hudson Hoagland

We humans share the basic mechanisms of biological evolution with all living things. Evolution by natural selection is no longer a theory but a fact. It involves chance changes from time to time in the structure of the molecules comprising the genetic material. This material is made up of nucleic acids (DNA and RNA), which are long molecular strands in the form of double helixes which carry information in their organized structure for the genetic characteristics of all living things – animals, plants and even viruses. DNA located in the nucleus of the cell acts as a template to produce RNA that then diffuses from the nucleus into the cytoplasm and there acts itself as a template to link together some 20 amino acids to form the vast variety of proteins which include, of course, the thousands of enzymes that regulate the chemistry of living cells. Changes that occur from time to time in DNA structures are called mutations and may result from effects of high energy radiation, including cosmic ray hits on the molecules, or action of certain ingested chemicals, or simply copying errors when cell division takes place. Such changes in the DNA germ plasm are propagated to the next generation after the manner of a scratch in a master recording of a Beethoven symphony that serves as a template for reproducing more records. The flaw will, of course, also be reproduced on the copies.

Over 99 per cent of mutations are lethal and so self-eliminating or harmful to the developing organism. Only a tiny fraction of 1 per cent may give the developing organism a survival advantage by natural selection over its competitors. Biological evolution of a species is thus a very slow and wasteful process, usually measured in millions of years, with thousands of new forms perishing for each one that survives. We people are a distillate of 3 billion years of this process of evolution.

In the past man has not tampered with his own biological evolution – the only exception I know of is his almost universal taboo against incest. But by substituting artificial selection in breeding for the very slow processes of natural selection, he has produced a vast number of domestic plants and animals with, for him, desired qualities. His reluctance to practice eugenics on himself is inherent in much of his ethical and religious beliefs, but it is also due to ignorance as to how one could selectively breed for desirable human characteristics without at the same time producing deleterious characteristics.

One of the most magnificent advancements of science of all time has been the discovery over the past 20 years of the chemical nature of the gene, the alphabet and sentence structure of DNA and RNA as a remarkable information system – a blueprint – to tell the developing embryo how to make a copy of its parents. This knowledge has also suggested ways to modify the DNA structure to eliminate errors of metabolism that cause a host of diseases. According to H. V. Aposhian 36 million future life years were lost in 1967 from birth defects (primarily genetic defects) in the United States. This is 4.5 times as many future life years as those lost annually from heart disease, 8 times as many as those from cancer and 10 times as many as those from stroke. The new knowledge of inheritance thus has great potential for medicine and it may also some day offer ways to improve human intelligence and other socially desirable qualities. While there are still enormous gaps in our knowledge as to how to do these things for man, it is probable that in a few decades we shall be able to do some of them, thus producing possible great benefits, or perhaps a veritable kettle of worms.

A unique thing about man is that he is the only animal that has now, or soon will have, knowledge to direct and control his own biological evolution. The significance of this in terms of law, medicine, ethics, and human values is what this issue of the *WPI Journal* is about. ■

DR. HUDSON HOAGLAND and a colleague at Clark University founded the Worcester Foundation for Experimental Biology in 1944, in a barn near the campus. The Foundation has grown to a world-famous research institution employing over 300 scientists and technicians, studying cancer, endocrinology, neurobehavior, and reproductive biology. Among the results of the Foundation's work is the birth-control pill.

Dr. Hoagland served as president of the American Academy of Arts and Sciences from 1961 to 1964 and as president of the Society of Biological Psychiatry in 1967-68. The American Humanist Association named him Humanist of the Year in 1965, and WPI awarded him an honorary degree the following year.

With an internationally known broad range of interest and expertise in scientific and social areas, Hudson Hoagland is uniquely qualified to moderate this symposium.

The Good That Can Come

by James F. Danielli

Genetic engineering is becoming possible. The time scale n which the different acts in this scene will occur is npredictable, and the consequences of these acts are also npredictable. Therefore, it's entirely desirable that we hould have intensive public discussion on this matter efore we become too deeply embedded in its conseuences. Indeed, one may say that of all the topics which ught to be in the public rather than in the private domain, nd which have hitherto lain mainly in the private domain, enetic engineering is perhaps the most important for us to onsider.

In general, too much attention has been paid so far in ublic debate to the role that genetic engineering may play n changing the future of man himself and too little ttention has been paid to the other uses which might be nade of genetic engineering. I shall nevertheless make one omment on the desirability of human genetic engineering. vidence appears to be accumulating that our civilization is ow operating close to the limit of human capacity, and if ve expect our civilization to advance beyond the point hich it has already reached, then it may be necessary to o more than simply abide with what we have now. However, although we have these grave troubles which lead ne to say that we are perhaps reaching the limit of our apacity, I think we should not blame ourselves too much. hese troubles arise from the way in which we have volved. In other words, we're not responsible for our volution, although we are to some extent responsible for hat we do now. But man as he now exists did not evolve or our present life.

The Evolution Time Scale

The time scale of evolution, for a significant change in a pecies like ourselves, lies somewhere between say 100,000 years and 10,000,000 years. Now, man moved out of the food-gathering stage of life about five to ten thousand years ago. In that period there has not been sufficient time for a significant alteration in the genetic structure of man. Therefore, one is bound to conclude that the genetic system, and the structure and functions we operate with now, are those which evolved before civilization developed, before men began to live together in communities of more than a few dozen people. The forces of natural selection, which have determined the nature of the human genetic system and given us our basic aptitudes, were not those of civilized life but those operating on man in his food-gathering stage of existence. And it's quite an extraordinary thing that we do as well as we do, considering the circumstances in which we arose. If we are to move into more advanced systems of civilization, then there is probably no choice but to study the techniques of genetic engineering and the theory of genetic engineering, because natural selection, which has brought us to where we are, operates on too long a time scale to be effective in solving the problems with which we are now confronted.

I'd like to give some sort of feeling for what is possible within the whole domain of genetic engineering. What, in other words, could we hope to achieve by artificial synthesis of life? I can do this best by giving a few figures. If you take an ordinary protein with 150 amino acids in it, the total number of alternative forms of that protein is 10^{195}. That is an inconceivably large number. In fact, it's so inconceivably large that one can only begin to appreciate it by thinking about other smaller but still immensely large numbers. Now, how do we do that? Well, suppose we take

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DR. JAMES F. DANIELLI and his team of researchers at be State University of New York at Buffalo have successully synthesized living cells from components. While he has reat confidence in man's ability to engineer genes, he ecognizes the scientist's need for guidance from society to nsure that the application of such knowledge produces an nprovement in the quality of life for all. Dr. Danielli is a ative of England, where he earned three doctorates (in hemistry, physiology, and biochemistry) from the univerities of London and Cambridge. He is presently director of be Center for Theoretical Biology at SUNY/Buffalo.

the Big Bang Theory of the origin of the universe. The latest figure that I've seen for the duration of the universe since the bang is 10^{30} seconds. Now suppose we divide 10^{30} into 10^{195}; we wind up near enough to 10^{150} different proteins would have to be formed every second in order to make one of every possible protein of this particular chain length. To do this, an inconceivably large number of proteins would need to be synthesized every second. Could that vast number have been synthesized? Let's say they contain just one electron per protein (that's of course a gross over-simplification). The present estimate is that there are about 10^{80} electrons in the universe. Now if we divide 10^{30} into 10^{150} (which is the number of proteins we have to make every second) we see each electron would have to make about 10^{70} proteins per second. Chemistry doesn't happen at that rate.

Now, what does this mean? It means that even if we consider only one type of protein, it has been absolutely impossible for one type of each of the possibilities to have been generated through the whole of the history of the universe. And this in turn means that far from natural selection having been able to operate upon all the possible variants of life and the protein structure and so forth, only the most minute trace of the possible variants could ever have existed. This situation becomes even worse when we move from considering proteins to considering whole organisms. Kim Atwood calculated that the number of variants of E. Coli bacteria is $10^{2,000,000}$ If we make the same calculation for man, it's easier to express it in a different way. The possible variants of man are of the order $10^{10^{12}}$. Now that is an even more inconceivably large number than any I've mentioned before. In other words, the prospects opened by artificial life synthesis and genetic engineering are infinitely far beyond the range of human understanding at the present time and may always be beyond the range of human understanding. And as an experimental science, of course, genetic engineering cannot exist in its own right. It can only exist as a feasible enterprise in the light of an appropriate theoretical science which enables us to select from this infinite range of possibilities those which might be most worthwhile investigating. And we must bear in mind that even if the universe goes on as long as it has to date and man practices genetic engineering for that length of time, we could make only a very small fraction of the possible organisms.

Having commented on the scale which is revealed to us, I would like to comment on some issues of greater immediacy. Too much attention has been paid to genetic engineering in relation to man. There are other fields in which, for the time being, it will be much more important – for example, in biological industry. Any chemical which can be made by a biological process can be made with much less pollution and very often with much less cost in the long run; if it's a complex substance, certainly with less cost and with less waste than by present chemical engineering methods. By replacing some of our present industries with others based upon organisms developed for those industries, we can reduce the scale of pollution by a scale of, say, 10^2 or 10^3 for those particular processes. Thereby we may be able to continue in certain ways the process of growth in our industry. This will certainly not be feasible if we are

obliged to rely upon the type of industry we have at this ime.

Another field where we might well benefit is genetic ngineering on plants. At the present time, plant breeders an only produce new plants by acting upon those genes which are already contained in the species. Which means hat a vast number of genes contained in other species are naccessible. But as far as genetic engineering is concerned, *ny* gene that actually exists is available to put into a new pecies by artificial methods. For example, it is probably ossible to take crops like rice and wheat and corn and nsert into them genes for proteins which will raise their utritional value. We might also put the nitrogen-fixing nechanism into them so it won't be necessary to synthesize itrogen to put on the land as fertilizer. One can foresee hat there are possibilities of an agricultural revolution hrough genetic engineering.

Then there are possibilities of taking cells like those rom the nervous system and building a completely ifferent type of computing and calculating mechanism, ne based on cellular systems. This is obviously fairly far in he future, but if you read the literature dealing with nerve ells, you will see that the first steps which can lead to this ort of thing are being made.

Aging

'll conclude by remarking about a study I've begun to nter into myself, which relates to the problem of health are. If one looks at what's going on in the world of health are, one cannot fail to be impressed by the rate at which he costs are rising and by the fact that, although we may ind cures for most of the killing diseases of the present ime, we shall not much extend the life-span of man. ndeed, according to the latest calculation, if all cases of ancer were cured instantaneously, it would add about one nd one-half years to the expectation of life. Now we could lo much better by stopping smoking, as a matter of fact, or y taking more exercise. If all the main killing diseases were bolished (presently killing diseases that is), it would only dd about three or four or five years to the expectation of ife for the average individual in western Europe. The imple reason is that by the time we reach the age of 70 or 0 or 90, we're so full of pathological conditions that if we lon't die of one, then we promptly die in a few months of nother. So, you see, there's absolutely nothing to prevent he cost of health care from escalating to such a degree that t is bound to become intolerable in due course, because very time we discover how to cure something, we also add o the cost.

Now there appears to me to be only one way of pproaching this problem, and that is to find out what the ging process is. Of this we are at present totally ignorant. And then take a look at whether something can be done bout it. For example, it would be very nice if instead of aving tumors and rheumatism and respiratory disorders which make one's health decline as time goes on, one could nstead have these disabilities clocked in at a particular oint, say, so that one lived at a good level of health and hen there was a precipitous decline. A sharp end to life without previous ill health, is much to be desired. One of my older friends, Sir Joseph Barcroft, who was professor of physiology at Oxford, managed this very neatly. He retired from Oxford and established the Unit for Animal Physiology at Cambridge, which he ran very successfully. He went home to lunch with his wife every day. One day he ran to catch the bus to go home for his lunch. He jumped for his bus, he sat down, he died. Now that is a very good way of going out of life. And if we could all do that at minimal cost it would save much money and much grief.

One of the ways of finding out about that possibility is by taking human cells apart and finding out what makes them grow old. And it's not a very simple process. But we do know that human cells, many of them, have a very limited life-span. They can go on for so many divisions, or so much length of time, and then they shut down. By using the techniques of genetic engineering, there is a very reasonable hope that we can find out what the basic process is that determines the life-span of a cell and of an organism and thereby see whether it's possible to adjust the various sorts of clocking devices which turn on in our tissues at different times and make us subject to the diseases of old age. ■

Genetic Engineering

By Whom and For What?

by Paul A. Freund

When someone says that we must improve the genetic inheritance of future generations, what exactly is meant by *we*? Who decides which questions, by what standards, subject to what checks? Lawyers are accustomed to differentiating questions of fact and questions of law, to define the roles of the jury and the judge; here it is necessary to be clear about the difference between questions of science and technology and those of ethics and policy.

The vision of a greater human race, the vision of positive eugenics, might take as its text, ironically, some lines of Walt Whitman: "The pride of America leaves the wealth and finesse of the cities and all returns of commerce and agriculture and show of exterior victory to enjoy the breed of full-sized men, or one full-sized man unconquerable and simple." "Full-sized men" – how do we recognize them (again the unanalyzed "we"), and "simple" men – how do we know their value for survival? It is much easier when we are breeding farm animals, for milk or meat or pulling power. During World War II there was a shortage of penicillin, a newly discovered drug, in the North African theatre of operations, and the question arose whether priority should be given to soldiers suffering from battle wounds or to those afflicted with venereal disease. The commanding officer, against the advice of his consultants, decided to give priority to the venereal disease sufferers, and justified his decision in a persuasive way. The overriding goal of his command was to put the maximum number of troops on the front line in the shortest possible time. The battle-wounded would require a longer time to recuperate, and they posed no danger of infection to others; therefore their claims must be subordinated. For better or worse, the goals of human existence are rarely so circumscribed and the choices so readily rationalized. And the further we peer into the future – from decades to centuries to millennia – the more problematic become our priorities, the more humble our pretensions to wisdom. Who shall choose, even for the sake of the survival of the species, between artists and scientists, poets and engineers, men of cognition and men of feeling?

Perhaps positive eugenics should be looked at in a closer perspective of time. The most nearly available technique for the controlled engineering of offspring appears to be offered by the prospect of cloning, the asexual replication of a male or female progenitor with no interfusion of chromosomes from a second parent. Since the donor's chromosomes are embodied in all his or her somatic cells, there is a practically limitless supply, subject to the availablilty of egg cells into which a donor cell can be nucleated for sustenance, either *in vivo* or (conceivably) *in vitro*. Thus we may be facing a new kind of nuclear explosion, this one of a biological nature. Whether the progeny will in fact turn out to be replicas of the parent is a question for science; possibly mutations will occur, possibly slight changes in nourishment and environment will make a substantial difference, and, particularly in the case of a genius as the forebear, the line between creative genius and hapless incompetence may prove to be a tenuous one. Whether the aggregate gene pool will be impoverished seriously is likewise a basic scientific question.

But the ethical issues go far beyond the scientific ones. What the xeroxing of human beings would do to the fundamental premises of personality, moral responsibility and freedom of will, must give us great pause. The mystery of individual personality, resting on the chance combination of ancestral traits, is at the basis of our sense of mutual compassion and at the same time, of accountability. Within the individual the mystery is a wellspring of striving and aspiration. To become a new edition, indeed only a new imprint of a parent, could undermine these expectations and aspirations and produce a breed of passive creatures waiting for the familiar ancestral scenario to unfold, a breed for whom praise, blame, wonder, and fulfillment would have lost their meaning.

One of the nation's most distinguished constitutional lawyers, PAUL A. FREUND began his legal career as a clerk for the late Supreme Court Justice Brandeis. In a decade of federal service, Freund was on the legal staffs of the Treasury and Justice departments. Since 1940 he has held several special professorships at the Harvard Law School. A fellow of the American Academy of Arts and Sciences, he succeeded Hudson Hoagland as its president from 1964 to 1967. He has written several books, including Ethical Aspects of Experimentation with Human Subjects, *which probes the relationship between medical researchers and their human subjects.*

Perhaps this is the destiny of the race. Perhaps moral premises will themselves have to alter drastically to accommodate the new technologies. If so, we can at least be clear about it and speculate on what the new morality will be like. Some changes have, of course, already occurred in response to scientific advance. Darwinism presented a crisis for literal religionists, as Copernicus had for medieval theology. But these shifts left it possible to retain the essential moral foundations of human responses to human beings; agnostic humanism is at one with revealed religion in its stress on humility and mystery, and the intrinsic human worth that emerges from these avowals of self-limitation. Indeed, as knowledge has grown the horizons of the still unknown have kept receding.

The issue is not whether the search for knowledge should be curtailed; that way darkness lies. The issue is rather whether individual human beings should be constructed with a set of preordained traits, and indeed whether an indefinite number of such identical products should be engineered. This is an issue that transcends scientific freedom, the freedom to inquire and to know, since it can determine for future generations the capacity and the will to know, no less than the possession of other traits of thought and feeling that we regard as the essence of the human. At whatever council table such an issue is decided, there should be spokesmen for the future generations in whose behalf we would be purporting to act, spokesmen like the guardian appointed by a court to represent unborn heirs or infant claimants.

More modest proposals, for negative eugenics, do not escape these problems of standards and procedures in decision-making. A good starting-point for discussion is the case of the mongoloid baby which was the subject of a symposium at the Kennedy Foundation in Washington last November. At a leading eastern hospital an infant was born and diagnosed as suffering from Downs syndrome (mongoloidism), together with an intestinal obstruction which would be fatal in a matter of days unless corrected by a relatively safe surgical operation. The facts were laid before the parents, who decided, in the interest of their two normal children, that the baby should not have the operation and should be allowed to expire in the hospital. The pediatricians took the position that this decision was binding on them, since as they understood the law it would be illegal to operate on a child without the parents' consent. And so the infant was permitted to linger, unnourished, until death came within some two weeks' time.

The first point of interest in this case is the nature of the decision to be made. For the doctors it was a legal decision, controlled by the parents' wishes. For the parents it was a decision conditioned largely on the assumption that the care of the child would devolve upon the family. Neither decision can be said to have been made with full understanding. It is true that one parent must consent to a form of surgery for a child where there is a genuine choice of treatment; but when the choice is between death and a life-saving intervention, the interests of the child cannot be finally willed away by the parents; there are a number of cases where a hospital, seeking instructions from a court in such a situation, has been ordered to perform an operation over parental objection based, for example, on religious scruples against blood transfusion. Those cases, to be sure, did not present the issue of a mongoloid child; but the doctors' position here professed to be based on a general principle of law. Likewise the parents' decision seems to have been based on the assumption of home care, without adequate exploration of the alternative of institutional care (and its costs). In short, there was lacking any forum where all the interests and possibilities could be explored. When it was suggested in the symposium that a hearing in court should have been arranged, with a guardian appointed to represent the child, objection was voiced that lawyers and judges are not experts in Downs syndrome. That, of course, misses the point, namely that the experts should have their full say and that a disinterested arbiter, taking account of the experts' testimony and also of moral standards of judgment, should make the ultimate decision.

What are these moral standards? They are not purely private; they can be educed by reasoning from analogy. Is it legitimate to put another human being to death in order to make life more comfortable, psychologically and economically, for the survivors? Is the case like that of the care of a terminally ill patient, when extraordinary supportive measures may not be taken and the patient is allowed to take leave of life without hindrance — are the prospects of the newly born and the aged dying patient comparable from the standpoint of the possibility for savoring some, if not all, of the wondrous experiences of life as a human being? Is there a point at which this prospect in the newly-born is so attenuated in its range that the offspring should not be regarded as a person (what in medieval theology was termed a monster, not "ensouled")? If the condition could have been discovered prenatally, and if abortion would then have been justified, is infanticide similarly justified? If not, is there an obligation on the part of the state to assume the care of the child when the parents seek to renounce it? Is the case for such a social obligation strengthened where the use and the non-use of prenatal diagnosis tends to correspond to the social class of the mother?

The question about social class is a reminder that lurking throughout the subject is the problem of economic and social inequality and how this factor would relate to the various measures proposed. In legal terms, the problem is the equal protection of the laws — the principle that classification must have a reasonable basis, and that where fundamental human values are involved classification must rest on a compelling public need.

The problem of equal protection has in fact arisen in connection with negative eugenics. In 1927 the Supreme Court considered a case under a Virginia law that required the sterilization of persons in state institutions who were afflicted with a hereditary form of feeble-mindedness. In a summary opinion, Justice Holmes sustained the law, closing his opinion with the quip "Three generations of imbeciles are enough." It used to be fashionable to quote this remark and add: "Mr. Justice Butler dissented." Today we are more likely to be embarrassed by Holmes' jauntiness. Whether such sterilization will have an appreciable effect on the prevalence of feeble-mindedness, in view of the number of apparently normal carriers, is a question for the biostatisticians. But conceding an appreciable effect, the issue of equal protection remains for moralists and lawyers. Is it acceptable to enforce sterilization only upon those in state-supported institutions — manifestly a limitation reflecting differences in social class? In 1970 the Supreme Court came close to reconsidering the 1927 decision, when it granted review of a Nebraska case involving a law that required the sterilization of mentally deficient persons as a condition of their release from a state institution. Fortunately or unfortunately the law was repealed before the case could be heard by the Supreme Court. It is a safe assumption that the Court would have had more trouble with the problem than did Justice Holmes and his colleagues (save for Justice Butler).

