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April, 1954

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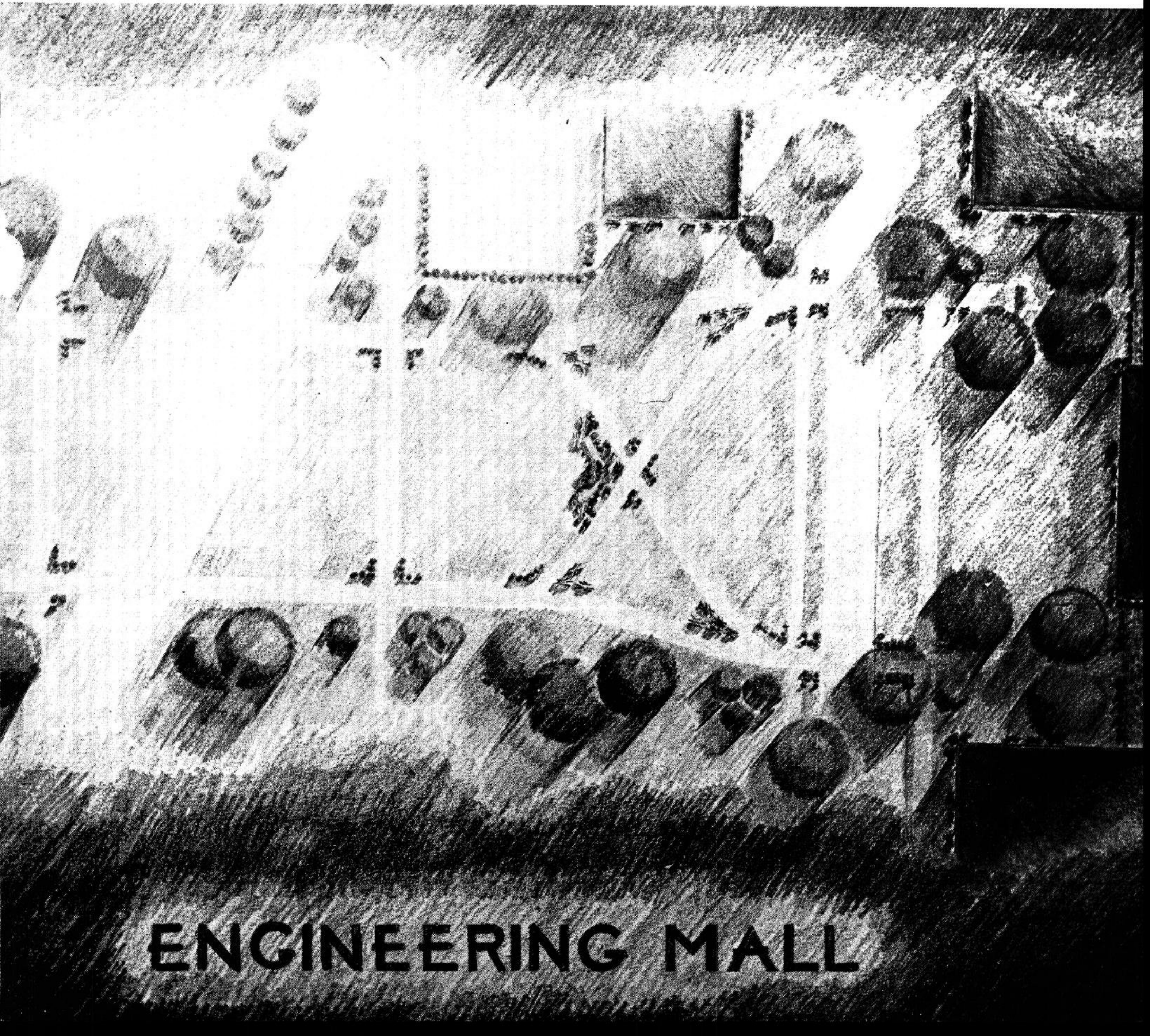