The principle of equal protection embodies an important political check, apart from its mandate of distributive justice to those immediately affected. Politically, a control device is likely to receive less thorough consideration as the class of those affected is small and relatively powerless. A law that bears equally on rich and poor, scions of wealth and wards of the state, will receive the kind of scrutiny in its enactment and its administration that the gravity of the subject requires.

Similar considerations apply when we consider straightforward proposals to encourage population control. It is attractive to search for the middle ground of incentives and thereby avoid both the weakness of mere persuasion and the heavy force of legal coercion. In a market economy, incentives tend naturally to be economic ones — subsidies for family limitation, tax burdens for family expansiveness. Unless, again, the result is to be fashioned along lines of economic class, great care will have to be taken to see that the incentives bear equitably upon all classes.

And so, in the end, whether we deal with positive eugenics or negative eugenics or the limitation of population growth, what is possible to accomplish is more than matched in difficulty by questions of what it is right to accomplish and what are the right means to employ. As Einstein said, physics is so much easier than politics. ■

The Morality of Manipulation

by R. Paul Ramsey

Three things are said to evidence the wisdom and greatness of the ancient Chinese people. They invented gunpowder and failed to invent firearms. They invented printing and didn't think of newspapers. They invented the compass and failed to discover America.

A similar attitude, I want to say, should be adopted toward future possible applications of biomedical knowledge. And I want to say that we must all get used to the idea that biomedical technology makes possible many things we should never do. Yet how unlikely it is that we will have any such sense of limits there where we need it most — namely, where technology promises mastery over human genesis, and the alleged perfectability of man's natural endowments.

I might begin by musing over what happened to the title of this symposium. It reads: *"Man's Responsibility to His Future."* Yet in a letter to me in January, President Hazzard was pondering whether seniors and others today might participate more knowledgeably in today's discussion if the title read *"Genetic Engineering: A Humane Technology?"* Or perhaps, he said, *"The Ethics of the Unethical."* While my mention of this may violate good taste and the civil tradition within a learned community, I want only to say that without any stolen Pentagon Papers detailing the decision-making processes around here, it is perfectly obvious what happened in the evolution of that title. It was honed into accord with the most basic, silently operating assumption of the modern age, namely, that we *should* do whatever we *can* do.

Now, *genetic engineering* is, of course, a metaphor. Only by adopting a limited referent for that expression can we make clear what we are talking about. Following the experimental effort, now in process, to change the genes of two small German girls who are suffering from an irreversibly degenerative disease known as argininemia, in the future it may be possible to effect gene-changes in many another existing individual human being (whether conceptus or infant): to alter the gene deficiency that causes PKU, or cystic fibrosis, or sickle-cell anemia, or Tay-Sachs disease, or simply to tell a person's pancreas to start making insulin (which would seem to be a better remedy for diabetes than injections). All such gene changes will be *treatments.* We should call those procedures as a class *genetic therapy,* in order to locate them alongside the non-genetic treatments, such as injections for diabetes, now available for some genetic illnesses. The appropriate metaphor for gene-change treatment when and as it becomes possible, I suggest, should be *genetic surgery* (not genetic engineering).

For that makes it immediately evident that treating the genes of existing patients, born or unborn, will raise no unusual moral questions, no issues not already present in investigational therapeutic trials or hazardous or other last-ditch surgery of any other sort. The sole exception is the complicating factor, which I will not go into, that gene-change surgery may raise serious additional moral questions not raised in other sorts of surgery because of its possibly erratic heritability.

By *genetic engineering*, however, I mean gene changes targeted upon the sperm and ova (or their precursor cells) in the case of suspected carrier couples with the objective of preventing the transmission of life suffering from serious genetic defect. Now since the word "gamete" is the generic term for ova and sperm and their precursor cells, we might call this "genetic engineering by gametic manipulation." But since that's a large mouthful, let us simply say *germinal engineering.*

This is a stipulative definition of our topic. Yet I hope it is a persuasive one since only so can we *keep clear* an important distinction between genetic engineering of gametes and the genetic treatment of individual patients, born or unborn, and since only in this way can we *make clear* the serious moral issues we will face in contemplating the possibility of genetically engineering our children when they are nothing.

For it should be immediately evident that, as a proposal, genetic engineering (in the limited meaning I give that expression) is first of all a proposal for preventing the

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transmission of life suffering from serious genetic defect. Such a new procedure would have to be compared with available alternatives in the practice of preventive genetic medicine, would have to be compared with optional uses of our rapidly increasing genetic knowledge in responsible parenthood or responsible non-parenthood. Those alternatives are, to mention a few, genetically conditioned prohibitive marriage licenses, genetically motivated sterilization, using three contraceptives at once, abstinence, or hieing yourself away to an old-fashioned Catholic monastery or nunnery if you can find one.

Now what would prompt anyone to adopt one or another of those seemingly more radical preventions as against the promise of germinal engineering that we can go ahead and have better babies anyway? Or what would prompt me to argue that genetic engineering cannot be the indicated, or even a choiceworthy, application of our knowledge of genetics?

Simply because, when measured by the principles of sound ethics or by the received canons of medical ethics, germinal engineering would be an immoral experiment on the child-to-be — immoral because not consented to by the primary subject; immoral because, when he is not yet, the child suffers no defect which could justify anyone in consenting on his behalf medically, or justify a physician in making the risk-filled balancing judgment which ordinarily warrants investigational trials or last-ditch efforts on actual patients (such as making a judgment to treat an unconscious patient by the side of the highway). Rightly ordered concern for the child-to-be, I suggest, would compel us to conclude that we ought not to choose for another the possible procedurally induced hazards he alone must bear while at the same time choosing to give him life in which to bear them, in which to suffer *our* chosen experiments, and to be the vehicle "progress" whatever the consequences.

When pressed, researchers in this field cannot deny that there may have to be not a few mishaps, not a few monstrosities discarded, more serious defects induced in place of the one sought to be prevented, before they can even get to know how to perfect the technology of germinal engineering. The last test done to detect induced damage may itself be injurious or may have to be omitted because it risks greater possible damage; the same for the last intrauterine screening or scanning, the last tap of the amniotic fluid.

The rejoinder that will be forthcoming is as follows. The incidence of probable risk of induced damage can be kept equal to or below the incidence of probable natural defect calculated from the genetic histories or tests of the would-be parents. Moreover, in the course of the necessary close attention to this life, the necessary testing and scanning of its development, a lot of other unsuspected defects or accidental damage (as, for example, from its mother's sleeping pills) may be discovered along the way. These too can be dealt with or their subject eliminated by genetic abortion. That is the rejoinder.

But the life we're talking about *would not have been,* and therefore would not have been subjected to those hazards, had he not first been produced by the choice of germinal engineering as our means of preventing of transmission of genetic defects. You cannot justify a questionable procedure by appeals that in thought assume it has already taken place. By no logic can this new sort of genesis be made to bottom on itself, or be justified by concomitant balancing of advantages that already presuppose the experiment (which was in question) that placed the child-to-be at risk of both induced and natural damage. The sperm and egg are in need of no physician; nor is there any child who has consented to be used at risk to cure his parents' need for a child.

It is therefore one thing for human ingenuity to find a way, even at great risk, to protect an unborn child or an infant from more serious risk by developing gene-change surgery or treatment. But it is quite another thing for human ingenuity to create, at the risk of procedurally induced damage, a human life thereafter to be monitored for those same damages.

The rejoinder I have posed to my argument, however, breaks down and analyzes the original proposal in a fine way. It shows us that the basic idea of genetic engineering or germinal manipulation turns human procreation into manufacture of our progeny, or rather replaces the transmission of life from life by the categories of manufactory (which of all human activities is most concerned with product design, and with doing anything at all to improve the product, or at least to seem to do so).

Therefore, the proposal to engineer sperm and ova or their precursor cells to prevent the transmission of serious genetic defects contains, in its rationale, and in principle, the use of biomedical technology to eliminate minor defects as well as serious ones; positive eugenics no less than negative; the introduction of a gene for blond hair, if desired, no less than genes for greater intelligence or musical ability; the delivery to people of a child with the wanted sex no less than producing from them a child without cystic fibrosis by manipulating their gametes; the production of a dwarf if I need one in the circus I own no

less than a potential Horowitz in the family; the mixture of chromosomes from other species with human ova and sperm cultures before they are brought together in the final product on the laboratory assembly line.

These are not just the fancies of authors of articles in popular magazines today – extrapolations to be denied by serious scientists. Joshua Lederberg of Stanford University begins by speculating on what would be "the effect of dosage of the human twenty-first chromosome on the development of the brain of the mouse or the gorilla"; he ends by contemplating "the introduction of genetic materials from other spheres" into the human. And Dr. R. G. Edwards – that "brave" pioneer in the manipulation of embryos at risk – asks whether medical ethics, having been stretched to warrant what he is doing in *in vitro* fertilization and embryo transplantation, can be further stretched to justify "the more remote techniques" for "modifying embryos," such as the productions of "chimeras" by adding to a human embryo the precursor cells for organs from other blastocysts, and perhaps from other species.

The speculation that most appeals to me is the idea that I might have been created with a contraption for photosynthesis on my back, so that like a plant I never had to eat. . . but still had a penchant for philosophy. In any case, the radical displacement of procreation by manufactory happens long before we begin to think of adding to future possible human beings organs and capacities not their own. That begins with the acceptance of genetic engineering as a project. With that, the fundamental moral argument for all subsequent steps would be completed, whether we take those steps or not or whether we judge them to be worth taking or not.

We must conclude that with genetic engineering by gametic manipulation we are already in the world of the Fertilizing Stations and Decanting Rooms of the East London Hatchery in Aldous Huxley's *Brave New World.* Huxley's vision of a pharmacological and genetic utopia, we should remember, was an entirely happy society. That means that, defendable step by defendable step, we shall all be happy on the way there. Otherwise Brave New World would not be the happy place its prescient author predicted it to be.

C. S. Lewis is another author, less famous perhaps, who shares with Aldous Huxley the prescience of having discerned, under the very shadow of Nazism, that genetics rather than the misuse of political power constitutes in our era the greatest danger of "the abolition of man." He wrote in the book of that title in 1942 that we should "not do to minerals or vegetables what modern science threatens to do to man himself." Lewis seemed to have discerned the last citadel from which technological applications are apt to be excluded or where we will discover limits we will agree to defend as we would defend our lives will prove to be the citadel of man's nature itself. While the leopard, the great whale, and the forests are to be protected in the ecological ethic of our day by restoring to mankind a proper sense of things, man as a natural being himself may be given no such protection. There are parameters of the cheetah's existence that ought not to be violated. . . but scarcely any we can think of of man's. Other species are to be protected in their natural habitat, in their natural functions, and in their natural courses of action, but man is doubtfully to be left like them.

There is a renewed sense of the sacredness of groves, and of the fact that air and streams should not be violated. At the same time there seems to be no abatement of the acceptance of the view that human parenthood can be taken apart and reassembled in Oxford, England; New York; or Washington, D.C. And of course, if we can disassemble and reassemble human procreation, it follows that thereafter human nature has to be wrought by Predestinators in the Decanting and Conditioning Rooms of the East London Hatchery or in commercial firms bearing the name "Genetic Laboratories, Inc." in all of our metropolitan centers. Significantly, that latter name was the one chosen for a commercial sperm bank recently opened in New York City, whose ostensible and entirely praiseworthy mission is simply to provide men with a backstop for voluntary vasectomy. Yet its founders called it *Genetic* Laboratories.

The reason this seems to me our future is that the agents of these vast changes are the authoritative figures in white coats. Defendable step by defendable step, they are deemed by the public to be not so much researchers or technicians but mainly members of the healing profession, those who care for us, who tend the human condition. That being so, before it is realized that the objective has ceased to be respect for the unborn patient and tending the garden of the human creation, it will be too late and Huxley will have been proved true.

Joshua Lederberg, speaking of how public policy may be determined in regard to clonal reproduction, ventured his opinion that how the public received would depend on "the accident of the first advertised examples. . . its batting average, or public esteem of the clonant; the handsomeness of the parahuman product. . . "

Perhaps I can conclude by expressing the paradoxical and macabre "hope" that the first example of the production of a child by the genetic engineering of its parents' gametes will prove to be a bad result and that it will be well advertised, not hidden from view. *I do not myself actually believe that the good to come from vast public revulsion in such an event would retroactively justify the impairment of that single child.* But then, for the same reasons, neither do I believe that germinal manipulation is a procedure that can possibly be morally justified, even if the result happened to be a Mahalia Jackson. ■

Probabilities and Practicalities

by Carl Djerassi

I have an advantage over the other speakers in this discussion of genetic engineering. I wear two hats — an academic one and an industrial one — and I can change these hats with considerable rapidity. I realize that this is sometimes disconcerting and unfair in discussions or arguments because at times a question will be asked of me from an academic viewpoint and I will reply to it with an industrial slant, or vice versa.

In my brief presentation I would like to give you a fourth view of the question of genetic engineering and, in particular, the possible involvement in this area by the scientific industrial community. In order to do so, we first need to define genetic engineering, at least from the industrial viewpoint. One convenient way of dividing the subject is to refer to it as *constructive* genetic engineering, meaning the improvement of progeny, and *preventive* genetic engineering, which would concentrate primarily on avoiding the birth of undesirable progeny.

Professionally I am not a geneticist, but I have spent a great deal of time, both in my own research work and in terms of policy decisions, on a subject that is fairly close to today's topic, namely the question of birth control. The moral, technical, and policy questions are rather similar to those posed by genetic engineering, and I would like to point out some of these similarities.

Abortion and Genetic Engineering

Preventive genetic engineering leads directly to the question of abortion, and this is an area of research in which a great deal of work is now going on in the pharmaceutical industry. I myself happen to be a strong believer in the importance of such research. I am firmly convinced of the great importance of abortion,[1] and I consider it a human right. I also recognize that this is a very controversial topic. Industry is involved in this field because of research on abortifacient agents — in other words, chemicals that will produce an abortion. If it is a very early one, then the question of abortion becomes almost semantic. Thus, do we consider expulsion of the fertilized egg after one or two days an abortion? If not, do we consider it after ten days, or twenty or thirty or eighty? In the Koran, for instance, life is supposed to start only around day eighty, because it is then that the fetus is supposed to acquire a soul. Therefore, under the limitations of the Muslim religion, elimination of the fertilized ovum during most of the first trimester of pregnancy (incidentally, by far the safest time from a clinical standpoint) would not be considered an improper abortion.

Professor Freund in his earlier talk raised the question of legal constraints and impositions in the field of genetic engineering, and I believe that he considered this especially in the context of potential human cloning. If we actually would reach that particular level of technical competence when human cloning is actually feasible, then I have personally great doubts about the efficacy and feasibility of effective legislative coercion in that field. Let me cite a fairly simple but not too well known example from the field of abortion to substantiate this view.

Abortion is in many respects the most widely practiced practical form of birth control. It is, of course, not preventive medical practice, but rather might be considered a cure for a "disease," if one actually considered an unwanted pregnancy to be a disease. In many countries, notably in eastern Europe since World War II, abortion is available free on demand. Furthermore, statistics from these countries are now fairly readily available, and they indicate that in several instances the number of abortions greatly exceeds the number of births. This appears to be also true in a number of western European countries, notably the predominantly Catholic nations such as France, Belgium, Austria, and Italy, where the number of illegal abortions apparently also exceeds or at least equals the

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number of births. Indeed, it is very likely that in the entire world somewhere on the order of forty million abortions occur in any one year, which would mean that nearly 8 per cent of all women of reproductive age undergo an abortion in any one year. From these staggering statistics one can conclude that even very oppressive legislation is unsuccessful in stopping a practice in the field of birth control when the motivation exists to use it.

Rumania happens to be the country in which, until fairly recently, the number of abortions per capita was higher than that in any other country and in the middle 1960s reached a level of approximately four abortions per live birth. As a result, the birth rate in Rumania dropped to the second lowest level in Europe. The Rumanian government became concerned with the situation and, in the fall of 1967, suddenly passed a very drastic anti-abortion law under which legal abortion in Rumania became almost as difficult as that in any other European country. As a result, within one year the birth rate in Rumania more than doubled, which is a spectacular increase and would tend to support Professor Freund's fear that issues dealing with birth (quantitatively, i.e., birth control; and qualitatively, i.e., genetic engineering) can be legislated and manipulated.

However, within two years of the initial passage of the strict anti-abortion law, the Rumanian birth rate had again dropped very strikingly and started to approach its original level, because it apparently took the Rumanian population only about that long to adjust to the changed circumstances and to switch over predominantly to illegal abortions. The technical facilities for such abortions were, of course, available, and it was simply necessary to set up the original system in an illegal manner. While I am not aware whether precise data are actually available, I would suspect that the only consequence of the shift was probably an increase in the maternal death rate, an effect which the government hardly wanted to stimulate. The point that I am trying to make, and which is equally applicable to abortion and to genetic engineering, is that when we talk about such basic issues as procreation we are dealing with individual decisions, and there really are no legislative and legal mechanisms for changing them in a fundamental manner. Education, public relations, religion, or appeals to chauvinistic and nationalistic motives are much more effective means of manipulating the quantitative and qualitative issues of birth.

Industrial Considerations

Let me now indicate how industry would consider the question of whether it should get involved to any major extent in the field of genetic engineering. From a purely pragmatic viewpoint, the industrial manager would first carry out an R.O.I. (return on investment) calculation. The factors that would be taken into consideration would be, for instance, the potential market (which in this case is essentially unknown), the development costs (which in this instance would be horrendous), the development time (which I think would be fantastically long), and, finally, the method of distribution (which probably would be highly restricted). Adding up all these factors, one would reach the almost inevitable conclusion that one cannot make a real case for any industrial organization getting involved in "constructive" genetic engineering unless that particular company is purely interested in doing basic research in genetics. However, to convert these research findings in the genetics laboratory into widely applicable agents for final human use would be prohibitively expensive and lengthy, and probably even unfeasible. It is for this reason that I believe that industry is very unlikely to get involved in this area.

Government Regulations

There is a second factor which industry would obviously take into consideration and that is the question of the role that government regulatory agencies play in this field. I am rather surprised that Professor Freund did not address himself to this topic because he would obviously be more competent to do so than any of the other speakers at this symposium. I would say that this aspect raises another very significant barrier to research in this field, and here again there is a considerable amount of similarity to the present situation in the birth-control field, which I have actually covered in two articles which appeared fairly recently in *Science*.[2,3] Thus, while there is more and more concern worldwide about the so-called human population explosion and about the desirability of carrying out more research in the area of reproductive biology and physiology, especially as it applies to birth control, in actual fact *less work* is being done currently insofar as practical applications are concerned. This is not something which one realizes if one reads ordinary newspapers or even most scientific journals. More and more money is apparently being spent in this field, but less and less practical work is actually being done and fewer results achieved from such endeavors. Most of the interesting advances are actually effected in the laboratory on experimental animals and less and less exciting new work is being carried out with humans because of the tremendously increased restrictions regarding human experimentation. I am not passing any value judgment on these restrictions other than to point out that they exist and that it would be pointless to ignore them.

Let me offer a quotation from an article which came out recently in *Science*, entitled "Gene Therapy for Human Genetic Disease."[4] The authors were dealing with the way-out genetic engineering that everyone is afraid about, notably about chemical treatment through modified DNA's. In the article the authors make what apparently seemed to them a new observation: "If synthetic DNA molecules are to be used, then we visualize the Food and Drug Administration or some similar organization enforcing quality standards for DNA preparations used in gene therapy." Note that the authors use the word "visualize." This seems to ignore the fact that it is not a question of "visualizing"; enforcing quality standards for DNA preparations is already the current duty and function of the FDA. In this particular instance we are dealing with genetic treatment through chemical agents, and DNA is just another chemical. There is no question whatsoever that any researcher in this field, if he wanted to work on human

applications, would have to follow already existing FDA regulations, which he would find very restrictive.

The same authors indicate that, in their opinion, one should first carry out extensive studies on animals to evaluate the potential therapeutic benefits. These tests should include long-term studies of the possible induction of cancer and genetic disturbances in experimental animals, and that this would require the development of animal models for human genetic diseases, etc. Apparently the authors of that article[4] again overlooked the fact that this is exactly what already needs to be done now in areas of medicine that are much simpler than genetic engineering. In fact, according to the relatively new legislative mandates of the FDA, that agency has to approve for all practical purposes all protocols for new clinical research upon humans. In other words, if the experimenter wishes to treat his patient with any chemical, and DNA is a chemical, he first will have to get permission from the FDA to do so. In my opinion, it is exceedingly unlikely that any employee of that agency would in fact have the courage to permit any of these experiments to be carried out at this time. He would not necessarily have to forbid them, but he could procrastinate in a manner which would make such experimentation legally impossible. In my opinion, investigators, whether they are academic or industrial ones, should not ignore this reality.