ENGINEERING MALL

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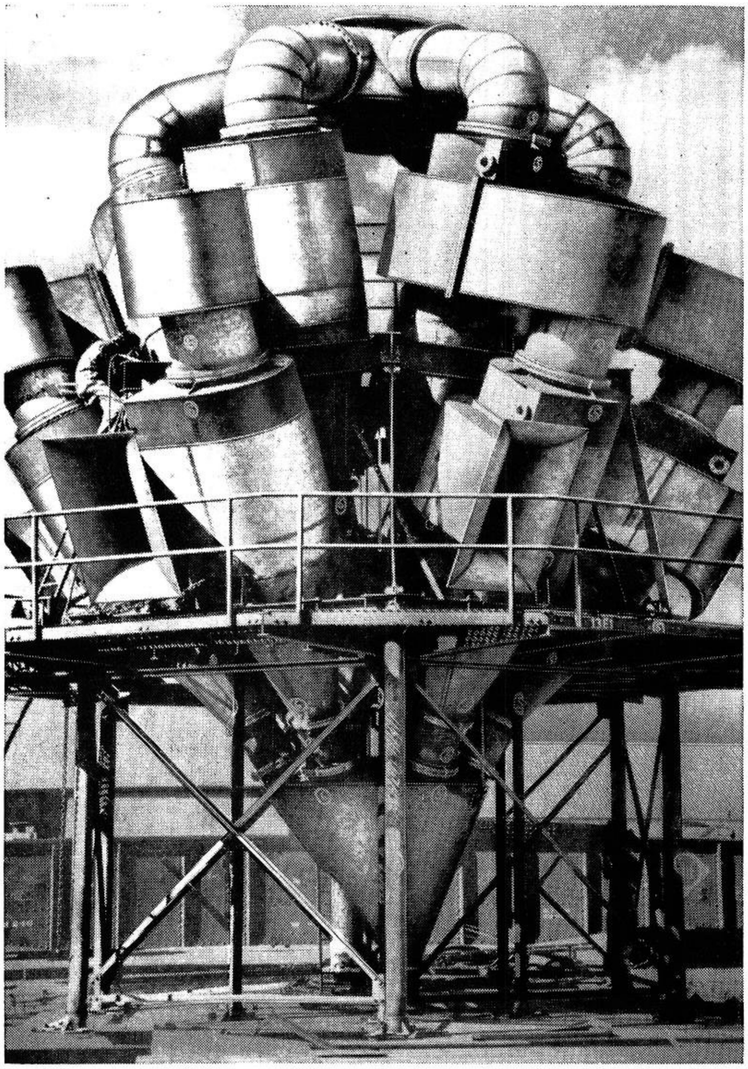
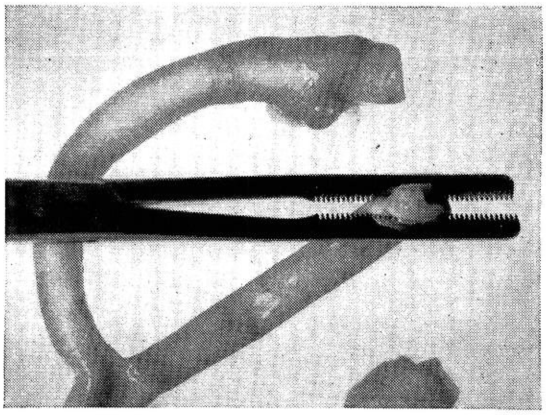


Visitor from Outer Space? No, despite its strange, other-worldly appearance, this is no product of extra-terrestrial intelligence, no flying saucer. It's a perfectly practical, very down-to-earth catalyst collector in a large petroleum refinery. Noteworthy, however, is the extensive use of USS Stainless Steel in its fabrication . . . to provide corrosion resistance combined with great strength.



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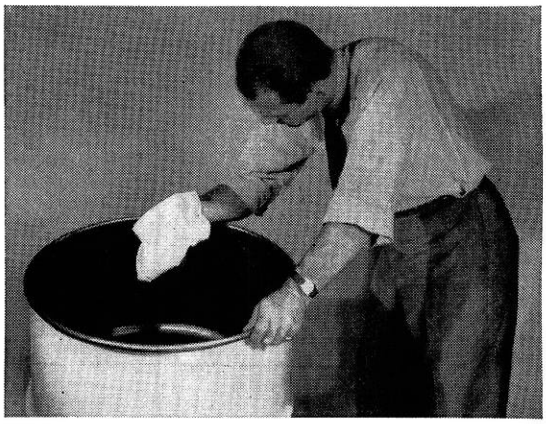

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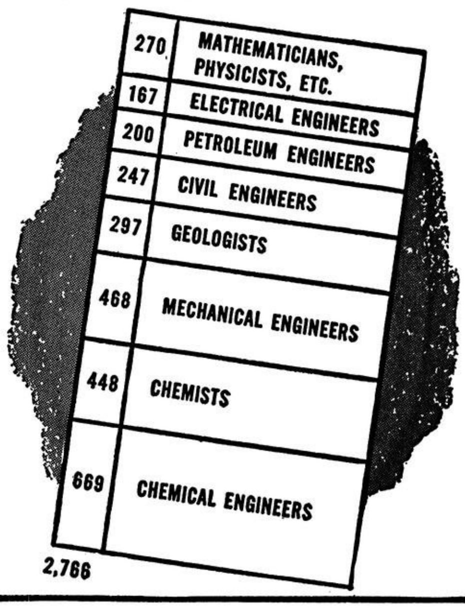

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The Student Engineer's Magazine

WISCONSIN ENGINEER

Founded 1896

In This Issue...