There is an apparent loophole to this control of a government regulatory agency and of the impact of legal restraints on research. Specifically, it is an area where human experimentation is easily possible and where experiments are sometimes carried out without applying all of the ethical and moral considerations that might be exerted. I speak of surgical interventions because, in the absence of drugs, regulatory agencies cannot, at this stage, enter. Thus, if one concerns oneself with questions of tissue transplantation, one does not require any government approval, or indeed any outside approval. The surgeon, if he so wishes, can decide, essentially on his won within the confines of the regulations that exist in his own hospital or institution, to perform such experiments. This, or course, is what has happened in the case of heart transplants. However, since almost any form of genetic engineering that one could conceive of at this stage will not be purely surgical but will involve, in one way or another, chemical manipulation, I believe that the tremendous barrier of externally imposed restraints by government regulatory agency should not be ignored and that this will probably be the most secure insurance that little, if any, of this research will actually be performed.

Prospects for the Future

Until now I have essentially covered only negative factors and you might ask whether there are any positive ones. Could industry conceivably get involved in the area of genetic engineering and, if so, could one really reach some goals in the foreseeable future? For the purposes of this talk, "foreseeable future" might be considered the time when the grandchildren of the class of 1972 are living.

I am convinced that genetic engineering will be used relatively soon in the veterinary field, and Professor Danielli

has already addressed himself to this topic. Moral restraints do not enter here, and neither do practical restraints. In this instance economic considerations are probably overriding, and progress in the field is such that marked advances can be anticipated.

What about applications of "preventive" genetic engineering in humans? Surely there are some areas where a consensus on the part of scientists, lawyers, and theologians can easily be reached; for instance, few of them will probably argue the point that the prevention of mongolism in babies is a desirable goal. In order to achieve it, advances in diagnosis at an early stage are crucially important. Technically it is possible to aspirate amniotic fluid and to analyze it. If one developed accurate diagnostic procedures, preferably automated ones, it would provide us with information on a wide variety of potentially deleterious genetic diseases, and it would then be possible to inform the pregnant mother of that fact and leave up to her the decision whether she wants to terminate pregnancy through an abortion. This, incidentally, is the reason why abortion is so intimately linked with genetic engineering.

In fact, Professor Ramsey in his book *Artificial Man* makes the explicit statement that people do not have the God-given right to have children and that he is prepared to give society and governments the decision-making power as to who should and should not have them under certain conditions. I would only go one slight step further and state that a woman who happens to be pregnant and is informed unambiguously that her child will be a mongoloid should have the option to decide by herself whether she wants to give birth to such a child. If you agree with that position, then you have already agreed with the principle that it is the prospective mother that should make the decision whether she wishes to have a child or not and, consequently, that the decision on abortion should be hers.

This brings us finally to the spectre of human cloning, and I really feel that it is only a spectre. It is a topic that lends itself to sensational magazine articles, but the chance of this really happening in a human being is enormously far away. Professor Ramsey alluded to my colleague, Professor Joshua Lederberg of the Stanford Genetics Department, who has written extensively on this subject. While Lederberg certainly does not exclude the theoretical feasibility of this being demonstrated in higher animals, I believe that he is quitc convinced that the lead times are much longer than most people are prepared to accept. I believe that no one working in this particular aspect of human engineering, namely human cloning, has ever tried to construct a critical path map. This is something that academic scientists are not accustomed to do, whereas industrial scientists find this an important intellectual discipline. Let me again cite an example from the birth control field.

Two years ago in a paper in *Science*[3] I considered what it would take to develop an ideal birth control agent, such as a once-a-month pill for women which would be a menses inducer. A woman would take such a pill once a month, and this would induce menstruation; if she had gotten pregnant during the preceding month, the pill would initiate what we might call a microabortion, because she would in fact have been pregnant for a couple of weeks. When I constructed a critical path map for such a hypothetical agent, I reached the conclusion that the lead times involved would be such that such an agent could not be developed until the mid-1980's at the earliest. This paper[3] actually generated more attention than any of the hundreds of other scientific articles that I have written, and I believe that in part this was due to the fact that I called attention to the stark realities of time and money costs involved in developing such complicated approaches for human application. It is a topic that academic and government scientists, as well as legislators and especially the press, like to ignore. If such a critical path map is prepared for developments in human cloning, then it will become perfectly obvious that we are talking about a development that, even if it got major scientific and governmental support, could not be developed until somewhere in the next century.

The statement is sometimes made that these are only technical problems in the sense that the fundamental scientific questions associated with cloning have already been solved, and that all that is required is a technological effort to apply these solutions to humans. Here again, my colleague Joshua Lederberg presents a very good answer to this simplistic view. He stated in so many words that, while we have the technical knowledge to build bridges, it does not follow that we are able to build a bridge from San Francisco to Honolulu. I would extend Lederberg's bridge-building analogy to cloning by stating that this is not evcn equivalent to building a bridge from San Francisco to Honolulu but rather from San Francisco to Sydney, or perhaps even across the Indian Ocean. I rather doubt that the chances of building such a bridge soon are very good, even for the highly competent engineers that graduate from Worcester Polytechnic Institute. ■

[1]C. Djerassi, "Fertility Control through Abortion — An Assessment of the Period 1950-1980," *Bull. Atomic Scientists, 28* (No. 1), 9 (1972).
[2]C. Djerassi, "Prognosis for the Development of New Clinical Birth Control Agents," *Science, 166*, 468 (1969)
[3]C. Djerassi, "Birth Control after 1984," *Science, 169*, 941 (1970).
[4]T. Friedmann and R. Roblin, "Gene Therapy for Human Genetic Disease," *Science, 175*, 949 (1972).

Genetic Engineering

Interplay

Questions and Panel Discussion

How does a clone differ from ordinary tissue culture? What makes cells clone?

DR. DANIELLI. In a clone, the genetic composition of all the cells is the same, whereas in ordinary tissue culture, there is a good deal of variation. due to accidents on the way before the stuff gets into tissue culture. The tissue culture in a clone, in other words, is a slightly refined ordinary culture.

Who decides on value systems in the future? Is anything being done on a reasonable scale in legal or political schools to address the question of who will answer these critical questions and how?

DR. FREUND. Well, there certainly is growing interest in the ethics of scientific advance. In medical schools, and I dare say even engineering schools, certainly in law schools, there is growing interest in professional ethics in a basic sense. I don't know how you arrive at these things. There is a kind of Alphonse-Gaston game, with the scientists and society waiting for the lawyers and judges and administrators to prescribe the ground rules, while the lawyers and judges and administrators are waiting for a consensus to develop in society.

I think that healthy development would be to try to arrive at a consensus, and that is why I think that even though advances like cloning may be fifty years distant, in the age of grandchildren rather than children of those present, that is not too long a time in which to consider these problems. Symposia like this are a modest beginning, but we need more systematic effort. I would hope that professional associations would do it in a more symptomatic way.

As you know, there are institutes now that do issue publications and do research. The Institute of Medicine was set up by the National Academy of Sciences. The Institute for Life Sciences in Hastings, New York, is doing important and interesting work both in research and in publication.

What we need is more such centers and more such intermingling of the disciplines.

The behavioral sciences are developing ways of exercising control over the individual by capitalizing on characteristics which may not always be controlled by the individual himself. Do you agree with this, and how do you categorize such research as compared to that of chemical alteration of the individual?

DR. RAMSEY. I think I have no real competence to answer that question. It is in the general department of the fact that there seems to me to be a difference of kind, not only a difference of degree, into which we are moving not only in the genetic alteration of the future of the race on certain suppositions, but pharmacological alteration or other kinds of alteration of human cells.

It is certainly arguable that every environmental change we have made in history has had a returning impact upon the genetic composition of the individual and the population. In other words, we have been altering ourselves all down through human history, but throughout most of this time we have had kickback. We could stick our tongue out at it.

The measure in which, I think, this now places in man's hands the ability to impose chronological and genetic control does not leave room for that reciprocity of freedom and destiny which has been a part of the human story to this point.

I may have misunderstood the question. In any case, I probably don't know the answer to it.

Are you hopeful as to the future of man? Would you care to comment on gene changes you expect?

DR. DANIELLI. I am caught as ever between my optimistic temperament and my judgment. It seems to me that human beings have managed to wriggle out of a great many tight corners in the past; it is reasonable to hope that they will do so in the future.

However, I think it may be necessary for us to have a drastic reorganization of our society, as occurred, shall we say, when the transition from food-gathering to agriculture took place, which after all is one of the most profound changes that mankind encountered.

In other words, what may be necessary to look with optimism on the long-term future of man is that a consensus will need to be established between the different cultures which we have existing in the world at the present time. We will have to agree, first of all, that the differences which exist between ourselves and other cultural groups of the world are trivial compared with the problems with which we shall be confronted in the future, and that we should be willing to lay aside our differences and try to work out some appropriate way through these certainly immense problems with which we are clearly going to be confronted in the next hundred years.

I can't say when one looks at the world right at this moment that one would be enthusiastic about the prospects. But after all, there are changes of heart that take place, and I may pull Dr. Ramsey's leg a little — it's only a hundred years ago that evolution was not respectable as far as the Church was concerned. Only a hundred years ago, and I am not pulling anyone's leg, very few people went to school. Many extraordinary changes take place without our having realized what happened, and I think it may well be that some are beginning to take place now which are as essential or more essential than those that have taken place in the past.

Therefore, let me say one should not base one's hopes entirely upon what is clearly predictable. It is a good thing to be hopeful.

It appears to me that the average quality of the human genetic pool is decreasing because modern technology is damping natural selection. Please comment.

DR. HOAGLAND. In a sense this is so, because it is medical procedures and medical therapy which are preserving the lives of people who in earlier times would have died because of the illnesses they happened to have. Take diabetes. The diabetic was fated not to live to reproduction very often before 1922 and the advent of insulin. With the advent of insulin and its use, the diabetic can live pretty much as long as anyone else.

Diabetes mellitus is a disease with a strong genetic comport, and of course diabetics who then proceed to have children who are also diabetics are increasing the number of genes for diabetes in the human gene pool by the fact that they reproduce, which they didn't before to anything like the same degree. A great many genetic diseases belong in this category, where medicine is making people live longer to be able to reproduce, which they didn't before.

This is all part of a humane approach to these problems, and yet the gene pool is certainly deteriorating under the increased number of defective genes that are being carried on as recessive or even dominant genes.

J. H. Mueller was one of the people most concerned about this problem. He calculated that it would be a considerable number of generations before this disastrous occurrence would be clearly in evidence, but he did predict the time would come when most of the occupation of human beings would be developing prosthetic devices for each other as a result of accumulating genetic defects which will pile up over a period of many generations. So there is deterioration, as a result of our basic humanity, of the very things that we think are important, namely to save lives and to prevent suffering, and this is certainly having some impact on our gene pool.

DR. DJERASSI. I think there's an oversimplification both in the question and the answer that Dr. Hoagland gave. That is, of course, true as far as it goes, but there are, as you pointed out, many diseases — diabetes being a very good example — where, by keeping diabetics alive, they are creative and otherwise exceedingly productive human beings, and the contribution that one diabetic can make to the future of the world can be enormous compared to the harm that he will do by perpetuating that undesirable gene.

To give you an example, suppose Einstein had been diabetic? There is no question whatsoever he would have died before he could have done what he did. If Mozart had been a diabetic, what then? I think it is unreasonable therefore to simply say that the genetic pool, using it in that context, is getting worse. In certain respects, it is improving the quality of life. This is where I think I would use preventive genetic engineering as a very important concept and define very carefully which particularly undesirable features I as a policy-making scientist or physician would be concerned about.

What is the value of considering whether or not genetic engineering is morally right when it is inevitable? Perhaps the more important question is, how can or should man adapt to this science?

DR. RAMSEY. The question asks what is the value of considering whether anything is right when it is inevitable. The questioner assumes that one can derive, I think, the right or the value of human reflection from a description of what is inevitable — a description of fact.

I myself, as a man who attempts to be reflective upon the human behavior — that's the definition of an ethicist, which means each of you is an ethicist if you would only let yourself go and be one — I would have to say that one cannot think reflectively about the right and wrong of human behavior if one proceeds to derive from what is hoped to be from what is inevitable or will be. Neither can one derive what will be from what "ought to be."

So a provisional answer to that for myself would simply have to be that it seems to me that the human being at all above the level of the beasts of the field would want to be able to say, if he is the last man around, the last dying being of this universe, if it came about by some wrong human action, some holocaust, some heinous immorality, he would have to have stature enough to say, though he knew it was inevitable because he stood there — he would want to be able to say that it came about by something that was wrong, as against simply a program of adjusting to the inevitable course of events.

Given Western civilization's peculiar attitudes towards non-Caucasoids, isn't it conceivable that there could be a systematic plan to mount a campaign of ethnic genocide?

DR. DANIELLI. Well, how good is the evidence that the attitudes of Caucasoids toward other racial groups is different from that of any of the racial groups to all other racial groups? There is very little difference between us except in the means we have of expressing our dislike of one another.

Elimination of one group is not going to solve any problems.

DR. HOAGLAND. For my part, I cannot conceive of any such thing.

DR. DJERASSI. I will give you my conclusions, for slightly different reasons. If some person really wanted to do this, he would only be able to accomplish this, even assuming all the political powers he would have to do it, within the very narrow confines of possibly a fraction of one country.

It is simply not logistical or feasible to carry this out worldwide, because a vast majority of the population, of course, is not Caucasian. Unless he blew up literally four-fifths of the world, he could not do this.

We have to remember that nearly one-third of the world is Chinese, and if you just add another third — just India and a few other surrounding countries — there is more than half of the world's population, in Asia, which is not Caucasian. So it is totally unfeasible.

If it is addressed in the context that a Californian would like to reduce the number of Chicanos, or the people in Manhattan would like to have fewer Puerto Ricans or blacks, that is theoretically feasible, but I think even in this day and age rather difficult to accomplish. And it is obviously undesirable to really accomplish.

In a given socio-political system, will those same groups who make political decisions also make genetic decisions?

DR. FREUND. This really breaks down into a formal answer and a somewhat more sophisticated answer.

Formally, the question would be, "Will the legislators and courts make the decisions about genetic engineering as they do about, shall we say, vaccination or quarantine?" I suppose in the end that will be so. However, remember that

it is one function of public lawmaking to decide what sectors shall be left to private choice.

In other words, it is a tricky question because it is the legislature that decides, for example, whether there shall or shall not be any law on abortion. But in a still more sophisticated sense, the legislators are going to reflect the consensus of their constituents, and that is a difficult question to answer.

My suggestion was that the more broadly affected the population is by any proposals, the better inherent check we have on a decision-making process. Just as one argument against a volunteer army is that we might be readier to go to war if the sons of most families were not subject to be called.

In other words, there isn't a real consensus if a measure is adopted that burdens a very small and special class which has relatively little political weight.

So that all I can say is that I think, though informed decisions will be made by the conventional decision-making organs, that more realistically these will depend on what consensus develops in society, and that in turn may be affected by how widely shared any programs of genetic engineering are, how many families would be affected.

That seems to me an important factor in assessing the reality of a consensus.

DR. RAMSEY. Don't you think, Dr. Danielli, about the real question behind that research you are doing on discovering the nature of the aging process? You have very charming notions as to what usage we would make of that — the value to the individual is that we would all function at a high level and suddenly we will go to pieces like the one-horse shay; the value to the society is that it would deal with the problem of health care.

Doctor, don't you really think there is a problem as to what the politicians and the power brokers are going to do with the knowledge of how to master the aging process?

I think they are going to want to live a long time. They're not going to take the solution you propose.

What of the abuses that stand close to the elbow of the scientist? The question that is really in the minds of the audience in some of these questions concerns the political processes by which one is going to even imagine how we could do anything other than make ourselves worse off by learning to master the aging process in terms of the actual

use that would be made by the people with decision-making power — or all of us, and our natural desires.

That seems to me to be an issue that may be different between you and me temperamentally, me being rather gloomy and you being rather more hopeful. But really, the question is, how does one, without stopping theoretical advance of knowledge, move a society into the actual social applications? We can all think of desirable applications; we can also think of probably many more probably undesirable applications.

DR. DANIELLI. I think there is little doubt, and it is by no means certain that we can do this, but if we do learn to adjust the rate of aging of individual organ systems and so forth, we may improve general health without necessarily changing the life span of man, which is a different thing altogether, irrespective of what the politicos might wish or might do that would be an advantage.

On the other hand, if for our future we are dependent upon the type of governmental process and the type of relationship between different communities on a worldwide basis which we see going on now, I think any sensible human would necessarily despair. It is quite obvious that the priorities are quite wrong in terms of the problems that confront us. For example, I suppose that on what is sometimes called "defense" we probably spend about two thousand billion dollars a year.

Now, most of this expenditure, in fact, is self-defeating in that everybody does the same thing within their means, and the hope is that we end up in a stalemate.

If the same resources were devoted to more serious problems, I think one would feel more hopeful about it, but quite clearly a change of heart is necessary before that sort of transformation takes place, and that is basically why I say that most of the major problems which confront us in the future are not likely to be solved unless there is a new ordering of society.

DR. DJERASSI. I think this is a very important question, and we have had significant comments on it. I would like to address myself to it from a different viewpoint.

There is really a negative feedback group in this which makes it fairly unlikely that this is going to happen very soon, for the following reasons.

When you consider the narrow question of aging and deterioration, which certainly is perhaps the most difficult one in medicine, very few advances have been made on a practical basis, and there are really not any just on the horizon soon in terms of practicable applicability.

Let's take as an example multiple sclerosis, which certainly is one of the most common killers of men, particularly males. If we would like to do something about this in terms of preventing, let's say, a deposition of cholesterol in the arteries in middle age and later on, we really ought to do something around age eighteen or nineteen, when the process starts. Theoretically we can indicate that if we give something to young men around that age, and they keep on taking that particular preventative, then it is likely that the incidence of multiple sclerosis at the age of fifty, sixty, or so on, would greatly decrease, and that would certainly have an impact on longevity — and on a lot of other things as well.

However, to carry out this particular experiment — even if we in fact found a suitable animal model — we would have to carry out these experiments for twenty, thirty, or forty years, in order to evaluate them statistically. I think you yourselves know that there are objections to this, even in the area of contraceptives, oral contraceptives in women.

A statement was made, quite validly, incidentally, as to what happened to a woman who was given something for twenty years? The only answer is that you are going to have to carry out the experiment for twenty years, and if you don't want to then you can never know with absolute assurance.

That boils down to the risk/benefit evaluation, which we are exceedingly poorly equipped to handle. This applies to politicians, it applies to I think even scientists, and I think this is the very, very serious restraining factor that extends at an astronomical rate the lead time between laboratory discoveries and the practical applications, and therefore social applications. ■

Reunion Roundup

Constitution and By-Laws Changes Approved

At the Annual Meeting of the WPI Alumni Association, called to order at the Reunion Day luncheon on Saturday, June 10, 1972 by Association President Irving James Donahue, Jr., '44, the proposed changes to the Constitution and By-laws of the Association were approved unanimously. Committee reports and reports of the officers were waived at the suggestion of the chairman, as Mr. Donahue noted these were all on file with the minutes of the May, 1972 Alumni Council meeting.

The vote marked the culmination of many months of hard work which began in 1969. At that time a master plan committee was appointed by Association President Robert E. Higgs, '40 and the committee was chaired by Professor Malcolm S. Burton, '40. Their report recommended that the activities of the Alumni Association be tied in much more closely with the operations of the College itself since a stated objective of the Association was to work for the betterment of WPI. Following this, Higgs appointed a Reorganization Committee of eight alumni to study the recommendations of the Master Plan Committee and to recommend a course of action. This committee was presided over by Vice-President of the Association, Bradley E. Hosmer, '61.

The Reorganization Committee recommended in its report that basically the Alumni Association should continue as a policy-making body in the area of alumni affairs at the college, but that the day-to-day operations of the Association should come under the direct guidance of the college administration. It recommended nine points of reorganization and those nine points were approved by the Alumni Council and the Association in June of 1970 for the Association to operate on a one year trial basis under the reorganized set-up during the 1970-71 year.

During the 1970-71 year, Mr. Higgs asked Mr. Hosmer to chair a three member committee to develop a proposal for revision to the Constitution and By-laws of the Association which would incorporate the nine points of reorganization. This committee did develop a detailed proposal, but in June of 1971 the Council decided to ask the Association to extend the trial period of operation for another year, rather than to vote on the proposal, so that it could be studied and developed more fully. The Association did grant this extension at its Annual meeting in June of 1971.

At a specially-called meeting in October, 1971, the Alumni Council devoted an entire Saturday to the revision and refinement of the proposal of the Hosmer committee. In the end a final proposal was developed and at the February, 1972 meeting of the Council it was approved unanimously. The Council-approved proposal was then mailed to all alumni of record on April 19, 1972 and the vote of the Association on June 10, 1972 approved the proposal unanimously.

In commenting on the vote, President Donahue said, "We feel extremely confident that the changes voted, which are primarily in operating procedures, will have a very positive effect on improving the efficiency and effectiveness of the alumni program at WPI. I am most pleased by the overwhelmingly affirmative vote given by the Association to the changes and I'm confident that we have taken a major step in the right direction. It has been most gratifying to see committee members and the Council work so conscientiously on this important topic and I'd like to thank each and every one of them for their help and dedication."

CLASS OF 1912

We had 14 at our sixtieth reunion, Friday, June 9, 1972. Included were Joseph and Helen Granger, Frank and Beulah McGowan, Henry and Madeline Rickett, Holman and Katherine Waring, Eugene and Gertrude Powers, Marjorie Nickerson, Howard King, Edward Tucker, and Harrison Brown. The Ricketts hold the record for attending all reunions in ten years.

As usual, we had dinner at the Marlboro Country Club and the meeting at the home of our President, Joe Granger.

There was only one death during the year, Bertram Cleveland on May 16. Our membership is now 28.

Over $3200 interest is available in the Herbert Foster Taylor Student Aid Fund.

It was decided to hold reunions every year as long as there are any who want to come.

1912

1917

Officers elected for the next five years: President, Joseph Granger; Vice President, Henry Rickett; Secretary-Treasurer, Harrison Brown.

Questionnaires sent out again this year showed that, in general, our members are continuing the activities previously reported. The number of descendants reported added to 31 children, 78 grandchildren, and 32 great-grandchildren. If you add to these the living offspring of classmates who have gone along, what a nucleus we have for improving the standards of our country!

Jim Shea is home from a month in the hospital and is recovering slowly. He has difficulty in walking. An interesting letter from John Beck in Florida shows he is still very active. Albert Humphrey is in a nursing home in Middleboro but is able to get around. Ernest (Nibs) Taylor writes us long letters twice a year.

Word was received of the death of Mrs. James (May) Cunningham, widow of the former Tech trustee. She had written several times in previous years that she and Jim were intensely interested in Tech.

Harrison G. Brown
Secretary

1922

CLASS OF 1917

The class of 1917 met for its 55th reunion, Friday night, June 9th, at the Worcester Club. A social hour followed by a nice dinner were enjoyed by all. During the evening we were pleasantly surprised by a visit from President and Mrs. Hazzard and Alumni Secretary, Stephen Hebert.

Those present at the dinner were: Mr. and Mrs. Wentworth Doolittle; Alfred W. Francis; Mr. and Mrs. William H. Green; Mr. and Mrs. Roland E. Greene; Mr. and Mrs. Robert C. Hanckel; Charles E. Heywood and daughter; Clyde T. Hubbard; Mr. and Mrs. Richard D. Lambert; Major General Kirke B. Lawton, USA, ret.; Ralph Merritt; Warren Parks and son, Russell, '41; Glendon M. Pomeroy; Mr. and Mrs. Henry W. Sheldrick; Mr. and Mrs. Russell H. Smith; Mr. and Mrs. Samuel Thompson; Mr. and Mrs. Max Tucker; and Mr. and Mrs. Allen D. Wassall.

Greetings were read from the members of the class who were not able to attend.

Saturday, most of the class attended the alumni lunch and meeting which was held in Morgan Hall.

Russell H. Smith

CLASS OF 1922

Several fortunate circumstances combined to make the 50th reunion of the Class of 1922 the best ever held by our class, if not the best ever held, period. First was the Institute's decision to separate commencement and reunion weekends; second was the valuable assistance rendered by Steve Hebert in the conception and execution of the program; third was the Institute's cooperation in making their facilities available to us; and last was the enthusiastic response of the members of the class.

The reunion stretched over three days, and had for its base of operations the Yankee Drummer Inn and Motor House in Auburn. Many of us arrived there in time for lunch on Thursday, June 8th, and spent the afternoon setting up headquarters, distributing costume hats and name tags, playing bridge and golf, renewing friendships, and greeting later arrivals.

By the time we had travelled by bus (furnished by WPI) to join the Worcester-based members of our group at 1 Drury Lane, our delegation numbered 30 classmates and 25 wives. It was a gala reception and cocktail party, hosted by George and Jean Hazzard, both qualified candidates for Doctor of Hospitality degrees. Then back to the bus for a five minute ride in the rain to Higgins House for a sumptuous repast amidst most unusual surroundings. After the meal, President Hazzard gave the class advance notice of the Ellsworth Foundation gift, which was followed by a guided tour through the mansion led by Mrs. Hazzard. Our faithful bus returned us to the Yankee Drummer, and everyone turned in early.

Friday's formal activities began with another bus ride to Worcester for a deluxe buffet lunch at Morgan Hall, followed by seminars for the studious on the WPI plan, admissions and placements, and a tour of the Worcester Art Museum for the artistic. Our official reunion banquet was held at the Yankee Drummer at 7 P.M., for which we mustered 47 classmates and 35 wives, as follows: With wives: Abbe, Aldrich, Barrington, Batten, Bennett, Bingham, Brigham, Brusnicki, Carl Carlson, Clarkson, Colesworthy, Cooney, Russ Cushing, Ellsworth, Dick Field, Russ Field, Heffernan, Holden, Bill Howe, Hurowitz, Keith, Marston, Meyer, Page, Parsons, Pickwick, Richardson, Russell, Sholz, Townsend, Turner, Watchorn, White, Whitney, and Wightman. Without: Alden, Hadden, Herr, Larson, Lloyd, Mason, Murphy, Parker, Schiller, Snow, Thayer, and Williams. In addition, Dick Williamson dropped in to say "Hello", and Harold Rice with his wife joined us at Worcester on Saturday. Howard Carlson, Red Hyde, and George Walker had planned to be present, but due to unforeseen circumstances were forced to cancel.

Preceding the banquet class pictures were taken; after the meal, with Pres. Keith as toastmaster, Eddie Sholz gave statistics on our 50-year gift to WPI, and Dean Grogan, our guest of the evening with Mrs. Grogan, spoke briefly. The affair concluded with that perennial feature: movies of past reunions.

Saturday at Worcester, after our induction into the 50-year Associates, we assembled with all other reunion classes at the general alumni luncheon in Morgan Hall, during which we received our 50-year diplomas, and won the attendance award. Pres. Keith received the Herbert F. Taylor Award for Outstanding Service to WPI, and later delivered the class message for the Class of 1922.

The final reunion event took place at the top of Institute Road, where a groundbreaking ceremony was held, symbolizing the start of construction of the Ellsworth Residence, made possible by a gift of $250,000 from the Ruth and Warren Ellsworth Foundation. Ground was actually broken, by our classmate, Warren, at the controls of a bulldozer.

Philip H. White, Secretary

CLASS OF 1927

From a prearranged meeting at Alden Memorial on Friday, June 9th, about half of those attending our 45th reunion visited

1927

1932

the newer buildings on campus. Guided by a senior student, the touring members were shown these fine facilities, which for most were being seen for the first time.

Returning to Alden they joined the later arrivals in the Music Room, where a Happy Hour was shortly in full sway with 24 members and 15 wives. The fun of trying to remember faces was made more confusing by being provided with a dinner menu on which was a list of names and the caption "How many do you identify?"

From this all too brief and pleasant gathering, we crossed the hall to the Janet Earle Room to enjoy a delicious roast beef dinner.

That the "Admiral" was there, smiling upon us from his painting, seemed most appropriate. Captain Earle came to Tech while we were students. As our '27 yearbook so well stated, "this man of action left his mark of achievement on the life of this college." Started during our last year, the building of Sanford Riley Hall was the forerunner of the expansion program we so greatly admire today.

With class officers absent, no formal meeting was attempted. Cliff Fahlstrom, co-planner with Phil MacArdle of the 45th reunion, did an excellent job as Master of Ceremonies. It was reported that of the 87 members listed in the last Alumni register, there are today only 76 active members. The ranks have been reduced by 7 deaths and 4 whose addresses are unknown or inactive. In making our plans, we made contact with 80 percent of our members, 36 of whom couldn't make it because of remote distances, conflicting engagements, or ill health. Cliff then asked for a moment of silence in respect for those who can never again be with us, with particular reference to James Rogers and Ellsworth Carpenter, whom we lost during the planning of our 45th.

Of those who wrote advising of their inability to attend, their letters and comments were read at the dinner. We missed them all, but were happy to hear that God willing most of them planned to be with us for the 50th.

Cliff called the roll of those present and each responded with a short sketch of his activities, numbers of children and grandchildren, etc.

Twenty-two of those from our Friday festivities, plus three that joined us on Saturday morning, attended the Alumni luncheon in Morgan Hall. The results of this reunion can best be summed up in a quotation from Vic Hill's letter just received. It reads as follows:

> "A member of the 1927 class can hardly return to WPI without being greatly impressed by the fantastic expansion of facilities on the campus; we can be proud of our Alma Mater. A great debt of gratitude is due those who, over the years, have built WPI to its present status. I have the greatest respect for Pres. Hazzard and think he is doing a wonderful job."

Those attending included: Mr. and Mrs. Richard E. Bliven; Mr. and Mrs. Edward F. Cahalen; C. Sture Carlson; Mr. and Mrs. Buell S. Dickinson; Mr. and Mrs. Herbert P. Dobie; Clifford I. Fahlstrom; Cecil R. Furminger; Albert M. Goodnow; Mr. and Mrs. Victor E. Hill; Mr. and Mrs. E. Carl Hoglund; Mr. and Mrs. Philip A. MacArdle; E. I. Merrill; Mr. and Mrs. Robert L. Parker; Mr. and Mrs. Nelson E. Parmelee; Frederick C. Pomeroy; William M. Rauha; Mr. and Mrs. Carl H. Schwind; Dr. and Mrs. Donald S. Searle; James M. Simmons; Mr. and Mrs. Nathan M. Southwick; Mr. and Mrs. Howard F. Stephenson; Thomas A. Steward; Mr. and Mrs. Emmett A. Thrower; Mr. and Mrs. Bernard J. Wahlin; Mr. and Mrs. Arthur Manning; and Frank E. Buxton, '28, who arrived on Saturday.

Philip A. MacArdle, Co-chairman

CLASS OF 1932

To celebrate our 40 years out of Tech, the Class of '32 returned to the hill on June 9. During the afternoon classmates and their wives began arriving, some to renew old friendships on the golf course, some to attend the informational activities at Gordon Library, and others to view exhibits at the Worcester Art Museum.

Evening found our group of 54 gathered at the delightful Higgins House for banquet and fellowship, so well arranged by Bill Asp and Dave Goldrosen. We were honored to have with us for a portion of the evening President Hazzard, who brought us up to date on new activities on the hill.

At the alumni luncheon on Saturday, our class initiated the 40-year gift to WPI with a substantial sum, especially considering that our class has always been known as the depression class.

Paul Nelson

CLASS OF 1937

Nineteen couples were on hand at Tech for the 35th Reunion of the Class of 1937 on Saturday, June 10th. President Bill Carew came the furthest distance—from Wilmington, Delaware—while several others made the trip in from New Jersey, New York, Connecticut, and elsewhere around the Commonwealth.

Daytime activities included the traditional class picture, special Alumni luncheon, ground breaking ceremonies for the new Ellsworth Residence (dormitory) and other afternoon festivities (some official and others not quite as formal).

In the evening, we gathered in the Janet Earle Room (in Alden Memorial) for a spirited social hour, followed by a very delicious roast beef dinner in the adjoining Music Room, very nicely arranged for the occasion.

In line with the relaxed atmosphere of the reunion, entertainment consisted of nothing more strenuous than the reading (with resulting reminiscing) of interested excerpts from the considerable number of letters and telegrams received from classmates located all over the United States and as far away as New Zealand (Frank Rollins).

Also we were honored the latter part of the evening by the presence of Steve Hebert (Alumni Secretary), Jean Hazzard and her husband George (President) who chatted informally with us about many aspects of life on and off the Tech campus these days.

Included in those attending were Bill

1937

1942

Carew, Gordon Crowther, Chapin Cutler, Mort Fine, Bill Frawley, Larry Granger, Caleb Hammond, Fran Harvey, Wes Holbrook, Ralph Holmes, Carl Larson, Dick Lyman, Jim Moore, Bob Powers, Foster Powers, Ray Schuh, Art Schumer, Paul Stone, John Sutliffe, and Bill Worthley.

With this nucleus we are "off and running" with plans for our Fortieth in 1977.

Gordon Crowther, Chairman

CLASS OF 1942

The class of 1942 held its thirtieth reunion on Friday evening, June 9, 1972. It was held at the Mt. Pleasant Country Club in Boylston. The social hour with fabulous hors d'oeuvres started at 6 p.m. followed by dinner at 7:30.

The Al Schwiegers and Ed Higginbottom were guests of the class, and both Al and Ed had a few fine words to say.

Although the turnout was small, everyone had a fine time. Those present were the Bob Allens, the Curt Amblers, George Andreopoulos, Ron Borrup, the Bob Chaffes, Hal Crane, Jim Fernane, the Herb Goodmans, the Bob Holdens, the Ed Jacobs, Steve Totti, and the Warren Zepps.

Herbert M. Goodman, Chairman

CLASS OF 1947

Rearrangement of the membership of the various classes immediately following World War II has established an official membership of 77 members for the class of 1947. Eleven classmates including Bill Rice, Carrol Burtner, Ed Swierz, Al Glazer, Don Thompson, Sam Ringel, Ed Lemieux, Norm Feldman, Ray Laferriere, Vince Zike, and John Hambor were fortunate to be on campus for the reunion activities.

At the Alumni Luncheon John Hambor presented Dr. Geo. Hazzard the Class Gift of $7,035 establishing "The Student Scholarship Fund of the Class of 1947." Later in the afternoon the class members had a delightful time at the Al Glazer homestead. Evening festivities included a cocktail hour and dinner at the fabulous Higgins Home. Honored guests of the class were Pres. Hazzard and Mrs. Hazzard, and Coach Charley McNulty and Mrs. McNulty.

John Hambor

CLASS OF 1957

The class of '57 began an active 15th reunion weekend with a cocktail party hosted by Fred and Shirley Barry on Friday evening, June 9th. After a sparsely populated class picture on Saturday morning, a class meeting was held with the principal topic of discussion being our 25th reunion class gift to WPI. Don Rising and Bob Yates presided over the meeting. It was agreed to implement a ten-year plan to raise a lump sum to be donated for a specific purpose. Al Papaioannou suggested the motto "Twenty-five for the Twenty-fifth" with reference to a twenty-five dollar annual donation each year until the twenty-fifth reunion.

After the alumni luncheon in Morgan Hall, the afternoon was spent touring the new campus, visiting local friends, or shopping at Spags! Prize winners for distance travelled to attend the reunion were George Klimchak from Florida and George Prozzo from Indiana. Most exciting job had to be Don Craig's. He is flying 727's for American Airlines. Some class members are self-employed, others in education, and many in industry—all doing well!

Saturday evening a prime rib dinner at Nick's Colonial Grille was followed by entertainment, dancing and socializing in the lounge. Those enjoying the evening were: Don and Marcia Rising, Bob and Sue Yates, Gerry and Cynthia Finkle, Al and Valerie Devault, John and Deanna Atchison, Paul and Marion Kerrigan, Bob and Arlene LeMay, Bill and Ann Rawstron, Herb and Mary Hemenway, Frad and Shirley Barry, Al and Marcia Papaioannou, Don and Nancy Craig, George and Ann Klimchak, George Prozzo, and Don Berth.

Alfred E. Barry, Chairman

1947

1952

1957

1962

CLASS OF 1962

The tenth anniversary of the Class of 1962 graduation was observed on Saturday, June 10, with relative moderation. Possibly a better choice of words would be that the occasion was met with a great burst of apathy by the class majority. Fifteen of the class total of 244 members attended the day's proceedings.

Fortunately numbers alone don't indicate the success of an occasion. For those who were present, the reunion provided good times and renewed friendships. Though most came from Massachusetts, Connecticut and New York, Dave and Judy Lyons drove up from Virginia to attend.

In the evening, fourteen couples joined for dinner at the Holiday Inn, downtown Worcester. At dinner and during the accompanying socializing, the whereabouts and goings on of each was learned. The evening was highlighted by a visit from President and Mrs. George Hazzard.

Those attending included Cliff Engstrom, Jay Fitzpatrick, Rudy Leistritz, Dave Lyons, Bill MacDonald, Pete Martin, Bob McIntosh, Spence Pooley, Paul Sharon, John Szymanski, Andy Terwilleger, Ed Weber and Dave Woodman. Verne Viele, who was on campus during the day with his family, was unable to attend the dinner.

Dick DiBuono, President

CLASS OF 1967

After a cocktail hour at the Higgins House, the Class of '67 had dinner at Putnam and Thurston's.

The stragglers then proceeded to the Penthouse for dancing 'til the wee hours of the morning.

In attendance were Mr. & Mrs. Roger Binkerd, Mr. & Mrs. Ronald Jolicoeur, Mr. & Mrs. Paul Kennedy, Raymond Fortin, Mr. & Mrs. Frank Manter, Mr. and Mrs. John Soulliere, and Mr. & Mrs. Peter Tallman.

COMPLETED CAREERS

WALTER T. GODDARD, '03

Walter T. Goddard died on January 13, 1972 following a long illness.

Born on January 19, 1880, he attended Webster (Mass.) High School and graduated as an electrical engineer from WPI in 1903.

After working as a graduate assistant at WPI, he joined the Locke Insulator Co. in Victor, N.Y. Later he founded the Canadian Porcelain Company, Ltd., Hamilton, Ontario, where he served as president for 46 years.

Always a faithful supporter of WPI, Mr. Goddard was a member of Sigma XI and also belonged to AIEE and the American Ceramic Society.

HAROLD B. LARNED, '05

Harold B. Larned, 89, of Glastonbury, Conn., passed away March 22, 1972.

He was born in Worcester in 1883 and graduated from WPI in 1905 as a civil engineer. For 47 years he was employed as a structural engineer with most of his work being centered along the Eastern Seaboard. In 1952 he retired from United Engineers and Constructors of Philadelphia, Pa. A life member of the National and Pennsylvania Societies of Professional Engineers, he also was active in the Darby Creek Joint Authority for Sewage Disposal, and as a member of the Academy of Natural Sciences and the Franklin Institute in Philadelphia.

L. BARRETT CAMPBELL, '07

L. Barrett Campbell, 87, of Waterbury, Conn., died November 24, 1971 following a long illness.

Born in Bridgeport, Conn., in 1884, he graduated from Worcester (Mass.) Academy and later studied at WPI.

Mr. Campbell, a life member of ASME, worked as a consulting and designing engineer for the American Chain & Cable Co., Inc., for 43 years. He was a member of Alpha Tau Omega Fraternity.

FRANK A. MARSTON, '07

A past president of the American Society of Civil Engineers, Frank A. Marston, passed away on February 22, 1972 in Gloucester, Mass. He was 86 years old.

He was born in Worcester, Mass. He received his degree from WPI in civil engineering in 1907. That same year he joined the Boston engineering firm of Metcalf and Eddy. He was a partner of the firm from 1920 until his retirement in 1966. His work was mainly in public water works and sewerage systems, for which he received wide recognition and the highest honors of his profession. In 1960 WPI awarded him an honorary Doctorate of Engineering.

Mr. Marston was past president of the Boston Society of Civil Engineers; a life member of the New England Water Works Association, the American Water Works Association, and the American Society of Testing Materials. A diplomate of the American Academy of Environmental Engineers and a Registered Professional Engineer in 14 states, he served as chairman of the board of engineers for the District of Columbia.

BRADFORD B. BINGHAM, '08

Bradford B. Bingham, 88, pendulum designer, passed away April 2 in Athol, Mass.

A native of Willimantic, Conn., he graduated from WPI as an electrical engineer in 1908. For over fifty years he was employed as a machine designer at United Twist Drill Division, UTD Corp., in Athol.

In 1964 he received national recognition for designing a version of a Foucault pendulum for clocks which kept time with remarkable accuracy.

FRED F. CHAPMAN, '09

Fred F. Chapman, 85, a retired assistant director of the technical division of the Du Pont Co., explosives department, died November 25, 1971 in Wilmington, Delaware.

He was born in Westfield, Mass. After receiving his BS in chemistry from WPI in 1909, he joined the Du Pont Co., where he remained until his retirement in 1951. His duties involved process work on chemical and explosives operations. During World War II he was involved in an advisory capacity in the development of explosives.

Mr. Chapman was a member of Sigma Alpha Epsilon and a 50-year member of the American Chemical Society and of the American Institute of Chemical Engineers.

ELWIN H. KIDDER, '09

Elwin H. Kidder died January 2, 1972 in LaPorte, Indiana.

He was born at South Wardsboro, Vt. He graduated from WPI in 1909 as a civil engineer. During his lifetime he worked with the Pennsylvania Railroad, the St. Lawrence Bridge Co., and Link-Belt Co. In 1942 he retired from his duties at the American Creosoting Co. in Chicago.

NORMAN B. POTTER, '09

Norman B. Potter, 85, a direct descendant of John Brigham, first settler of Northboro, Mass., died February 11, in Marlboro, Mass.

Potter began his banking career with the Commonwealth Trust Co. of Boston. He worked 40 years for the Worcester County National Bank, retiring in 1952. He also served as Northboro town treasurer and a director of the Northboro National Bank.

ERNEST W. BISHOP, '10

Ernest W. Bishop died on April 17 in Hamden, Connecticut. He was 84.

Born in Talladega, Ala., on October 14, 1887, he later studied at Mt. Hermon. In 1910 he graduated from WPI with a degree in mechanical engineering.

After working for the American Locomotive Co., Schenectady, N.Y., he joined the Western Electric Co., New York City, in 1917. He was a telephone specialist at the time of his retirement in 1952.

OTTO H. ESCHHOLZ, '10

Otto H. Eschholz of San Marino, Calif., passed away last winter at the age of 82.