Cover

Last year a class in city planning conducted by Professor L. F. Rader and Mr. W. M. Haas of the Civil Engineering Department took as his project the design of a mall for the School of Engineering campus. The rendering on the cover is the work of one of the students—A. Sidney Malbon. His design follows through from Ag Mall directly across University Avenue to the front of what eventually is to be one large new Engineering Building.

University Avenue is the street at the far left. The diagonal right-of-way is the present railroad track. The completed new Engineering Building is located on the far right.

Articles

Departments

The Student Engineer's Magazine

WISCONSIN ENGINEER

Founded 1896

Volume 58 APRIL, 1954 *Number 6*

Entered as second class matter September 26, 1910, at the Post Office at Madison, Wisconsin, under the Act of March 3, 1879. Acceptance for mailing at a special rate of postage provided for in Section 1103, Act of Oct. 3, 1917, authorized Oct. 21, 1918.

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In and Around
The Great State of WISCONSIN

Wisconsin to Get Westinghouse Network Calculator

A network calculator will be installed at the University of Wisconsin as a gift from the Wisconsin Utilities Association, it has been announced. The calculator, the only one of its kind in the state, will enable its users to solve many complex power system problems.

In addition to the gift of the calculator, a group of Association companies will pay for its use and operation. These firms include: Wisconsin Electric Power Company; Wisconsin Public Service Corporation; Wisconsin Power and Light Company; Madison Gas and Electric Company; Northern States Power Company of Wisconsin; Lake Superior District Power Company; and Allis- Chalmer Manufacturing Company.

The calculator, valued at $240,000 installed, will be built by the Westinghouse Electric Corporation. It will be made available to engineering students and research workers, to members of the Wisconsin Utilities Association, and to all public utilities and industries in the state.

The calculator is scheduled to be ready for operation in the University's new engineering building within two years.

Electric Welding Conference In Milwaukee

The fourth conference on Electric Welding under the sponsorship of the American Institute of Electrical Engineers in cooperation with the American Welding Society, has been scheduled for Milwaukee (Wisconsin) on May 19, 20 and 21 (1954) at Hotel Schroeder. The conference is being arranged by the AIEE Committee on Electric Welding. A full program of papers on electric welding and inspection of welding processes in Milwaukee plants will feature the three day meeting.

E. J. Limpel of A. O. Smith Corporation, Milwaukee, and Chairman of the AIEE Committee on Electric Welding, will be in charge of the 1954 meeting. His executive committee consists of the following:

Papers, A. U. Welch, General Electric Company of York, Pennsylvania; publications, H. W. Tietze, Public Service Electric & Gas Co. of Newark, New Jersey; publicity, R. E. Young of Public Service Company of Kankakee, Illinois; secretary, R. J. Krieger, Titanium Metals Corporation of America of Henderson, Nevada; conference treasurer, C. E. Pflug, Nash Motors Division, Nash Kelvinator Corporation of Kenosha, Wisconsin; local chairman, J. W. Brown, Square D Company of Milwaukee.