He graduated from WPI in 1910 as an electrical engineer. He received his law degree from Duquesne University Law School in 1929 and was later admitted to practice before the Pennsylvania Courts, U.S. Supreme Court, and U.S. Patent Office.

Mr. Eschholz was employed by Westinghouse Electric and Manufacturing Company from 1910 to 1951. He made many

inventions relating to arc welding, circuit breakers, and transformers. Forty-eight patents were issued in his name. He retired as patent department manager in 1951. In 1936 he received the Westinghouse Order of Merit.

He was active in the Pittsburgh Chapter of the Alumni Association and a faithful supporter of the College.

FRANK W. GREEN, '10

Frank W. Green died March 20 in Clearwater, Florida. He was 85 years old.

Mr. Green was born in Lye, England. He graduated with a WPI degree in mechanical engineering in 1910. He worked for Technicolor Motion Picture Co., Heald Machine Co., and Telechron, Inc.

DONALD B. WHEELER, '10

Donald B. Wheeler, the retired president of Shipmark Co., Boston, died in Gloucester, Massachusetts on December 27, 1971.

He was born in Newtonville, Mass. He graduated from WPI in 1910 as a mechanical engineer. He was with Shipmark for forty years.

F. BERTRAM CLEVELAND, '12

F. Bertram Cleveland, 83, of Barrington, Rhode Island, died May 16, following a brief illness.

A native of Woonsocket, R.I., he was a member of Phi Gamma Delta fraternity.

For thirty years he was the owner and proprietor of the F. B. Cleveland Rubber Company in Providence. Later he was a sales representative for Barnes Rubber Co., Cranston.

Mr. Cleveland was a past president of the Rhode Island Chapter of the Alumni Association.

GEORGE R. BARKER, '13

George R. Barker, 80, died in Lawrence, Mass., on February 15 following a short illness.

A North Andover native, he graduated from WPI with a degree in electrical engineering. He was a member of Phi Sigma Kappa.

For more than 50 years he operated a dairy and produce farm.

A member of the New England Milk Producers Association since 1929, he was also a director of the Essex County Cooperative Farming Association.

VINCENT J. MLEJNEK, '13

Vincent J. Mlejnek, 79, died February 20 in Worcester, Mass.

For 46 years he was a quality control supervisor for the Graton & Knight Co. of Worcester. He retired 15 years ago.

His degree was in chemical engineering. He was a 50-year member of the American Chemical Society and past president of the American Leather Chemists Association.

GEORGE A. WIGHTMAN, '13

George A. Wightman of Bay Village, Ohio, died December 24, 1971, at the age of 80 years.

He was born in Holyoke, Mass., on June 6, 1891, attended Huntington High School, and graduated from WPI in 1913 as a mechanical engineer. For over 30 years, before his retirement in 1956, he was with the engineering division of the Associated Factory Mutual Fire Insurance Companies of Boston. A registered professional engineer of the State of Ohio, he also served in World War I.

BENJAMIN B. D'EWART, '15

Benjamin B. D'Ewart passed away at his home in Pasco, Washington, on January 30.

A Worcester native, he graduated as a civil engineer from WPI in 1915. He was a member of Phi Gamma Delta. A retired U.S. Army Lieutenant Colonel, he was president of the Franklin Soil and Water Conservation District and was on the board of directors of Bay Bend Electric REA.

ALFRED W. PRIDE, '15

Alfred W. Pride passed away April 6, 1972 in Oakland, Calif., at the age of 78.

For 37 years he was with the Westinghouse Electric Corporation. In 1959 he retired after having served as power transformer commercial engineer and division representative for five western states.

A member of Sigma Alpha Epsilon and Pi Tau Sigma, he was also a California State Professional Engineer and a Life Member of AIEE.

WILFRED D. CHAPMAN, '17

Wilfred D. Chapman of Secane, Pa., passed away recently at the age of 77 years.

After studying civil engineering at WPI, he accepted a position with the Providence Water Supply Board. He retired in 1958 from General Electric Company in Philadelphia, Pa.

A member of Phi Sigma Kappa, he was also a licensed professional engineer.

STANLEY G. CHILSON, '17

The official police photographer for Franklin, Mass., Stanley G. Chilson, died March 17 in Wrentham. He was 81 years old.

After attending Dean Academy and WPI, he devoted most of his life to photography. He was official fire photographer in area towns, and his films are well known to the Boston Firefighters Association.

RAYMOND H. SHAW, '18

Raymond H. Shaw, 77, passed away April 26, in Rutland, Vermont.

From 1916 until his retirement in 1959, he worked as a senior toll testman for New England Telephone and Telegraph Co. His interest in electronics led to his being one of the several East Coast crystal radio operators who heard the cries for assistance from the ocean liner Titanic, which struck an iceberg off the coast of Newfoundland and ultimately sank in April of 1912.

EDWARD J. P. FISHER, '21

Edward J. P. Fisher passed away on January 26, 1972 in Riverside, California.

Professor Fisher was born in Berlin, Germany and graduated as a chemical engineer from WPI in 1921.

He was the recipient of the Wire Association Award in 1933 and was a practicing metallurgical consulting engineer. During his 22 years with the Youngstown University (Ohio) he established the department of metallurgical engineering and was chairman from its inception. A member of Lambda Chi Alpha, Prof. Fisher was also an active member of the Wire Association, American Society for Metals, and the American Ordnance Association.

RALPH G. NOURSE, '22

Ralph G. Nourse of Providence, Rhode Island, passed away January 3 after an extended illness.

Mr. Nourse, who was retired, was the former owner of the Carter Insulation Co., Providence.

DANA S. GREENLAW, '24

Dana S. Greenlaw, 72, passed away on April 1 in St. Petersburg, Fla.

An electrical engineering graduate of WPI, he was a former district manager with Sonotone Corp.

Shortly before his death, Mr. Greenlaw had written a book on printing for amateurs. He set all the type and made all the illustrations himself, and privately printed it on his own press in an edition of 30 copies. One of those 30 is now in the WPI Library.

JOHN N. STYFFE, '24

John N. Styffe, the retired Director of Building for S. H. Kress & Co., New York City, died in February at the age of 72.

His degree in civil engineering from WPI led him to jobs with Eastern Bridge and Structural Co., Worcester; Scofield Engineering Co., Los Angeles, Calif.; Aberthaw Construction Co., Boston; and Post & McCord, New York. He retired in 1959.

Mr. Styffe, who was active as a WPI Alumni Council representative, and former treasurer of the New York Chapter, was a member of Phi Sigma Kappa Fraternity and a corporate member of the American Institute of Architects.

VICTOR CARADONNA, '25

Victor Caradonna, 70, passed away on February 14, 1972 in Toms River, N.J.

After graduation from WPI he joined the Consolidated Edison Co., New York City, where he worked until his retirement. During World War II he served in the Navy Engineer Corps in Africa and Italy.

ELLSWORTH B. CARPENTER, '27

Ellsworth B. Carpenter, 67, a retired railroad supply executive, died April 19 in Kirkwood, Mo., after a long illness.

From 1927 until 1959 he was associated with ACF Industries (formerly American Car & Foundry Co.) as vice president in charge of eastern region sales. He then joined Alco Products, Inc. (American Locomotive Co.) as sales manager of the spring and forge division until his retirement in 1970. Mr. Carpenter was also vice president and director of Utility Service and Maintenance, Inc., Clayton, Mo.

JAMES C. ROGERS, '27

James C. Rogers, the former superintendent—fire training for the Vocational Educational and Extension Board, Nassau County, New York, died March 18, 1972.

He was born in Webster, Mass. His WPI degree was in mechanical engineering. Mr. Rogers served Nassau County in a variety of positions for many years. Previously he was a plant engineer for the New York Telephone Co., and a designer for the Curtis Aeroplane Co.

A member of Phi Sigma Kappa, he also belonged to the National Fire Protection Association.

JOHN F. WOOD, '27

John F. Wood of Newton Center, Mass., passed away suddenly December 26, 1971.

An electrical engineering graduate, he worked as a financial analyst with Sheraton Corp. of America, Investment Trust of Boston, and ITB Management Corp., Boston.

He was a member of Phi Sigma Kappa Fraternity.

DWIGHT E. JONES, '28

Dwight E. Jones, 67, a former WPI trustee and retired vice president of the Jones Division of Beloit Corp., Pittsfield, Mass., died April 26, 1972 in Arcadia, California.

Mr. Jones was born in Otis, Mass. During his years at WPI he worked summers at the Jones paper machinery mill. After he received his degree in mechanical engineering, he was assigned to special cost analysis work. Working his way up the ladder, he became chief engineer and director in 1939. In 1953 he was made vice president and in 1956, he was elevated to executive vice president.

He was issued 15 patents on ideas he developed for improvements in equipment manufactured by the company. He wrote a number of technical papers and a history of the Jones company.

Active in civic affairs, he was the former chairman of the Pittsfield Sewer Commission; director and president of the YMCA; director of the Girls Club; and past president of the Y Men's Club. He also belonged to the Kiwanis and Rotary Clubs. In 1959 he received the annual civic award of the South Congregational Church Brotherhood. Professionally he was a member of ASME, TAPPI, Tau Beta Pi, and Sigma XI. Last winter he was honored by being elected a WPI Trustee Emeritus in recognition of his active service on the Board from 1956 to 1966.

HAROLD L. PARTRIDGE, '28

Harold L. Partridge, 66, who recently retired as chief chemical engineer at Picatinny Arsenal, Dover, N.J., died April 25, 1972 in Newton, New Jersey.

He graduated from WPI as a chemical engineer.

Prior to his association with the Picatinny Arsenal, he had been located at various arsenals and chemical installations at Washington, Pa., Weldon Springs, Mo., and Tamaqua, Pa.

ALLEN HASTINGS, '29

Allen Hastings, 67, died May 6 at his home in East Douglas, Massachusetts.

Mr. Hastings was a design engineer at Collins Brothers Machine Co., Pawtucket, R.I.

LOTHAR A. SONTAG, '29

Lothar A. Sontag died April 17, 1972 in Tonawanda, New York. He was 64 years old.

Born in Clinton, Mass., he graduated from WPI as a chemical engineer. For many years he was with Hooker Chemical Corporation, Durez Plastics Division, North Tonawanda, N.Y. A senior research scientist, he was credited with making major contributions to the success and growth of the plastics industry. A holder of six patents issued to Durez, he produced the first mobilator, a patented device for accurately measuring critical flow of phenolic resin materials in molding operations. He also developed the "cup test" for measuring the flow or plasticity of molding compounds, a test that was adopted for the industry by the American Society for Testing Materials and which is still a standard.

Mr. Sontag retired in 1970. He was a member of Sigma Xi, ACS, AIC, ASTM and the Masonic Order. Active in the Alumni Association, he was formerly president of the Western New York Chapter and was also an Alumni Council delegate.

WARREN C. WHITTUM, '30

Warren C. Whittum, former president of the WPI Alumni Association and a WPI trustee, passed away February 17, in Derby, Conn. He was 63 years of age.

Mr. Whittum was born Dec. 20, 1908 in Worcester, Mass. He attended North High School and graduated from WPI in 1930 as a civil engineer.

Until retiring several years ago, he had been employed as director of engineering development for the Farrel Co., Ansonia, Conn., and later as director of development and research for the City of Ansonia.

Mr. Whittum was past president of the Ansonia Community Chest, the Ansonia Rotary Club and YMCA, and the Housatonic Council of the Boy Scouts of America. He was a director of the Ansonia Water Co. and the Savings Bank of Ansonia. He was also an honorary trustee of Griffin Hospital in Derby, a member of the Graduate Club of New Haven, Sigma Alpha Epsilon, Tau Beta Pi, and Sigma XI.

CLARENCE W. ASHCROFT, '41

Clarence W. Ashcroft of Massapequa, L.I., New York, died December 25, 1971.

Born in Lynn, Mass. on November 2, 1918, he graduated from Tilton (N.H.) Academy and later attended WPI.

He was formerly with the Prebuilt Company.

CAMERON F. CAMPBELL, '48

Cameron F. Campbell of Elizabethtown, Pa., passed away January 6, at the age of 44 years.

Mr. Campbell, an associate member of AIEE and AISE, was an electrical engineer at the Naval Ship Engineering Center, Mechanicsburg Division, Standardization Branch, Mechanicsburg, Pa.

GORDON E. HALL, '48

Gordon E. Hall of Barrington, Rhode Island, passed away April 14 at the age of 50.

He was chairman of the mathematics department at St. Andrews School, Barrington. Previously he had been a resident master of Laurelcrest Preparatory School, Bristol, and the owner-director of Creative Services, a commercial art agency in Hartford. He had also been with The Factory Insurance Association.

A member of Phi Sigma Kappa and Pi Delta Epsilon, he also had served as councilman for the Town of Paramus, N.J., and on the Mayor's Committee for Youth in Hartford.

THOMAS J. McNAMARA, '50

Thomas J. McNamara passed away on November 26, 1971 at Memorial Hospital in Worcester, Mass. He was 42 years old.

Born in Worcester, he graduated from WPI with a degree in electrical engineering.

Mr. McNamara, a member of Phi Kappa Theta and Eta Kappa Nu, was a sales engineer for Machinery Electrification, Northboro, Mass.

SIDNEY J. LAINER, '58

Sidney J. Lainer, 43, died in Longmeadow, Massachusetts on February 9.

He was an electronics engineer at Hamilton Standard and later at the Springfield (Mass.) Armory for six years.

EMERY G. SWARTZ, SIM '67

Emery G. Swartz, 59, manager of manufacturing engineering for Crompton & Knowles Corp., Burlington, North Carolina, died April 4, 1972.

He was born in Pennsylvania and was educated at the University of Kansas, Pennsylvania State University, Swarthmore College, and WPI's School of Industrial Management.

Until last fall he was with Crompton & Knowles in Worcester where he began as chief tool engineer in 1961. Previously he was with Curtiss-Wright Research Division, Westinghouse Aviation Gas Turbine Experimental Division, and Westinghouse Electric Corporation's Aviation Gas Turbine and Steam Turbine Divisions.

YOUR CLASS AND OTHERS

NOTICE!

Items appearing in Completed Careers and Your Class and Others are based on information received at the Alumni Office by June 1, 1972. Deadline for the October issue is August 1.

1908

"Although they are not as noisy as they used to be, the Class of 1908 claims they have not reached the point where they can be placed in the category of extinct species of Techmen," writes DONALD D. SIMONDS, secretary. "There are only 16 of us now left, including ELLIOTT A. ALLEN, who for years has been listed in the Alumni Directory as 'address unknown,' " he continues. "1908 is getting nearer the front of the Directory each year, but that doesn't bother us for we were always up front."

Every Sunday afternoon for the past six years Don Simonds has been calling on HERBERT P. SAWTELL at the Lincoln Nursing Home, 299 Lincoln St., Worcester, Mass. 01605. (He admits that perhaps his attendance there has been more regular than at church.) Don says Herb would greatly appreciate receiving a card or letter from his classmates even though a stiff hand would prevent his writing a reply. Herb spends most of his days in a wheelchair solving crossword puzzles, reading and listening to the radio.

RICHMOND W. SMITH, who had seven children, now has twenty grandchildren and eight great-grandchildren. "Can any other class compete with these figures?" Don asks.

1910

F. LELAND HEWES writes that he and his wife Mildred are kept busy sitting with grandchildren and great-grandchildren. The latest addition to his family is a great-grandson, David Leland Hanket, born in Newton, Mass. in May of 1971. Fred says he still drives but tires after 200 miles. After a 200-mile drive, who doesn't? . . . "HAP" MARTIN has reported to class secretary CHARLES E. BARNEY that he is no longer called "Hap"—now it's "Jerry." However he will always be "Happy" Martin to 1910 men.

1912

Through Mrs. HERBERT F. TAYLOR we have learned of the death of Mrs. JAMES W. CUNNINGHAM on February 27, 1972 in North Carolina. Mr. Cunningham, who passed away in 1961, was president of the Alumni Association from 1941 to 1943 and a member of the board of trustees from 1945 to 1955.

1914

WILLIAM H. MELLEN, under the sponsorship of the National Huguenot Society, will take a six-week jaunt through England and France this fall—and all because he has devoted his lifetime to tracing his family tree. During his lifetime search he has discovered that he is a descendant of the signers of the Magna Charta in 1215, William the Conqueror, Charlemagne, and 21 American patriots indluding John Alden of the Mayflower and colonial clergyman Roger Williams. During his fall trip he hopes "to catch up with some loose ends and fill in the gaps in the family tree."

1921

After wintering in Palm Beach, Fla., EARL B. PICKERING has returned to his home on Old Gibson Rd., New Ipswich, N.H.

1923

ERWIN H. MATTSON has retired as manager of the Union Furniture Co., Worcester. . . . ALBERT H. PENDLETON has retired as a partner of Pendleton, Neuman, Williams & Anderson, Chicago, Ill. He will continue in active practice as counsel to the firm. . . . After 44 years of service, JOHN H. TSUI has retired from his duties at Westinghouse Electric Corp., Sharon, Pa.

1924

EDWARD H. GOODRICH has been awarded the first Red Shield Award ever presented by the Bristol (Conn.) Salvation Army. Mr. Goodrich, who retired in 1965 as the attorney in charge of the Bristol office of General Motors patent section, has been active in working with the Salvation Army Advisory Board. The Red Shield Award is presented to an "outstanding member of the community in recognition of faithful and efficient leadership." Mr. Goodrich has also served the Chamber of Commerce; Clock Museum; Kiwanis Club (as president and secretary); the Boy Scouts (for which he received the Silver Beaver Award); and the First Congregational Church (as deacon and past president of the Men's Service Club).

1926

CHARLES B. HARDY, superintendent of the Worcester Bureau of Water and a deputy commissioner in the Dept. of Public Works, retired Aug. 1. He has been superintendent since 1942 and was named a DPW deputy two years ago. He joined the Worcester DPW in 1930 after having served 12 years with the Bureau of Sewers. City Manager McGrath said that Hardy "has been a credit to the city—He has an established reputation as one of the best water engineers in the state." . . . CHARLES M. HEALEY, JR., has been presented the Harry J. Graham Memorial Award in appreciation of his devotion to the purchasing profession by the Purchasing Management Association of Boston. Healey, who is currently the executive director of the Holyoke Taxpayers Association, was the Springfield (Mass.) Purchasing Agent for 22 years. He is the first municipal purchasing official to receive the Graham Award and is also the first person outside the Boston area to be named. In 1967 he won the William Pynchon Award for distinguished civic service while the previous year he received the Boy Scout Silver Antelope Award. He was the first Scouter in the U.S.A. to receive the St. George Cross, the highest religious award the Catholic Church bestows on a Scout. . . . C. HAROLD NORDSTROM, retired as staff director of planning and control in the government products group of Avco Corporation, is now the permanent chairman of the Massachusetts Business Task Force for School Management, Inc. The Task Force, which is made up of 33 top business executives, has studied the business aspects of more than 200 school departments, including Worcester, on a voluntary basis. Mr. Nordstrom, as chairman, is convinced that the principal answer to soaring public school costs lies in the adoption of modern business techniques by school administrations.

1929

IRVING H. CAMPBELL, formerly with the U. S. Envelope Co., Worcester, has retired. . . . STEPHEN D. DONAHUE, business and financial editor of the

HAT IN THE RING

Who says you have to be a lawyer or a political scientist in order to be a winner in politics?

If David F. Emery, EE '70, had believed that old chestnut, he wouldn't have run for a seat in the Maine State House of Representatives—so, of course, he couldn't have won. But he *did* run and he *did* win after defeating a 22-year veteran incumbent in the primaries by the amazing margin of nearly 2 to 1.

Dave, a communications equipment engineer, has been involved in Republican politics in his home town of Rockland since he was 15. In 1968 he attended the Republican convention in Miami.

Now a duly elected representative, he is especially interested in the problem of state property taxes and has done much research in preparation for his presentation next year of a bill to revamp the present system.

Already with an eye on the future, he plans to campaign again next term, and if reelected he hopes to run for the position of house majority leader. If all goes well in this venture, he would be pleased to try for a U.S. House seat in 1974.

David Emery's political future appears to be bright, indeed.

Another EE, Edwin F. Nesman, '55, currently a staff engineer at EG & G, Inc., Bedford, Mass., was recently elected to the Bolton School Committee. A member of the Bolton Citizens Association for three years and chairman for the past two, he also served as financial secretary of the school building committee during the construction phase of a one-million dollar addition to the Emerson School.

A former design engineer for the General Electric Company, high school science teacher, and present director of science for the Braintree (Mass.) Public Schools, was a successful candidate for a seat on the Georgetown School Committee last spring. Dr. Charles A. Woodman, PH, '48, the newly elected committee member, believes that local control of the schools should be preserved to the fullest extent permitted by law and that "we must maintain a balance between desirable educational programs and facilities and the ability of the town to pay for them."

Paul W. Snyder, Jr., '53, has been elected to the Pitman (N.J.) Board of Education. After the election he said, "We will try to do what we can to provide the best possible education within the limits of our tax capabilities." Paul is with Mobil Corp., Paulsboro, N.J., as R & D manager.

In the November elections Marcus A. Rhodes, Jr., ME, '40, treasurer and assistant manager of M. M. Rhodes & Sons, Taunton, Mass., won his 6th term on the Taunton School Committee, while antiques dealer, Sturgis A. Sobin, '48, won his first full term as Mayor of Ansonia, Conn.

So, a growing number of WPI men are channeling their lives into public service and meeting a variety of challenges. They are winners—in every sense of the word.

Worcester Evening Gazette, has retired after more than 40 years as a reporter and editor. While he was a student at WPI he began his newspaper career as a campus correspondent for the *Worcester Telegram*. In 1931 he accepted a full-time reporting job with the *Evening Gazette*. While serving as city editor, his home was destroyed by the 1953 Worcester tornado. The next day he wrote a first-person account of his impressions of the disaster which won second prize in the New England Associated Press News Executive Association contest. In 1959 he was awarded the certificate of recognition for the Continental Air Command for his services in the Air Force Reserve, from which he retired with the rank of colonel in 1967. Mr. Donahue is Director of the WPI News Bureau. . . . J. KENDALL FULLERTON has retired from his position as eastern sales manager for the Simonds Saw & Steel Division, Wallace Murray Corp. . . . GEORGE V. KENNEDY, former manager of the Massachusetts Electric Co. Division in Leominster, was honored at a retirement dinner given in Shirley in March following his 43 years of service with the company. The 225 persons present at the testimonial dinner saw him presented with a chain saw from his associates, a citation from the state House of Representatives and a plaque given in recognition of his wide range of community service from the Mass. Dept. of Commerce. . . . EDWARD E. LANE works as regional manager for NAPCO Graphic Arts, Inc., Milwaukee, Wis.

1930

HERBERT W. DAVIS has retired as vice president, research, Triumph Machinery Co., Hackettstown, N.J. Now he serves as vice president, product development, Brunt Equipment Co., Mt. Holly, N.J. . . . ALLAN L. HALL reports that he has retired after 32 years with the U.S. Post Office Dept., Portsmouth, N.H. . . . DANIEL S. HORGAN, SR., chief engineer of the (Mass.) State Department of Public Works, was the keynote speaker at the March testimonial held in Framingham for retired DPW Commissioner, Harry P. Loftus. Horgan, a personal associate of Loftus for over 25 years, has served 42 years with the Commonwealth since graduating from WPI. Recently he received the seventh annual Booster Award given by the Auburn (Mass.) Chamber of Commerce. The award is presented to an Auburn resident who has given outstanding service to the community. Horgan was active in Boy Scouting for over 30 years. In 1947 he became the first president of the Auburn High School PTA. He has served as a commissioner of the Auburn Water District and on the local Board of Appeals . . . JOHN J. LYONS is the new deputy chief engineer for highway maintenance for the Mass. Dept. of Public Works. He will be responsible for the maintenance of all state highways and bridges, including snow removal, roadside development, signs, and signalling, as well as procurement and upkeep of highway equipment. A veteran of 43 years with the DPW, he has been serving as the department's research and materials engineer. . . . WARREN R. PURCELL was a staff member at the 17th Annual Practical Statistical Engineering Institute held in June at The University of Connecticut, Storrs. Purcell has been a factory engineer, quality control supervisor, and quality control manager for the Brown Company. Until recently a private consultant, he is now chief of Reliability Engineering and Quality Control for Raytheon.

1932

Vice Admiral FRANCIS J. BLOUIN, US Navy (ret.), has been chosen Grand Marshall for the Northbridge (Mass.) Bicentennial Parade slated for July 16. Admiral Blouin, during 36 years of commissioned service, saw duty with the Chief of Naval Personnel; Commander in Chief, U. S. Pacific Fleet; Chief of Naval Operations; and with the Joint Chiefs of Staff. In June 1968 he became Deputy Chief of Naval Operations after having served as Commander of the Pacific Fleet Amphibious Force. . . . JOHN NIZAMOFF writes that he has time for reading and gardening now that he is retired from Engelhard Industries, Newark, N.J. He spends the summer months at the Jersey Shore.

1933

The former president of Mills Pharmaceuticals, Inc., and Glencoe Research, Inc., St. Louis, Mo., DR. HERMAN W. DORN, is now the owner and director of Dorn & Co. (food and drug consultants), of Glendale, Calif. . . . GEORGE W. NICOLETTI serves as regional manager for Gibbs Wire & Steel Co., South Bend, Indiana.

1934

GORDON S. CRUIKSHANK is the new vice president of Gregory & Appel, Indianapolis, Ind. He has spent 36 years in the insurance business. Until his promotion he served as secretary of the firm. . . . LUTHER C. LEAVITT, former president of The Otto Konigslow Mfg. Co., Cleveland, Ohio, has been elected vice chairman of the board of the company.

1935

ALFRED CANTOR serves as West Coast area manager for FLUOR Ocean Services,

Inc., Santa Barbara, Calif. . . . THEODORE D. McKINLEY, a pigments department research supervisor at Du Pont's Experimental Station, Wilmington, Del., has been elected president of the Electrochemical Society, Inc. He has served as vice president twice and five terms as a member of the organization's board of directors. The society is devoted to the advancement of electrochemistry, electrometallurgy and electronics. Its membership of 5,000 is drawn from scientists associated with industry, education, and government. . . . GEORGE H. PERRY has been named manager of finance for the Warner & Swasey Co., Grinding Machine Division. It is a newly created position at the Worcester plant, which was recently purchased from Norton Co. Previously, Perry was controller of the division for Norton.

1936

ROGER W. BRUCE has been named to the Worcester City Planning Board. Now retired, he was formerly general superintendent of the Worcester Works of U.S. Steel Corp.

1937

ERVING ARUNDALE has retired from his position as president of Esso Research in Europe and is currently living in South Yarmouth, Mass. . . . MORTON S. FINE has formed a new company, Morton S. Fine & Associates, Inc., in Bloomfield, Conn. It is an engineering, surveying, and landscape architectural firm. Mr. Fine is also the present chairman of the Hartford Conservatory of Music. . . . A. HAMILTON POWELL holds the post of director of engineering, Arrow-Hart, Continental Division, Florence, Ky.

1938

JOHN G. DESPO has been promoted from director of engineering to vice president-engineering of Granite City Steel Company, Granite City, Ill. Mr. Despo went to Granite City Steel, a subsidiary of National Steel Corporation, in 1970 as director of engineering in charge of the Engineering Dept. Previously he was manager of construction for the Chicago District of United States Steel Corporation. Before joining U. S. Steel he was with the Massachusetts Highway Dept. and Metropolitan Boston Water Supply Commission. . . . DR. JOHN B. SCALZI, coordinator of the engineering program at Research & Technology, U. S. Dept. of HUD, Washington, D.C., resides in Arlington, Va.

1939

JACK F. BOYD writes that he is semi-retired as chairman of the board of the Nashua (N.H.) Brass Co. . . . DR. DONALD M. BURNESS has been appointed as a senior research associate in the organic research laboratory at the Kodak Research Laboratories, Rochester, N.Y. He joined Kodak in 1939 as a chemist in the synthetic chemicals division and in 1942 participated in a national defense research program at the University of Illinois. In 1945 he returned to Kodak as a research chemist. He was appointed a research associate in the chemistry division of the Kodak Research Laboratories in 1956. . . . EDWARD C. DENCH, a Raytheon Company engineer, is the inventor under a recent patent assigned to the company of a cold cathode traveling wave tube with improved operating characteristics. Traveling wave tubes are used in microwave radar communication and other electronic systems. The inventor has been a staff consultant in Raytheon's Microwave and Power Tube Division in Waltham, Mass. for 24 years. A member of Sigma Xi and Tau Beta Pi, he holds more than 60 patents on microwave tubes and in associated fields. . . . CARL W. LEWIN has been named president of the International Division of The Austin Company, Cleveland, Ohio. Previously he was vice president and sales manager responsible for coordination of sales activities of the company's overseas subsidiaries. Mr. Lewin joined the company in 1940 as an assistant project engineer in the Chicago district where he played an important role in the development of many major Austin projects in the middle west. He is a member of the American Society of Chemical Engineers and the American Management Association. . . . HAROLD E. WHITE was recently appointed general manager of the Bonded Products Division of Norton Abrasives Ltd., England. White joined Norton in 1946 as an engineer and later was director of manufacturing for the Abrasives Materials Division, Worcester.

1940

WILFRED T. BLADES has retired as works supervisor, process control, at American Steel & Wire Co., Worcester. . . . The first administrator for Atlantic County, N.J., is ROBERT J. CANNON. In his newly created position, Cannon will be working for the county Board of Freeholders. He has spent the past 29 years in federal engineering services.

Despo '38

Burness '39

Lewin '39

1942

ERIC W. ESSEN, former executive assistant to vice president of manufacturing for the L. G. Balfour Co., Attleboro, Mass., has joined General Business Services as an area director responsible for activities in Attleboro, North Attleboro, Easton, Norton, and Mansfield. . . . PAUL YANKAUSKAS is with Thermco Products, Orange, Calif.

1943

S. BAILEY NORTON, JR., has been named a director of Daniel O'Connell's Sons, Inc., building contractors, of Holyoke, Mass. He is general manager of Acme Chain Division of North American Rockwell Corp., Holyoke. . . . ROBERT S. SCHEDIN, former director of engineering for Crompton & Knowles Corp., Worcester, has been named vice president of Fairlawn Hospital. He will be responsible for preparing and implementing a plan to enlarge the hospital's service to the Worcester community.

A technology breakthrough that could reinvigorate the SST-less aerospace industry has come from the planning board of Dr. RICHARD T. WHITCOMB, '43, the NASA scientist who discovered the "Coke bottle shape" design that made supersonic flight practical in the 1950's.

Because of his vision, jet airliners may someday cruise 20 per cent faster on the same amount of power. Promise of this bonus in speed comes from NASA's supercritical wing, which Whitcomb designed. The prototype has been installed on a Navy F-8 jet and test flown successfully during the past year. The basically new airfoil shape permits aircraft to fly at increased speeds before encountering a significant rise in aerodynamic drag.

Theoretically, jet airliners that cruise at about 550 m.p.h. will be able to fly considerably closer to the sonic barrier, gaining over 100 m.p.h. without having to use more powerful engines. This would shave at least two hours off an eight-hour flight.

The innovative wing is flatter on top than are conventional wings, and has a curved trailing edge. As an extra bonus, engineers have found that it can be thicker, allowing more fuel to be carried and thereby increasing the range of the aircraft.

The Whitcomb wing may help the U. S. aerospace industry get firmly back onto its feet again.

1944

"Electric Power and a Clean Environment—Can We Have Both?" was the title of the talk given by JOHN W. LEBOURVEAU at the March meeting of the International Management Council's Zone 52 Chapters held in Taunton, Mass. Lebourveau, who is manager of environmental research for the New England Electric System, is responsible for technical programs of environmental effects evaluation for the Massachusetts Electric Co., the New England Power Co., and the Narragansett Electric Co. . . . WALLACE A.

UNDERWOOD is sales manager for Marshall Marine Corp., South Dartmouth, Mass.

1945

JOHN A. TEMPLETON holds the position of senior staff engineer with TRW Systems Group, Norton Air Force Base, San Bernardino, Calif.

1946

Principal engineer at Westenhoff & Novick Consulting Engineers, Wheaton, Ill., is ALFRED J. WOOD.

DONALD H. GILMORE has been appointed sales manager of Rodney Hunt Company's water control equipment division in Orange, Mass. The division produces sluice gates and related equipment for water pollution and flood control projects. A former research assistant at WPI's Alden Hydraulic Laboratory, Gilmore joined Rodney Hunt in 1952 as a technical sales engineer in the water control equipment division. Prior to his recent promotion, he had held a number of managerial posts with the company.

FRANK L. MAZZONE serves as vice president and general manager of Acres American, Inc., an engineering and consulting firm that is currently moving from Niagara Falls to new quarters in Buffalo, N.Y.

1947

DR. MORREL H. COHEN, University of Chicago professor in the James Franck Institute in the Departments of Physics and Theoretical Biology and in the college, has been appointed the Louis Block Professor of Physics and Theoretical Biology. Cohen, who has written more than 125 research

Cohen '47

Shupp '47

publications, joined the university as an instructor in 1952 and became a full professor in 1960. From 1968 until last year he was director of the James Franck Institute, an association of scientists with primary interests in the study of chemical physics and solid-state physics, especially the condensed states of matter. He is a former Guggenheim Fellow and National Science Foundation Senior Postdoctoral Fellow. Currently he is a Fellow of the American Physical Society and a member of Sigma Xi. . . . ROBERT C. MARK is manager, new plant/non-union relations for the corporate employee relations staff at General Electric Co., New York City. . . . GEORGE A. SCHUPP has been elected vice president and chief engineer, color TV products, for Zenith Radio Corporation, Chicago, Ill. He joined Zenith in 1966 as staff assistant to the vice president and chief engineer. He was named director of television engineering in 1971 and chief engineer, color TV products, earlier this year. Previously he was vice president and director of operations for Trans-American Electronics, International, Inc. For three years, he was chief engineer of the Magnavox Company. He was with G. E. from 1948 to 1963. . . . Scan-Optics, Inc., East Hartford, Conn. has announced the appointment of DONALD B. THOMPSON as board chairman, president and chief executive officer of the company. After 20 years in the computer industry, Thompson comes to the firm from Potter Instrument Co., Long Island, where he was vice president and a member of the board of directors. Prior to joining Potter in 1968, he spent 17 years with IBM holding positions in advanced systems design and general management. Scan-Optics, which he now heads, produces optical character recognition systems.

1948

ROBERT H. ADAMS has been appointed manager of the Home Entertainment Strategic Planning Operation for the General Electric Company. His office is located at Operation headquarters. . . . ERNEST P. FERNSTEN serves as airways facilities sector manager for the Federal Aviation Administration at Buffalo (N.Y.) International Airport. . . . ROBERT W. HENDERSON has been promoted to vice president of marketing at Rodney Hunt Co., Orange, Mass. Mr. Henderson will be responsible for the sales activities of its water control equipment division, textile machinery division, international sales division, industrial rolls division and advertising. In 1956

ALUMNI TRUSTEES

Fyler '45

Smith '37

Bonin '38

Anson C. Fyler, '45, J. Morrison Smith, '37, and Charles C. Bonin, '38, Alumni Council nominees for the WPI Board of Trustees, were elected to serve as board members June 3.

Fyler, who was elected to his first five-year term as trustee, is chairman of the board and president of Arrow-Hart, Inc. (manufacturers of electrical wiring and controls), Hartford, Conn. He is also director of Veeder Industries, Connecticut Bank & Trust Co., and Phoenix Mutual Life and the Manufacturers Association of Hartford County. A resident of West Hartford, he is married and has two sons.

Smith, also a first-term trustee, is president of National Radio Institute (electronics school), Division of McGraw Hill, Inc., Washington, D. C. He is an officer and founder of the Macamor Foundation of Washington; chairman of the Providence Savings and Loan Association; and a director of the Washington Society for the Blind, Washington YMCA, and Capital Radio Engineering Institute. He is the son of James E. Smith, '06 and the uncle of Michael Galbraith, '58. Married and the father of four children, Smith resides in McLean, Va.

Bonin was reelected to his second five-year term on the Board of Trustees. He is president of Chemical Construction Corporation, New York City, a subsidiary of Boise Cascade Corporation. Since joining Chemico he has been involved in the engineering and erection of plants valued at more than one billion dollars in the United States and around the world. He is the only professional engineer to hold engineering licenses in all the 54 states and territories. A member of the Executive Committee of both the Board of Trustees and the Alumni Association, he is married, lives in Mendham, N.J., and is the father of two children.

Fifteen WPI trustees who have at various times served on the board with distinction were elected to the newly created position of Emeritus Trustee at the winter meeting of the Board of Trustees.

Following the election, Pres. Hazzard said, "We are pleased that we can continue to enjoy the wise counsel of these men. We look forward to their giving continued leadership and support to WPI."

Those elected were: J. Norman Alberti, '24; Phillip R. Delphos, '26; Sidney W. Farnsworth, '06; Dr. William E. Hanson, '32; Frank C. Harrington, '98; Chandler W. Jones, '26; Dwight E. Jones, '28 (Deceased April 1972); Arthur W. Knight, '29; Harry B. Lindsay, '13; Burton W. Marsh, '20; Charles R. Michel, '37; Arthur Nutt, '16; Warren W. Parks, '17; George W. Smith, Jr., '15; and George A. Walker, '22.

he joined the firm as an application engineer. In 1962 he advanced to product manager and to division manager two years later. He was elected vice president and manager of the water control equipment division in 1970.

1949

ROBERT W. BATCHELDER has been appointed as a vice president of Johnson & Higgins of Pennsylvania, Inc. (International insurance brokers and employee benefit consultants). He joined the Philadelphia office in 1964 and became an assistant vice president in 1967. He has been a senior account executive in the commercial department. . . . KARL R. BERGGREN, JR., is manager of quality control for Buffalo Forge Company, Buffalo, N.Y. . . . Capt. JAMES B. MORIN, USN, is commanding officer of the USS LaSalle, an amphibious transport dock of the Atlantic Fleet. In June Capt. Morin was slated to take the LaSalle to the island of Bahrain in the Persian Gulf, where she will become the flagship for the Commander, Middle East Forces. The LaSalle will be the U.S. Navy's only representative in that part of the world. . . . LEO D. ROSE has recently joined Baldwin Stewart Building Systems in North Haven, Conn., where he is active in sales promotion, public relations, engineering and "design-build" contracting. He is the current president of the Connecticut Building Congress, Inc. . . . ROBERT A. ROWSE has been named director of research and furnace plants for the Norton Co. Abrasives Division, Worcester. Formerly he was director of research. . . . ELLSWORTH M. SAMMET has been promoted to District One Construction Engineer at the Lenox (Mass.) office of the State Dept. of Public Works. Previously he served as the District Two Maintenance Engineer at the Northampton office.

Batchelder '49

McComiskey '51

1950

Married: ROBERT L. TAGEN and Miss Marie Leonne Couture in Gardner, Massachusetts on March 24, 1972. Mrs. Tagen is assistant treasurer of The Gardner News, Inc. Her husband is a media salesman with J. Bain, Inc.

LESTER J. REYNOLDS has been appointed manager for textile dyes and textiles at the American Cyanamid Company, Bound Brook, N.J. With Cyanamid since 1956, he was most recently manager of marketing research in the commercial development department. . . . A. KENNETH STEWART has been named general manager of Bendix Corporation's abrasives division in Jackson, Michigan.

1951

ROBERT W. BALDWIN is currently employed by the New York Division of AMF Incorporated, York, Pa., as a sales representative. . . . DEXTER E. CATE, a former electrical engineer with Raytheon in Portsmouth, R.I., manages a new branch of The Reed Elwell Real Estate Agency in Tilton, N.H. He received his New Hampshire realtor's license last November. . . . NORRIS H. COREY has been advanced from system operator to chief system operator at the REMVEC Facility of the New England Electric System. He was one of the original system operators at the facility. . . . THOMAS A. McCOMISKEY has been appointed as manager of construction in the western district of Bethlehem Steel Corporation's fabricated steel construction department. In his new position he will be headquartered at the firm's Pinhole Point fabricating works near Richmond, Calif. Previously he had been project engineer in Bethlehem Steel's Central erection district in Leetsdale, Pa. . . . Capt. CHARLES G. DARRELL, USN, is director, underseas programs, Office of Naval Research, Arlington, Va. . . . THEODORE A. MELLOR serves as quality assurance manager for Riley Stoker Co., Worcester, Mass.

1952

HAROLD R. ALTHEN works as general sales manager for the Cochrane Division of the Crane Co. in King of Prussia, Pa. . . . RICHARD H. ENGLUND now serves as pastor of the Church of Our Saviour (Evangelical Lutheran) in Fond Du Lac, Wis. . . . ROBERT C. HENEGAN is manager of engineering in the Capacitor Division at General Instrument of Taiwan Ltd., in Taipei.

1953

DR. RAYMOND P. PORTER has accepted a position with Acushnet Co., New Bedford, Mass.

1954

DAVID F. GILBERT is works manager for E. I. du Pont De Nemours & Co., Montague Works, Montague, Mich. . . . DUDLEY REDDEN, Holliston (Mass.) assessor of taxes, has announced that he will seek the Democratic Party's nomination for State Representative of the 41st Middlesex District which encompasses the towns of Sherborn, Ashland, Hopkinton and Holliston. Redden is a professional land surveyor and holds registration in Massachusetts, Connecticut, Vermont, Maine, and Ohio. He is a vice president and a member of the board of Schofield Brothers, Inc., land surveyors and civil engineers of Framingham. . . . WALTER A. REIBLING has been named plant manager at General Machine Shop, Fall Brook Plant and Components, Inc., a subsidiary of Corning Glass Works, Corning, N.Y. He has been production superintendent at the plant since 1970. He joined the company in 1964 as a senior equipment engineer at Wellsboro, Pa., where he was named supervisor of equipment engineering in 1965. In 1967 he was named plant manufacturing engineer at the Parkersburg, W. Va., plant.