Stevens Point Promotes New Industry

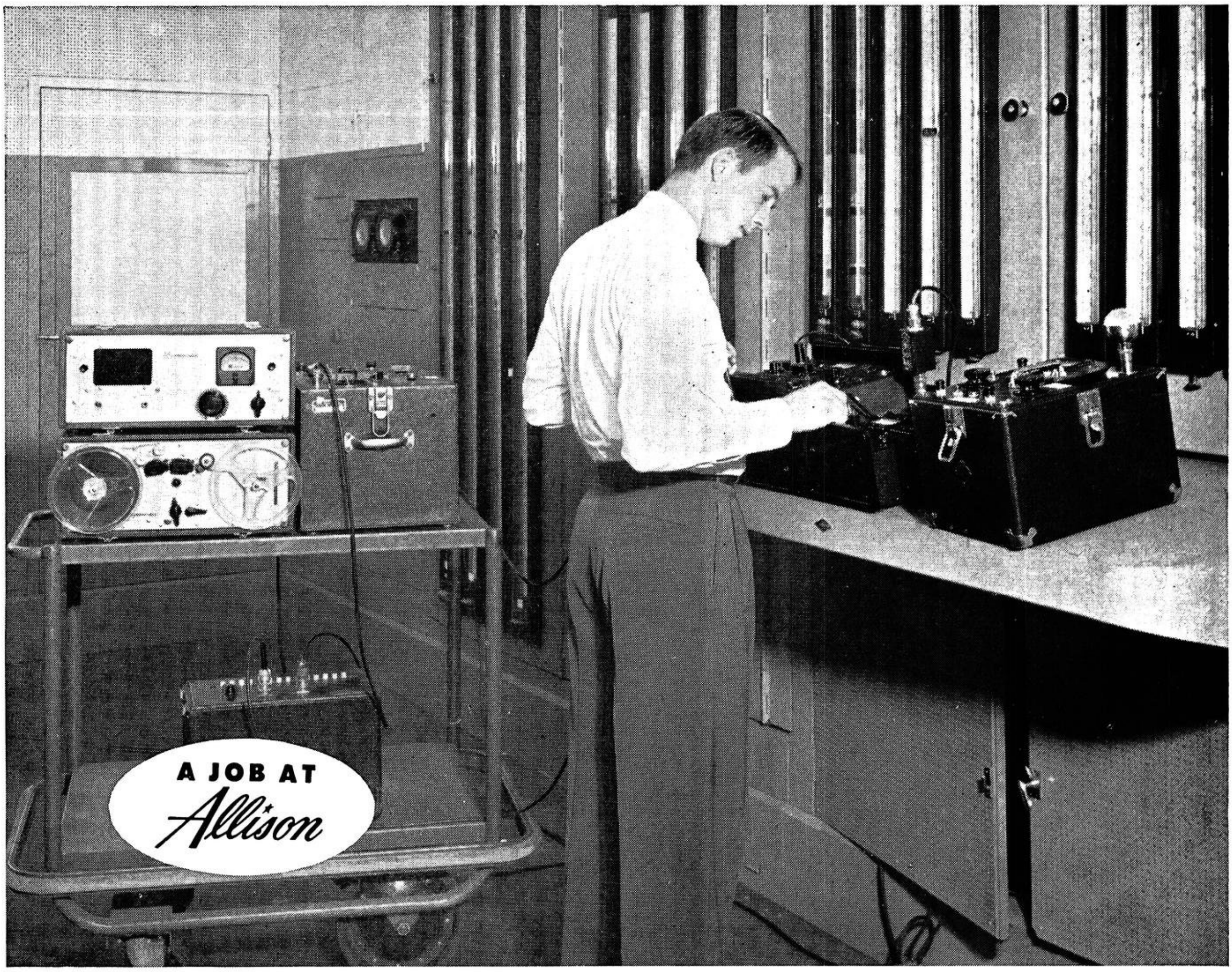
January 4 marked the start of a concentrated campaign by the Stevens Point Industrial Development Committee directed to the attention of industries with expansion and relocation on their schedules. The campaign is based on the results of a recent survey made of the industrial potential of Stevens Point. This study brought to light the advantages of abundant labor, choice plant sites, excellent transportation, easy accessibility to major midwest markets, low-cost utilities, recreational and educational facilities and many other benefits to be found in this central Wisconsin city.

This campaign answers a question which had long been on the minds of many forward thinking businessmen of Stevens Point. Their question: "How can we best attract new industries to Stevens Point?"

The first step these men took toward answering the question was to join together forming the Stevens Point Industrial Development Committee and selecting K. B. Willett, vice-president of Hardware Mutuals Insurance Companies, as their president. The next step involved setting up a plan of action to get industries to locate in Stevens Point. The Committee spent considerable time and effort formulating the course of action to be taken, and as a result of their study they decided to use a "package promotion." As Mr. Willett states, "This well thought out promotion eliminates the trial and error methods used by so many other cities in their attempt to accomplish the same results. There is sound thinking and reasoning in this plan, and it stands a good chance of achieving our goal."

The Committee had a complete study made by Sherrill-Noonan, Inc.; they located the best plant sites, got the most up-to-date facts and figures on the availability of labor, skills, utility rates, rail, air and highway transportation facilities, everything an industry would want to know about. They laid out a plan to help prospective industry in locating and securing the site, designing the building, grading the land, constructing the building, and obtaining necessary utility and transportation facilities, all within a guaranteed completion date and guaranteed-cost lease.

A complete advertising campaign directed to an audience of business executives, stressing the advantages offered by Stevens Point, will appear in leading industrial and business publications. A weekly, direct mail promotion will supplement the space advertising. Illustrated brochures filled with factual information will be sent to all those who request them. The W. H. Long Co., York, Pa., is the advertising agency handling this complete advertising program.