1956

PAUL A. CNOSSEN has purchased an independent hardware store, Center Supply, in Uxbridge, Mass. The business supplies hardware, paint, plumbing and other products to the public as well as servicing local industries on a six-day-per-week basis. . . . JOHN K. DERBY holds the post of assistant manager of manufacturing at Staley Chemical Division, Marlboro, Mass. . . . JAMES L. FORAND is a self-employed consultant-transit in Kresgeville, Pa.

1957

DR. RENE R. BERTRAND was one of the authors of the article, "Sampling and Analyzing Air Pollution Sources" in the January issue of the magazine *Chemical Engineering*. Rene is a senior research chemist with the Government Research Laboratory at Esso Research and Engineering Co., Linden, N.J. For the past two years he was project leader for a team defining the R&D needs in air-pollution-measurement techniques and the market for air-pollution instrumentation, under an Environmental Protection Agency contract. He is a member of the Air Pollution Control Association. . . . JOHN J. KELLY has

joined the staff of the Grant Chemical Division of the Ferro Corporation, Baton Rouge (La.) plant. His prime responsibility is in the design, construction and operation of Grant's distillation facilities. He was formerly associated with Vulcan Materials, Olin-Matheson Chemical Corporation and Allied Chemical Corporation. . . . PHILIP L. ROTONDO works for Combustion Engineering, Inc., as a stress analyst in the nuclear department. . . . Maj. RICHARD A. STEVENS currently serves at Marine Corps Air Station, El Toro, Calif.

1958

ANTHONY J. DiGIOVANNI has been appointed general superintendent for Mystic Valley Gas Company in Malden, Mass. He joined Mystic Valley in 1960 as planning engineer after moving from NEPSCO in Worcester. He became distribution engineer in 1961 and assistant general superintendent in 1967. . . . BURTON L. KEELER is now a contract administrator for the General Electric Co. in Pittsfield, Mass. . . . Attorney ARTHUR P. McGOWAN, JR., of Canton, Conn., has become a partner in the Hartford law firm of Halloran, Sage, Phelon & Hagarty. A former employee of Electric Boat Division of General Dynamics Corp., he is a member of the Hartford County, Connecticut, and American Bar Associations. . . . WESLEY W. PINNEY serves as chief engineer, Royal Packaging Equipment Co., Maywood, N.J. . . . BERNARD PODBERESKY is manager of Business Operations at General Electric Co., Schenectady, N.Y.

1959

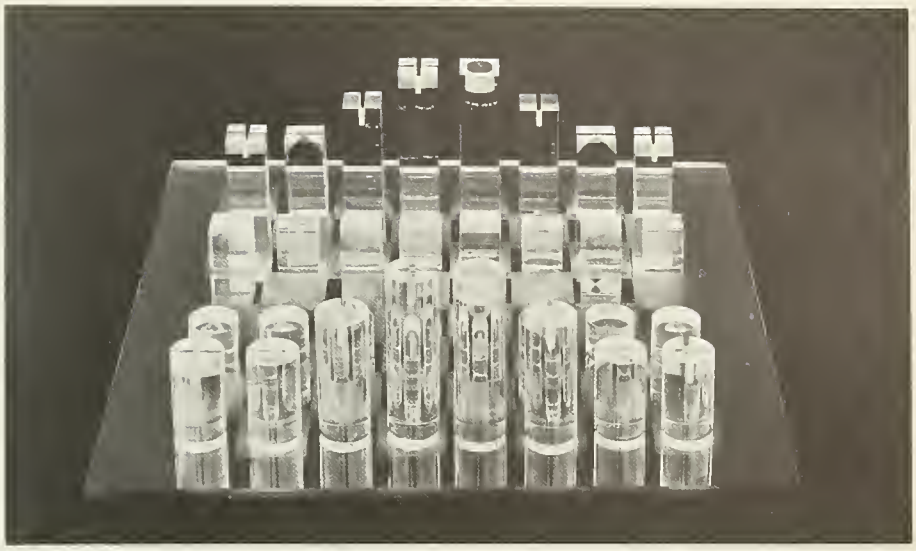
CARL M. FROVA is vice president of sales and marketing services, Universal Interloc, Inc., Santa Ana, Calif. . . . MORGAN M. WHITNEY, JR., is material utilization manager, Ford Motor Co., Dearborn, Mich.

1960

Married: ROBERT J. PAVANO and Miss Judith T. Barnhart on March 25, 1972 in Plainville, Connecticut. Mrs. Pavano is a supervisor of the business teaching department in a high school in Columbus, Ohio, where the couple resides. Mr. Pavano is a sales engineer with Borg-Warner Mechanical Seals Division.

MARTIN BECK currently works as a technical service representative for Cabot Corp., Seine, France. . . . PAUL M. BRYON is factory manager at Fisher Engineering Co., Rockland, Me. . . . WILLIAM F. HESTER holds a new position as manager-general administration at Turbo Power and Marine Systems, Inc., Farmington, Conn. He will have charge of all administrative functions for the corporation. Hester joined Pratt & Whitney Aircraft Division as an analytical engineer in 1960. After accepting a series of increasingly important engineering assignments in the analytical field, he moved into administration. He transferred to Turbo Power and Marine Systems in 1968. . . . JOHN S. REISINGER has been promoted to district equipment superintendent by the Southern New England Telephone Co., Manchester, Conn. He joined the firm in 1960 as an assistant engineer. . . . Worcester City Manager Francis J. McGrath has appointed NORTON S. REMMER to fill the position of plans inspector and senior building inspector in the Bureau of Public Buildings. The new inspector has an MS Degree from Oxford University in England where previously he served as a research and teaching assistant. For several years he has been a senior research engineer for Norton Co. . . . . STUART P. ROBERTS is a salesman with S & S Electronics, Inc., Chelmsford, Mass.

Hester



Whether it's creating a design for an Earth Week poster, a signage system, or a futuristic chess set, Robert A. Propper, '57, of the designing firm of Propper/Elman, New York City, can usually come up with a fresh idea.

Last year his designing firm created the green, black, and white Earth Week symbol which was adopted by New York State's Council of Environmental Advisors. His other design work includes: a sign system for the Memphis, Tenn. airport; book jackets for major publishers; and a limited edition plexiglas chess set which has been featured in *Industrial Design* magazine.

The chess set, entitled "Urban Gambit," has cut and polished plexiglas pieces and a mirrored glass board imprinted with squares.

Mr. Propper's photographic work has appeared in many publications including *The New York Times, Art in America, Art News, Architectural Forum, American Home, House & Garden,* Museum of Modern Art Bi-Annual Report, and Architectural League of New York publications.

In the past Propper has also worked as a design engineer (mechanical and electrical), technical writer and industrial photographer, and exhibition designer and photographer for the New Haven Redevelopment Agency.

Propper is currently teaching corporate design at Parsons School of Design, New York City. He graduated from Yale University's School of Art and Architecture with a BFA and MFA after receiving his degree in electrical engineering from WPI in 1957.

1961

EDWARD J. BAYON, '31, president of Tighe & Bond, Inc., consulting engineers, has announced the appointment of JOHN W. POWERS as associate with the Holyoke, Mass. firm. Powers joined Tighe & Bond as a project engineer in 1968 and has been responsible for design of civil engineering projects in the western Massachusetts area. He has been most recently responsible for the development of the design of Easthampton's waste water treatment program. Previously a sanitary engineer with the Naval Facilities Engineering Command in Boston, he supervised the operation of waste water treatment facilities for various naval installations in the area. . . . IBM Corp. of Des Plaines, Ill., employs PETER D. BEEKMAN, advisory industry marketing representative. . . . BRADLEY E. HOSMER, who now works for Marketing Action Group in Fairfield, Conn., as a consultant, has moved to Redding Center. His hobby is building and refinishing furniture. His wife, Jaunita, works out of their home as a free lance designer of infants' wear. . . . ALLAN MADNICK has employment as an elec-

tronic engineer with the Federal Government at Fort Monmouth, N.J. . . . JOHN A. MATLEY has been named senior systems analyst at Manufacturing Management Sciences, Burlington, Mass. . . . DR. GORDON M. PARKER is manager—R & D —for Akashi Lab., Honny Chemicals Co. Ltd., Akashi, Japan.

1962

JAMES L. FORAND, JR., recently received his MBA degree from Lehigh University. Jim is with Homer Research Laboratories, Bethlehem Steel Corp., Bethlehem, Pa. . . . DAVID L. GOODMAN has acquired an industrial electrical concern, Beaudreau Electrical, Inc. in Waterford, Conn. . . . KENNETH A. HOMON is now manager of sensor programs at IBM Corp., Gaithersburg, Md. . . . KENNETH C. KRIKORIAN is a professor at Quinsigamond Community College, Worcester. . . . LCDR (USN) BRIAN J. O'CONNELL, who received his master's degree in civil engineering at Stanford last year, is now executive officer of the Seabee battalion, Port Hueneme, Calif. . . . RONALD A. PENQUE has come up with a brand new recycling story. Protected by patents, Penque proposes to treat ordinary household garbage by chemical and mechanical means which will convert it totally into usable products. He plans to accomplish this without burning, without odor, without stream or air pollution. He says his Biocel process will produce such commercially marketable items as paper pulp, iron and steel, aluminum, glass, metals, fertilizer, and building products. The president of Biocel Corporation, he also owns the Land Chemical Company, Paterson, N.J. . . . Assistant Department of (Mass.) Public Works Commissioner, PAUL SHARON, has been appointed to serve as acting commissioner until a permanent replacement is found for retiring Harry P. Loftus. The acting commissioner is a member of the Mass. Registered Professional Engineer Society; Mass. Registered Land Surveyors; Notary Public; Municipal Engineers Assoc.; Highway Association; Metropolitan Area Planning Council, and Central Mass. Conference of football officials. . . . STEPHEN M. WELLS works for ITT as a senior systems consultant in New York. . . . The product manager for Webster & Martin, South Burlington, Vt., STANLEY M. WILBUR, recently was elected president of the Shelburne Jaycees.

SUCCESS IS SPELLED "1-2-3"

When Robert R. Cassanelli, '62, was a chemistry student at WPI, he probably never dreamed that in just a few short years he would be awarded a Patent for a prize-winning product that is currently being marketed coast to coast. Back then "Cass" was concerned with the "Tech News," the "Peddler," R.O.T.C. and his duties with Lambda Chi Alpha fraternity. He probably didn't think twice about the strawberry gelatin that was occasionally served with his meals.

During the past few years priorities have changed, and gelatin has concerned him virtually all of his waking hours. A group leader in the General Foods Jell-O research division, Tarrytown, N.Y., Cassanelli shares a patent for his work in the development of the popular gelatin dessert, "1-2-3."

He recalls that "1-2-3," a three-layered dessert (topping, chiffon, and gelatin), came about as sort of a happy accident, a laboratory curiosity. Somebody was whipping Jell-O with emulsified vegetable oil when it was discovered that a product had been created that developed its own topping. From then on ideas sprouted like mushrooms. Interesting textures were looked into and Jell-O was mixed with other ingredients.

Although chocolate is Cassanelli's favorite flavor, strawberry took precedence over it in the test product. (Jell-O has a water base that does not bring out the best in chocolate.) But strawberry is his second favorite flavor and that was the one that was used in the new product shown to the marketing new products committee.

With a go-ahead from marketing, small home-use tests were scheduled. Hundreds of consumers used the product and answered questionnaires. The consensus was that there should be more topping and that the dessert texture and taste could be improved. After the formula was changed slightly and other emulsifiers were evaluated, the product was resubmitted for more consumer testing. Still more improvements were suggested and made. Ultimately the dessert was named "1-2-3," production methods were established, and it was put into the hands of the marketing and advertising men.

When it came time for *Canner/Packer* magazine to give out its seventh annual New Foods Awards, "1-2-3" received one of the top seven national prizes. "A tremendous innovation . . . a very unique approach to a simple everyday dessert," were some of the judges' reactions.

"I feel fortunate to have had a hand in working on something that made it," Robert Cassanelli says. ("1-2-3" has now successfully tempted the public palate in not only strawberry, but cherry, raspberry, orange and lime.)

He declines to report what he may have bubbling on the back burner at present; but he claims that if it is a hot dish it will definitely not be called the "Cassanelli Casserole."

1963

Born: To Mr. and Mrs. DONALD M. WOOD II, a daughter, Kara Yvonne, on August 12, 1971. Don, who is president of his own company, Wood's Marine Supplies, Inc., of Lake Park, Fla., is fast becoming the largest stocking dealer in Southern Florida for sailboats under 30 ft.

STANLEY J. BELCINSKI, JR., works as a quality control supervisor for the Massachusetts Steel Treating Division of Presmet Corp., Worcester. . . . DR. ROBERT M. DESMOND has just been made head of the mechanical engineering department at Rochester (N.Y.) Institute of Technology. . . . EDWARD J. KALINOWSKI now serves as a senior compensation analyst for Eli Lilly & Co., Indianapolis, Ind. . . . JAMES M. KELLY, JR., is sales engineer for the Dustex Division, American Precision Industries, Buffalo, N.Y. . . . Prof. JOSEPH R. MANCUSO has been appointed head of the Department of Management Engineering at WPI. He succeeds Dr. Albert J. Schwieger who is retiring after 42 years on the faculty. Presently Mancuso is completing work for his doctorate at the University of Massachusetts as well as teaching management subjects at WPI. He is also president of a management consulting firm, Applied Marketing, Inc., of Framingham, Mass. . . . DR. ROBERT E. MURPHY serves as assistant astronomer and assistant professor of astronomy at the Institute for Astronomy, University of Hawaii. . . . DR. WILLIAM J. SAVOLA, JR., who received his Ph.D. in physics from the University of Connecticut last year, is currently working for his MBA at New York University.

1964

Married: DAVID O. ADAMS to Yvonne L. Alexandre in Ogunquit, Maine, on January 29, 1972. Mrs. Adams, who attended Boston University, is a secretary at MIT in Cambridge. David is with Sikorsky Aircraft in Stratford, Conn. The couple resides in Newtown, Conn. . . . PETER DORNEMANN to Miss Penelope Hebberd of Boston, Mass. on October 23, 1971.

NEED A JOB?

Don't forget that the resources of the WPI Placement Office and the Alumni Association are available to you. Contact Warren B. Zepp at WPI for information.

Born: To Capt. and Mrs. ELLIOT F. WYNER their second child, a son, Robert Harris, on April 8, 1972. Wyner has been working at the U.S. Army Natick Laboratories since his return from Korea.

ALBIN A. HASTBACKA has been chosen to receive RCA's Engineer of the Month Award at the RCA Aerospace Systems Division, Burlington, Mass. He received the award in recognition of his outstanding work as the system architect of a command and control computer system for the Air Force. The approach that he developed was a major factor in RCA's receiving a multi-million-dollar contract. Hastbacka is a leader, Technical Staff, in the Command Control Program Management Office. . . . RICHARD F. HEALING is with Frank Healing & Son, Easton, Conn. . . . JOHN C. RYDER, who since 1969 has been a senior engineer in advanced tire engineering at The Firestone Tire & Rubber Co., Akron, Ohio, has been promoted to supervisor of private brands tire engineering. . . . DR. DAVID H. LAANANEN serves as a project engineer-aviation safety at Dynamic Science, Phoenix, Arizona. . . . WALTER E. LANKAU, JR., is senior management scientist at Management Decision Systems, Waltham, Mass. . . . PETER MARSTON has been named engineer-electric operations in the Connecticut Light and Power Company's Willimantic district. Marston joined the firm in 1964 as cadet engineer and was appointed junior engineer in 1965. In 1966 he was transferred to the Berlin office, later being reassigned to the Willimantic office in 1968 as assistant engineer. . . . MASON H. SOMERVILLE received his Ph.D. in mechanical engineering from Pennsylvania State University in March. . . . GERALD E. TAMMI is now manager-automotive product engineering at Fairchild Semiconductor, Mountain View, Calif. . . . SEYMOUR WILLIAMS III is a project programmer for Leeds & Northrup, North Wales, Pa. . . . DR. ROBERT A. PEURA, WPI assistant professor of biomedical and electrical engineering, will read his paper, "The Measurement of In Vivo Tissue Transfer Functions by Cross Correlation Techniques as it Pertains to the EKG Conduction System" which he prepared with STEEN HANNIBAL (MS, '72), at the Third International Conference on Medical Physics in Gothenburg, Sweden, July 30-Aug. 4.

1965

DONALD C. CARLSON is bearing engineering coordinator, International Division, Torrington Co., Torrington, Conn. . . . ALLEN H. DOWNS is an electrical engineer at Electronic Instrument and Specialty Corp., Winchester, Mass., where ROBERT A. PAINTER, '43, is president. Al says to be sure and report, "Al Downs finally graduated—with the Class of 1971!" He also writes, "While a student I looked forward to graduating, but from the outside looking back in, I miss WPI." . . . Area engineer for the construction division of the engineering department of the Du Pont Co., Washington, W. Va., is GLENN P. HURST. . . . JAMES B. KNITTER is one of three persons who founded a new company, Trimetrix, Incorporated on March 1, 1972 in Norwood, Mass. Knitter, who serves the company as vice president of engineering, is well known for his innovative analog circuit designs used in over 36 successful modular and instrument products. He has authored several technical articles and has two patents pending. His previous positions include manager of analog design, Intronics, Inc.; design group leader, Teledyne Philbrick Co.; project engineer, Nexus Research Co.; and circuit designer, Block Engineering Co. . . . HENRY A. SCHNECK has employment as a civil engineer in the planning division with the Suffolk County Department of Public Works, Long Island, N.Y.

1966

Born: To Mr. and Mrs. SIGMUND S. DICKER, their first child, a daughter, Lori Michele, on April 16, 1972. Sig is a project manager for Diesel Construction Co., New York City. . . . To Mr. and Mrs. J. GARY DYCKMAN a daughter, Jennifer Anne, on August 8, 1971. Gary is an engineer in the structural division of Stone and Webster Engineering Corp., Boston. The Dyckmans recently purchased a home in Burlington, Mass. . . . To Mr. and Mrs. DONALD W. PETERSON, JR., a son, Kyle Kirby, in September of 1971. Don is a systems engineer with IBM. . . . To Mr. and Mrs. LAWRENCE A. PENONCELLO, a son, Jamie Lawrence, on May 1, 1972. Larry is a general foreman at the Torrington Co., Torrington, Conn.

L. THOMAS BENOIT is treasurer and sales manager of Flame Treating and Engineering Co., West Hartford, Conn. . . . JOHN W. BENSON II is with U. S. Electrical Motors, Milford, Conn. . . . Presently employed at the Electromagnetic Compatibility Analysis Center in Annapolis, Md., is JOHN D. CUTHBERTSON. . . . ANDREW J. FISH, JR., is now a Captain in the U.S. Air Force. . . . GEORGE H. FLYNN is with Sanders Corp., Nashua, N.H. . . . DR. JOHN H. LAUTERBACH currently serves as a project supervisor for the Central Technical Evaluation Group, National Starch & Chemical Corp., Plainfield, N.J. . . . PAUL R. LINDBERG of Augusta, Me., is self-employed as a free-lance writer. . . . HUGH R. McMENAMY is project engineer for Esso Research & Engineering, Florham Park, N.J. . . . JOHN P. SEFERIADIS has employment as a senior civil engineer with the New Bedford (Mass.) Department of Public Works. . . . Professor JOHN D. SHERRICK, who has been on the faculty of Schenectady (N.Y.) County Community College since 1970, has been promoted to associate professor in the department of science, mathematics and technology. . . . Mobil Oil Corp., Waltham, Mass., employs RONALD A. TATA as district engineer in the Springfield area where he also resides. . . . DOUGLAS L. VIZARD recently received his Ph.D. in biophysics from Pennsylvania State University where he pursued a DNA sequence study in the field of molecular biology. Currently residing in Houston, Tex., he is a postdoctoral fellow in the department of physics at the M. D. Anderson Hospital and Tumor Institute.

1967

Married: JOSEPH F. KIERONSKI and Miss Roberta Page, February 19, 1972 in Middletown, Connecticut. The bride teaches mathematics at Pinkerton Academy, Derry, N.H. The groom is a civil highway engineer with the Highway and Bridge Division for the New Hampshire Department of Public Works. . . . JOHN E. ROGOZENSKI, JR., and Judith Ann Fuller on April 22, 1972 in Medfield, Massachusetts. The bride is a graduate of Colby Jr. College. Her husband received a degree from the University of Massachusetts Graduate School last year.

Capt. HERBERT R. BROWN, project engineer with the 6511th Air Force Test Group (Parachute) at the El Centro Naval Air Facility (Calif.), has been named as the group's candidate for junior officer of the year award given annually by the Air Force Flight Test Center, Edwards Air Force Base. Officials said Capt. Brown was selected for this honor on the basis of his continuous, outstanding performance in directing the testing of the parachute systems to be used in the crew escape capsule on the Air Force's new B-1 bomber. . . . Capt. STEPHEN B. COTTER has been selected Outstanding Instructor in his unit at Moody AFB, Ga. A T-37 instructor pilot, he was honored for his effective teaching techniques and exemplary devotion to duty. He is assigned to a unit of the Air Training Command which provides flying, technical and basic military training for USAF personnel. . . . RICHARD E. De GENNARO is an MBA candidate at the Wharton School, University of Pennsylvania in Philadelphia. . . . RONALD S. GOSK was the author of an article concerned with pressurized ink writing for graphic representation of data which recently appeared in the magazine, "Industrial Research." Presently he is analog product manager for Mechanics for Electronics Corp. (MFE). . . . JOHN M. KUENZLER is a sales engineer with The Foxboro Company, Foxboro, Mass. . . . ROY P. LINDQUIST works as product engineer for Foxboro Company, Foxboro, Mass. . . . LEONARD E. ODELL, assistant actuary in the life actuarial department at Aetna Life & Casualty, Hartford, Conn., has been designated a Fellow in the Society of Actuaries upon completion of all the examinations.

RICHARD A. ORMSBEE has been employed by the Best Foods Research Center, Union, N.J. . . . STANLEY P. PIETREWICZ is systems engineer for Tenneco, Newport News, Va. . . . ROBERT E. RICHARDSON, JR., is an engineer at the Naval Weapons Lab., Dahlgren, Va. . . . SUDHIR A. SHAH has employment as senior structural engineer at James P. Purcell Associates, Inc., Hartford, Conn. . . . RICHARD SYMONDS is with Westinghouse Electric, Philadelphia, Pa. . . . NELSON F. (SKIP) THUNE

been studying. . . . JOHN S. SIMPSON to Miss Jeanne Marie Drapeau on July 1, 1972 in Tiverton, R.I. Mrs. Simpson is a teacher in the Portsmouth School System. Her husband is employed at the Naval Underwater Systems Center in Newport. . . . FRANCIS W. SKWIRA to Miss Gerald Carreker Fowler on June 24 in Atlanta, Ga. The bride has received a master's degree in French literature from Emory University in Atlanta. The groom is employed by the General Electric Co., San Jose, Calif.

RICHARD D. ALPERT is on sabbatical leave in Europe. . . . STEPHEN R. ANDRUCHOW is a construction engineer for Stephen Andruchow, Inc., West Warwick, R.I. . . . DAVID W. EATON serves as systems programmer for General Electric Company, Phoenix, Arizona. . . . THOMAS C. GURNEY is a student at Central Bible College, Springfield, Missouri. . . . ROY C. JOHNSON, JR., recently received his PhD in civil engineering from Rice University, Houston, Texas. . . . PHILIP M. KAZEMERSKY is a nuclear engineer for the Tennessee Valley Authority in Chattanooga. . . . Z. RONALD STELMAK serves as a sales engineer for Westinghouse and is currently located in Syracuse, N.Y. . . . MICHAEL W. NOGA has employment with Stone & Webster, Boston. . . . CARL NOTHNICK is with Westinghouse Electric, Baltimore, Md. . . . STEPHEN R. PHILLIPS is completing his thesis for his MS in industrial design at the Institute of Design, Illinois Institute of Technology.

GREGORY E. POLLACK is assistant marketing manager in the micrographic division of Canon USA, Inc., Lake Success, N.Y. . . . GERALD M. ROBBINS is a graduate student in the department of landscape architecture at the University of Illinois. . . . RONALD P. ROSADINI is a teacher in the Torrington, Conn. School System. . . . ROBERT J. SCOTT is a graduate student in city and regional planning at Cornell University, Ithaca, N.Y.

NEIL M. GLICKSTEIN has been appointed math-science teacher at Home Base School, Watertown, Mass.

1970

Married: A. PATTON ABBE II to Miss Christine Driscoll on May 28, 1972 in Windham Center, Connecticut. Abbe is the owner of Keats Krafts Clothing Store in Mystic, Conn. His bride is employed as a model for the portrait painter, Robert Brackman, N.A. of Noank, Conn. . . . RICHARD F. ABRAMS to Miss Jean M. Parker on June 10 in Spencer, Mass. The bride is an elementary art teacher in the Spencer schools. Her husband is with Artisan Industries, Waltham, Mass.

Married: MARK E. BROWN and Miss Carolyn Marie Gilbertson June 17, 1972 in Battle Lake, Minn. Mrs. Brown has completed graduate studies in social work at Washington University, St. Louis. Mr. Brown is a candidate for a doctorate in chemical engineering at the University of Minnesota, Minneapolis. . . . RALPH DiIORIO to Miss Rosemary Calcagno in Seaford, N.Y. on June 3. Ralph is a senior engineer for ATT Long Lines Department. . . . DUNCAN H. GILLIES and Miss Patricia M. Teczar on July 7, 1972 in Worcester, Massachusetts. The bride teaches at Union Hill School. The bridegroom is with the Massachusetts Electric Co. . . . ROGER P. HENZE to Miss Judy Lynn Welch in North Adams, Massachusetts on July 15, 1972. Mrs. Henze is a student at North Adams State College. Mr. Henze is a candidate for his master's degree in city and regional planning from Cornell University this year.

KENNETH C. BASSMANN, who was recently promoted to first lieutenant in the U.S. Air Force, has received an award for a military improvement suggestion which he gave at Andrews AFB, Md. He is a communication-electronics officer with the Air Force Communications Service. . . . 2/LT. GERRY A. BLODGETT has completed a nine-week ordnance officer basic course at the Army Ordnance Center and School, Aberdeen Proving Ground, Maryland. . . . JAMES HANNOOSH was awarded a master of science degree in mechanical engineering from MIT last June. He has been accepted for the doctoral program in the field of material behavior at MIT. . . . JERRY L. JOHNSON, who received his MS from Holy Cross this year, is starting his PhD program at Dartmouth College, Hanover, N.H., this fall. . . . PETER F. LALOR was recently awarded his master's degree in metallurgy from the University of Connecticut. . . . JOHN J. LYONS is a systems programmer for WPI. . . . KALVIN W. NGOON is a programming trainee at State Mutual Life Assurance Co., Worcester. . . . 1/LT. DENNIS L. NOVAK has completed the four-week Army Alaska Summer Leader's Course at the Northern Warfare Training Center, Ft. Greely, Alaska. He is a platoon leader at Ft. Wainwright, Alaska. . . . GEORGE E. PHILIPPON has been named systems manager, Identicard division of Management Service Associates, Lancaster, Pa. . . . ROSS A. WILLOUGHBY is a sales representative for Air Way Sales, Worcester.

LAURENCE P. VALLEE has received his MS degree in civil engineering from the University of Connecticut. He has accepted a position with the structural firm of Stone and Webster Engineering Corp., Boston.

1971

Married: ANTHONY SCHEPIS to Miss Laura Candace Fabrizio in Quincy, Massachusetts on May 21, 1972. Mrs. Schepis, a graduate of Forsyth Dental School and Northeastern University, is employed as a dental assistant. Her husband is an industrial engineer at Sealy Mattress Co., Randolph, Mass.

Married: DAVID P. BUELOW and Miss Helen M. Laptewicz on June 10, 1972 in Westboro, Massachusetts. Mrs. Buelow is a graduate of Salter Secretarial School, Worcester. David is with the U.S. Army Corps of Engineers in Waltham. . . . STEVEN G. EMERY to Miss Mary Evelyn Jackman July 15, 1972 in New Haven, Connecticut. The bride is a registered nurse with the Visiting Nurse Association of Worcester. The groom is in the cardiology department at St. Vincent's Hospital, Worcester. . . . ROBERT P. HART and Miss Elizabeth T. Cushwa on July 8 in South Hadley, Massachusetts. Mrs. Hart is a graduate of Framingham State College. Her husband is a design engineer at Norden Company, Norwalk, Conn.

Married: DOUGLAS E. HOLMES to Miss Christine F. Holda on June 24, 1972 in Worcester, Massachusetts. Mrs. Holmes is a kindergarten teacher. The groom is a graduate student in the material sciences division of the University of Connecticut, Storrs. . . . JEFFREY P. LASSEY and Miss Lynne K. Maniero on June 25, 1972 in Worcester. The bride, a graduate of Worcester State College, is a teacher. Her husband is with New England Electrical Co., Weymouth, Mass. . . . EDWARD C. LOWE, III to Miss Judith S. Cogswell on July 8, 1972 in Longmeadow, Massachusetts. Mrs. Lowe is a French teacher. The bridegroom is a sales engineer employed by General Electric of Schenectady, N.Y. . . . 2/LT. PETER J. MARKUNAS and Miss Victoria R. Chicoine on May 13, 1972 in Leicester, Massachusetts. Mrs. Markunas is a graduate of Ward Business School. Her husband is a candidate for his master's degree in mechanical engineering at WPI. . . . SPAFFORD A. MARTINDALE, JR. and Miss Betteanne Mitchell in Worcester, Massachusetts. The bride is an alumna of Anna Maria College.

Married: VINCENT T. PACE and Miss Maryann Bagdis on June 10, 1972 in Grafton, Massachusetts. DONALD TANANA and FRANK STEINER were ushers. Maryann, a former WPI student, is a senior at Drexel Institute of Technology in Philadelphia. Her husband is an electrical engineer at Philadelphia Electric Co. . . . RICHARD B. HOPEWELL to Miss Claudia Louise Secrist July 1, 1972 in Needham, Massachusetts. Mrs. Hopewell is a music education teacher. The bridegroom is doing graduate work at WPI. . . . NORMAN W. SOUSA, JR., to Miss Barbara K. Phillips on July 1, 1972 in Pearl River, N.Y. EDWARD J. SHERMAN was best man. The bride is a Becker Junior College graduate. Her husband is with the Sousa Corp., West Hartford, Conn. . . . PAUL R. SWENSON and Miss Elaine M. Zoppo on June 24, 1972 in Paxton, Massachusetts. Mrs. Swenson, a graduate of Becker Junior College, is a senior at The Memorial Hospital School of Nursing. The bridegroom is a field engineer for Granger Contracting Co., Worcester.

Married: JOHN ANDERSON and Miss Josephine Vanni in April in Ho-Ho-Kus, New Jersey. Mrs. Vanni is a graduate of Newton College of the Sacred Heart, Newton, Mass. Her husband is with Public Service Electric and Gas Co., Newark, N.J. EDWARD "NED" CUNNINGHAM was best man. Ushers were GARY MASON, PAUL RUSSO, and ROBERT KELLEY.

CHIA-SOON KU is a graduate student in the Department of Chemical Engineering, Pennsylvania State University, University Park, Pa. . . . ALAN SHAPIRO, who is currently home on leave from his duties with the Peace Corps in Ecuador, expects to return soon to finish out his two-year enlistment. Recently a full page of photos he took in that South American country was published in the *Transcript*, North Adams, Mass.

PAUL B. ASH has earned his master of arts degree in teaching, with an education major, from the University of Massachusetts at Amherst. . . . THOMAS R. BALL is employed by Astra Pharmaceutical Products, Inc., Worcester, in the area of data computer-research and development. . . . MICHAEL J. GRADY is a software systems engineer at Honeywell Information Systems, Inc., Cambridge, Mass. . . . UMBERTO MILANO is with the U.S. Bureau of Reclamation, Denver, Colo. . . . MARTYN H. STRONG has received his master of engineering in electric power engineering at RPI, Troy, N.Y. He is returning to RPI this year to study for his master's degree in environmental engineering. . . . JAMES E. TROUTMAN, JR. is currently a computer instructor at Lowry AFB, Colo.

1972

Married: GARY A. FOOTE and Miss Catherine E. Bogard on May 27, 1972 in Worcester, Massachusetts. The bride is a graduate of the University of Connecticut. . . MICHAEL W. THAYER to Miss Cynthia Ellen Roff last spring. Mrs. Thayer graduated from Wheaton College. . . . PETER A. BERTASI and Miss Janet A. Juzwinski in New Britain, Connecticut on June 17, 1972. The bride has been studying for her BS degree in education at Central Connecticut State College. The bridegroom is a graduate student in business administration at the University of Rochester, N.Y. . . . DOUGLAS E. BEST to Miss Claudia J. Taylor in East Longmeadow, Massachusetts. Mrs. Best attended Salem State College and graduated from Chandler School for Women, Boston. Her husband is employed by Heald Corp., Worcester.

Married: CHARLES J. BRINE and Miss Patricia Ann Rimo on June 3, 1972 in New Brunswick, N.J. The bride is an alumna of Douglass College in New Brunswick. Both he and her husband plan to attend graduate school. The groom expects to enter the College of Marine Studies (Chemical Oceanography) at the University of Delaware where he will enroll in the PhD program. . . . MARK C. DUPUIS and Miss Karen F. Fitzgibbon in Lunenburg, Massachusetts. Mrs. Dupuis graduated from Fitchburg State College. The groom is in production management at Procter and Gamble in Quincy, Mass. . . . LOUIS A. FERRARESI, JR., to Miss Susan Ann Jones on June 18, 1972 in Worcester, Massachusetts. Mrs. Ferraresi graduated from Emmanuel College, Boston. Her husband is a controls-systems engineer for Stone & Webster Engineering Corp., Boston. . . . GEORGE A. OLIVER and Miss Barbara Frances Davis on June 10, 1972 in Bedford, Massachusetts. The bride is a graduate of Westfield State College. The bridegroom is attending California Institute of Technology, Pasadena. . . . DONALD J. POLONIS and Miss Patricia Ann Theresa Yarusawych in Easthampton, Massachusetts on June 10, 1972. The bridegroom has accepted a teaching fellowship at Union College, Schenectady, N.Y., where he is working for his master's degree in operations research in the School of Industrial Administration. . . . MARCELLO A. RANALLI to Miss Diane Rose Bianco on June 10, 1972 in Worcester. Mrs. Ranalli is a casualty rater at Travelers Insurance Co.

JOSEPH BIANCA is working for Combustion Engineering, Windsor, Conn. He is a research and product development engineer in the company's Kreisinger Development Laboratory. . . . ROBERT A. COLP is a graduate student at the University of Wisconsin, Madison. . . . Currently DR. RAYMOND M. FISH is employed by the National Institute of Health in Bethesda, Md. . . . ANDREW J. GLAZIER is with the U.S. Army Corps of Engineers. . . . ROBERT L. LYONS is with the field service support group at Leeds & Northrup Co., North Wales, Pa. . . . FRANK D. McMAHON has employment as a sales trainee for W. R. Grace, Pontiac, Mich. . . . ROBERT I. PARRY has accepted a position with the Philadelphia Electric Company.

ROBERT M. PASUCCI is a transportation planner at Raymond, Parish, & Pine, White Plains, N.Y. . . . JEFFREY A. PETRY is with the Torrington Company, Torrington, Conn. . . . GARY E. RAND serves as an associate engineer at Raytheon Co., Wayland, Mass. . . . W. J. Megon & Co., Naugatuck, Conn., employs EDWARD D. SCHRULL as assistant project manager. . . . WALTER J. SMITH was commissioned an ensign in the U.S. Navy Reserve in September. He has been at the Naval Officer Training Center in Newport, R.I. . . . KENNETH R. WADLAND is a graduate assistant in the math department at the University of New Hampshire.

ROBERT M. BYRNE has employment at The Gazebo, Torrington, Conn. He is also president of the Torrington Men's Choral Club. . . . ROBERT S. AMES plans to do graduate work in mathematics at Syracuse University this fall. . . . GLENN E. CABANA has been employed by Western Electric, North Andover, Mass. . . . DOUGLAS B. HARRINGTON is a technical marketing program trainee at the General Electric Company. . . . JOHN D. KALETSKI holds the position of manager at Clairol, Stamford, Conn. . . . WALTER R. McILVEEN serves as a designer for Walter McIlveen Associates, Avon, Conn. . . . JOHN C. MOORE is a field service engineer for the power division of Westinghouse, Minneapolis, Minn. . . . Uniroyal Chemical Division, Naugatuck, Conn., employs THOMAS A. REYNOLDS as a process engineer. . . . MARK F. SAMEK is a graduate student at WPI. . . . LESLEY E. SMALL has employment as a staff engineer for the Southern New England Telephone Co., New Haven, Conn. . . . THOMAS J. TRACY is with Stone & Webster, Boston, Mass. . . . LT. STEPHEN A. WILKINSON expects to be assigned to Ft. Bragg, N.C. . . . WALTER L. BALLARD recently joined Eastman Kodak Company, Rochester, N.Y. and has been assigned as a development engineer with the Apparatus Division. . . . JOHN G. CROFT, JR., SIM, is assistant purchasing manager, Wyman-Gordon, Worcester. . . . HENRY E. HIRVI, SIM, is a project leader at Cincinnati Milacron-Heald Corp., Worcester. . . . GUS L. SANNICANDRO, SIM, serves as engineering design supervisor for Fenwal, Inc., Ashland, Mass.

HOWARD H. LEVINE is in the department of physics at the University of Illinois. . . . JEFFREY ASKANAZI is a medical student at Upstate (N.Y.) Medical Center. . . . RICHARD J. WALLACE is studying at WPI. . . . KURT M. WUSTERBARTH has accepted employment at the Goodyear Tire & Rubber Co.

of Engineering.... JAMES G. GARRAHAN started work in March as an analyst for the Computer Sciences Corporation in the Software Application Division. He is closely concerned through a company contract with the Goddard Space Flight Center. In this capacity he uses celestial mechanics to investigate problems that a satellite in a synchronous orbit might incur before the 1973 actual launch date. He is a supporting member of the launch team. . . . LEO R. GILLIS, JR., is an engineer in training at New England Power Co., Westboro, Mass.

DOUGLAS E. HOLMES, who is working for his Ph.D. at the University of Connecticut, is a teaching assistant in the chemistry department. . . . RICHARD B. HOPEWELL is studying for his master's degree at WPI. . . . Airman LOUIS R. HOWAYECK has graduated from the U.S. Air Force supply inventory specialist course conducted by the Air Training Command at Lowry AFB, Colo. The airman, trained to inventory supplies by use of electronic data processing machines, is being assigned to Otis AFB, Mass., for duty with a unit of the Tactical Air Command which provides combat units for air support of U.S. ground forces.... ERNEST R. JOYAL is an engineer in training at the Naval Ship Engineering Center, Hyattsville, Md. . . . STEPHEN P. KATZ is employed as a special projects supervisor at Beechmont, Inc., Canajoharie, N.Y. In the evenings he attends Union College where he is in the Industrial Administration Department.... DOUGLAS A. KEILY is with the Department of Environmental Protection, Hartford, Conn. . . . DANIEL F. KING works as a junior chemist for New England Nuclear Corp., Boston. . . . MICHAEL S. LATKA is fire prevention engineer for Kemper Insurance Co., Boston. . . . WILLIAM G. LIGHT, who is studying for his master's degree in chemistry at the University of California, Berkeley, expects to start on his Ph.D. in environmental health sciences in the fall of 1972.... Currently CLAUDE P. MANCEL is a graduate student at WPI. . . . Sister DONALD MARIE SSJ is head of the Mathematics Department at St. Peter's Central Catholic High School, Worcester. . . . RICHARD J. MATTES, associate engineer, works for New England Telephone, Boston.

ROBERT A. PACE currently holds the position of design engineer at Electric Boat, Groton, Conn.... PAUL T. POSCO studies as a graduate student at Cornell University.... Gordon Library, WPI, employs NORMAN D. POWERS, programmer. . . . Army Specialist Four JOHN R. PRATT recently completed with honors a 28-week tactical microwave systems repairman course at the Army Signal School, Ft. Monmouth, N.J. . . . Airman 1/c GORDON R. PETERSON has been named Outstanding Airman of the Quarter in his Unit at Croughton RAF Station, England. Peterson, an electrical systems repairman, was selected for his leadership, exemplary conduct, and duty performance. . . . EDWARD J. SHERMAN, JR., is in the Air Force. . . . PAUL B. SULLIVAN is with Western Electric Co. (Bell Labs), Madison, N.J.... CALEB H. THOMAS, JR., is associated with Mohawk Data Sciences, East Herkimer, N.Y. . . . Airman JAMES E. TROUTMAN, JR., has completed basic training at Lackland AFB, Texas. He has been assigned to Keesler AFB, Miss., for training in communications electronics systems.... Dr. RICHARD A. TUFT, who has been a senior member of the technical staff at RCA, Burlington, has been appointed assistant professor of physics at WPI. Dr. Tuft received his doctorate in physics from WPI last year.... KENT VAN HEUKELOM serves as a teacher aide in Central Falls, N.Y. . . . 2/Lt. PETER B. WELLES has completed a nine-week ranger course at the U.S. Army Infantry School, Ft. Benning, Ga.

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Coming
Home Coming!

October 14

We found the right combination for Norton Borazon wheels. It opens up a lot of possibilities for you.

Naw the spectacular grinding capabilities af Barazan abrasive really came inta their awn... in Nortan Borazan wheels. Nartan research engineers have unlocked the full patential of this amazing abrasive with their unique custam-tailared bands. Barazan wheels save mare time and money than ever on taday's taughest tool steel grinding jobs.

Nartan custam-tailared bands are a precise cambinatian af special additives, meticulausly blended and processed ta cape with the heat generated during grinding, and minimize bond wear by the material being graund. The result? High, constant cutting ability in a wheel that keeps an cutting.

In shart, you can do more with Borazon when yau da it with Nartan Barazan wheels. Use them ta put a prafitable plus in yaur internal grinding, tool sharpening and wet surface and cylindrical grinding jabs.

Get the camplete stary from yaur nearby Norton Distributar. Nartan Campany, Grinding Wheel Division, Warcester, Massachusetts 01606.

NORTON GRINDING WHEELS