A JOB AT
Allison

Spires of industry rise above the woods and fields of Kershaw County, South Carolina, where E. I. duPont de Nemours & Company has built the first full-scale commercial plant for manufacturing "Orlon" acrylic fiber in the world. Above are units for recovering essential materials for re-use in the process. See the story on "Orlon and Dacron" on page 17.

editorial

Tau Beta Pi is an all-engineering honorary association. It selects its membership from the scholastically outstanding male students in all branches of engineering. This year, the Wisconsin Chapter of Tau Beta Pi was asked to decide whether they wished their constitution to be amended so as to allow women to join the association. The Wisconsin Chapter instructed their convention delegate to vote "No!"; but despite themselves, the convention, for the first time in history, decided "Yes!" The next step in a constitutional change required ratification by three-quarters of the active members. Again, the Wisconsin Chapter countered, almost to a man, with a resounding "No."

I then asked the members to kindly explain this overpowering expression of dislike for the female species. This explanation is presented her by Fred Culver, Tau Beta Pi President and convention delegate from the Wisconsin Chapter. I have presented the minority viewpoint.

Because of this recent turn of events in the question of membership for women there has been quite a bit of discussion both pro and con among the members. Now, not wanting the Association of Tau Beta Pi branded as being misogynistic, I would like to present a few of the arguments against the admission of women.

The first argument stems from a questionnaire sent to 150 of Tau Beta Pi Women's Badge wearers. Eighty six women replied to this questionnaire; of these 21 were either completely satisfied with the present plan and as a result answered no to the question about their preference for membership, the other 63 were in favor of full membership. The results of this poll, although it showed that the majority were in favor of membership, would cause one to wonder about the 24.4 percent who were satisfied with things as they stood.

A further breakdown of this questionnaire shows that nine of these women were still in school; thus when the remaining 77 were analyzed as to what they were presently doing, the results were:

> Of those who were graduated at least 3 years ago or more, 79.6 percent remained in engineering for 3 years. of those who were graduated 5 years ago or more, 51.1 percent remained in engineering for at least 5 years. Of those out of school at least 10 years, only 33.3 percent stayed in engineering for 10 years. The longest anyone in the survey had stayed in the profession was 11 years. Of the 3 women who have been out of school 15 years or more, not one of them is still working.

It is because of these facts that I believe a majority of the men were opposed to the admission of women. They feel that Tau Beta Pi means as much, if not more, to the engineer after he is out of school as it did when he was in. Tau Betes who are alumnus members are proud of their distinction and they actively take part in the furthering of the engineering profession and of their organization. Because only a small proportion of the graduate women engineers stay in the profession it is felt that they can not carry on this tradition effectively.

We do, however, honor and recognize the scholastic ability of women engineers. Up to the present time 164 Women's Badges have been presented to women who have shown outstanding work in the engineering field. Until the percentage of those who stay on in engineering after they graduate rises, it is the opinion of those who are opposed to admitting women that Tau Beta Pi should remain a men's association.

Past initiation procedure of this chapter has placed complete emphasis on scholarship, and virtually no consideration has been given to personality or outside activities. It is in every sense a **scholastic honor society.** And yet, this same organization has put aside scholastic considerations and overwhelmingly voted NOT to allow women to become members. In the two years in which I have been associated with Tau Beta Pi, I have never seen any actual consideration given to anything other than scholastic acumen.

When asked their reasons for voting as they had, the Tau Betes replied that they saw no reason for bestowing this honor on a woman when they weren't sure that she'd stay in the field of engineering—she'd probably just get married anyway. (I defy any and every Tau Bete to guarantee with absolute certainty that they will be in engineering 5 or 10 years from now.) One might as well refuse to give a Medal of Honor to a valiant soldier because he may be discharged and would no longer be connected with the military. This honor is based on what one has done in the past and not on what we think he **may** do in the future.

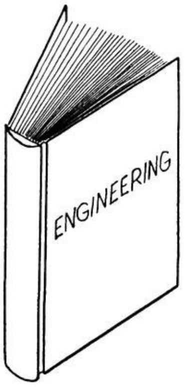
And then, as typical engineers, the "facts" were presented showing that the women did not want membership—three-fourths wanted full membership; one-fourth didn't care. My fellow Tau Betes were concerned over the satisfied 25 percent; well I'm concerned with the dissatisfied 75 percent. How could engineers, who are literally steeped in figures, misinterpret the facts so grossly. The women want membership three to one and that's conclusive evidence in my book.

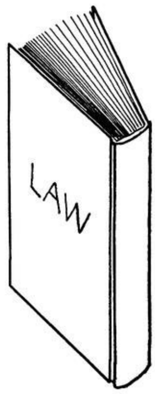
Oh yes, the association has condescended to give Honor Badges to outstanding women, and the Wisconsin Chapter has elected a Wisconsin woman to that distinction this semester. But why must we treat them as inferiors? They have to work just as hard or harder than we males, and they deserve equal recognition for their efforts.

What then is the real reason for this apparent display of discrimination? I've asked many Tau Betes and have received only pseudo-reasons.

It seems to me, fellas, that you feel the presence of a woman would necessarily force obscene jokes and vulgarity out of your conversations. Well I've gone through college with a girl in most of my classes and I really haven't missed too much. I know we're engineers, but why don't you try meeting a girl sometime; they aren't half bad! —**J. E. B.**

Protect Your Inventions





by Ken Kulik, m'56

What Is a Patent?

A United States patent is a grant to the patentee, his heirs and assigns, for seventeen years, of the exclusive right to make, use and vend the invention or discovery throughout the United States and the territories thereof.

Eligibility of Inventor to Obtain a Patent

The patent statute specifies that any person who has made a patentable invention may obtain a patent. However, there is an exception. An employee of the United State Patent Office may not apply for and receive a United States patent. Patents may be granted to an adult or to an infant, to a man or a woman, to a citizen or an alien. An insane inventor can apply for a patent through his legal guardian; the executor or administrator of a deceased inventor can apply for a patent on the inventions of the deceased.

A corporation, partnership or organization cannot apply for a patent, but the patent application may be assigned to any of them by the original inventor.

What Is Patentable?

The statute specifies that patents may be issued for any new and useful art, machine, manufacture, or composition of matter, or on any new and useful asexually reproduced variety of plant other than a tuber-propagated plant. An art is a process—an operation or a series of operations performed on matter to effect a desired change in form, properties, or composition. A machine is a combination of mechanical elements acting on matter to produce a desired result. The term 'manufacture' as used in the patent law has a very comprehensive sense, embracing whatever is made by the art or industry of man, not being a machine, a composition of matter, or a design. A composition of matter is a chemical substance or a combination of substances.

The Form of the Application

Section 4886 of the revised statutes specifies that the inventor of a new and useful device "may, upon payment of the fees required by law and other due proceedings, obtain a patent therefore." Each original application must be accompanied by a filing fee of sixty-five dollars plus one dollar for each claim in excess of twenty claims. When the patent is issued, the patentee must pay a final fee of sixty-five dollars plus one dollar for each claim in excess of twenty claims. The term "other due proceedings" covers the filing of an application in proper form and the proper prosecution of the application until granted. The application consists of the filing fee, as previously specified, a petition requesting the granting of the patent, an oath, and the specification and claims. In the oath, the applicant swears that he believes himself to be the first inventor of the invention described in the specification.

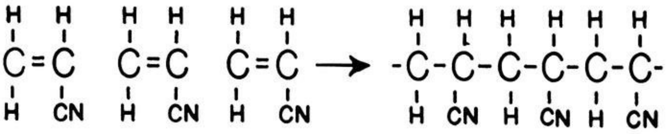
The specification and claims constitute essentially a single document. The specification, as distinct from the claims, is a full description of the invention. It may, and usually does, contain some discussion of the related art and makes clear just how the invention relates to that art, and precisely in what respects it represents an advance over the previous knowledge and practice.

The claims are the essence of the patent. Only those aspects of the disclosed invention that are specifically claimed are protected; all other are dedicated to the public. A single patent may convey one or many claims, the number depending on the scope and complexity of the invention. There is no limit to the number of claims allowable. Each claim must cover a unique aspect of the invention and be based on a disclosure in the specification.

When the nature of the invention admits of disclosure by drawings, drawings must be submitted with and as part of the specification. When the examiner so requires, a model must also be submitted. The drawings that accompany an application are not ordinary mechanical drawings but must be in special form, as specified in the rules of practice.

(please turn to page 58)

ORLON



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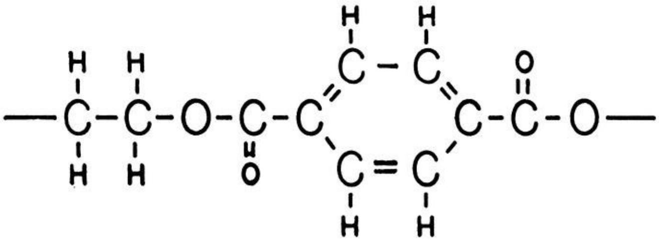


DACRON*

Better Things For Better Living

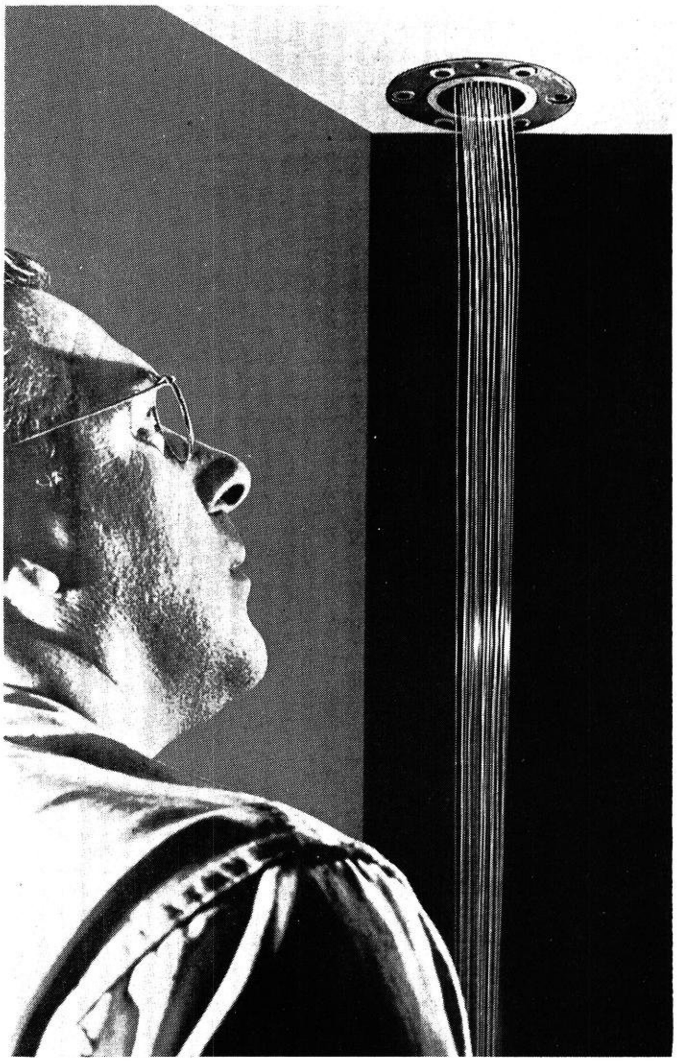
by Robert A. Hentges, ch'55

HISTORY AND DEVELOPMENT

Like many of the engineering miracles which have appeared on the industrial horizons in recent years, the minds of men who lived centuries ago were the origins of "Orlon" and "Dacron." Throughout the early history of the world man lived in fear of nature, and was content to humble himself before it, merely observing with fear or wonderment its various phenomena. Then man became bolder; he began to seek explanations of his observations, and then to put his ideas—and nature—to work. Finally, in the last century and especially in the last three decades, man has been defying the so-called laws of the universe and has been rejecting the products of nature in favor of those born of his own ingenuity.

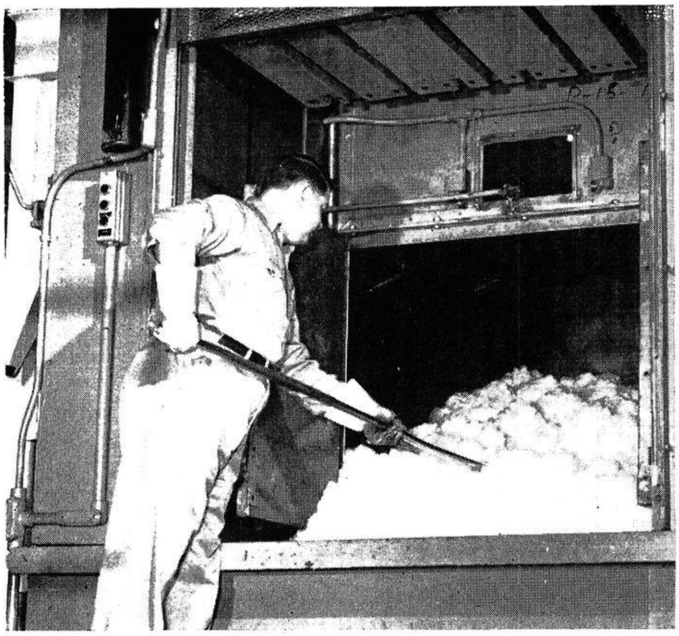
The history of synthetic fibers, the development of which led to "Orlon" and "Dacron," is a good example of man's evolution from slave to master of his environment. From the time that man discovered the art of spinning and weaving, he was plagued by the crudities and limitations of the raw materials, and the unstable economic system which produced them.

In 1664, the British physicist, Robert Hooke, predicted the development of artificial silk, the natural product being a costly product of the Orient. He realized that the problem involved the finding of an "artificial glutinous composition . . . much resembling that out of which the silkworm wiredraws his clew," and he stated that "if such a composition were found, it were certainly an easy matter to find very quick ways of drawing it into small wires for use . . . I need not mention the use of such an invention, nor the benefit that is likely to accrue to the finder, they being sufficiently obvious." Hooke had the insight into the problem, which indeed resolved itself into the finding of a composition with the desired physical and chemical properties, and shaping and drawing this composition into wires or filaments.



The birth of "Dacron" filaments. From tiny holes in this spinneret are extruded fine filaments of "Dacron". All of the filaments shown here will be wound together to form a single strand of yarn.

*Registered trade mark of E. I. duPont de Nemours & Company, Incorporated.



"Dacron" as it enters the baling machine to be packaged for delivery. This is the last step in the processing of the fiber which was first a chemical solution, next a molten mass, then a mass of endless filaments forced through a spinneret. Thousands of such filaments, cut and crimped, reach the form shown above.

However, little progress was made until 1880 when Count Chardonnet produced an "artificial silk," a regeneration of naturally found cellulose from cellulose nitrate. His production of the filaments, or fibers, resulted from the observation of a spaghetti machine extruding the large filaments of spaghetti. After Chardonnet's discovery of his "artificial silk," which was really only externally modified cellulose, chemical science attempted to find a truly man-made material as a starting point, but again could proceed only slowly.

In 1920, the Du Pont Company bought the United States rights to Chardonnet's viscose process from the Comptoir des Textiles Artificiels in France and set up the Du Pont Fibersilk Company in Buffalo, New York. In 1928 Du Pont began development of acetate rayon in this country as the result of another French negotiation. Their knowledge of cellulose chemistry through the production of smokeless powder contributed to the tremendous subsequent development of rayon. However, at this time chemistry still had not penetrated the structure of matter, and both viscose and acetate rayon were still only exterior modifcations of nature's own cellulose—therefore only semi-synthetics.

The birth of the truly synthetic fibers occurred in 1927 when the late Dr. Wallace H. Carothers, probably the most brilliant organic chemist this country has seen, began his program of fundamental research at the Du Pont Experimental Station. By early 1930 he found that ordinary condensation reactions or organic chemistry (i.e., reactions in which two substances join as the result of the elimination of one molecule of water between them) could be used to synthesize linear molecules of high molecular weight. These molecules, called polymers, are compounds which have entered a so-called chain reaction with themselves to form long chains of repeating groups, much like a chain of paper clips.

In 1930, during his investigations, Carothers learned that some of these polymers were soft and pliable when removed from the still in which they were made. After cooling, this plastic-like mass culd be further stretched to three or four times its original length and became stronger and more elastic than the original form. This was the important discovery which led to the development of truly synthetic fibers. Carothers decided to devote his entire study to polyamides, as a result of which decision he discovered and developed nylon. However, as a result of his published work in fundamental polymer research, a British firm worked out an idea which led to the discovery of "Terylene"—a synthetic fiber derived from the same polymer as "Dacron." The production of fiber-forming condensation polymers was found by Carothers to be general phenomenon, provided the molecular chains possessed symmetry.

In 1940, J. T. Dickson and J. R. Whinfield, working in the laboratories of the Calico Printers' Association, Ltd., of Lancashire, England, started further study into this idea and as a result discovered the fiber-forming properties of the polymer of terephthalic acid and ethlyene glycol, known as polyethylene terephthalate. Although exhaustive research into many related compounds was carried out, no other polymer gave such a powerful combination of physical and chemical stability which ultimately led to its development as a major synthetic fiber. This development was delayed, however, until after peace had been restored following World War II.

After the war the patent specifications of "Terylene" were published, and the Du Pont Company, whose researchers had independently undertaken a search for new fiber-forming polymers, learned of the discoveries of Whinfield and Dickson. In 1946 they negotiated for the purchase of the United States patent rights to polyethlene terephthalate, then owned by the British firm. Du Pont gave this polymer and the resulting synthetic the title Fiber V and conducted further development work on it.

The discovery of "Orlon" came about in 1941 when Du Pon't Rayon Division was experimenting with a substance called acrylonitrile to increase the wet strength of nylon. They decided that this compound was suitable for polymerization into a good fiber itself. Consequently, Du Pont's chemical department did fundamental research on the polymerization of acrylonitrile under the direction of Dr. Hale Charch*, who developed moisture-proof cellophane. Development of this polymer was also delayed by the war, however.

Having found the "artificial glutinous compositions" of the desired chemical and physical properties, Du Pont bent its efforts to the commercially feasible production of these fibers.

*Influential in the development of "Orlon" acrylic fiber was Dr. Donald Gordon, a University of Wisconsin Chem. Engineering graduate in 1936. He received his Ph.D. in 1942, also at Wisconsin.

CHEMISTRY AND MANUFACTURE

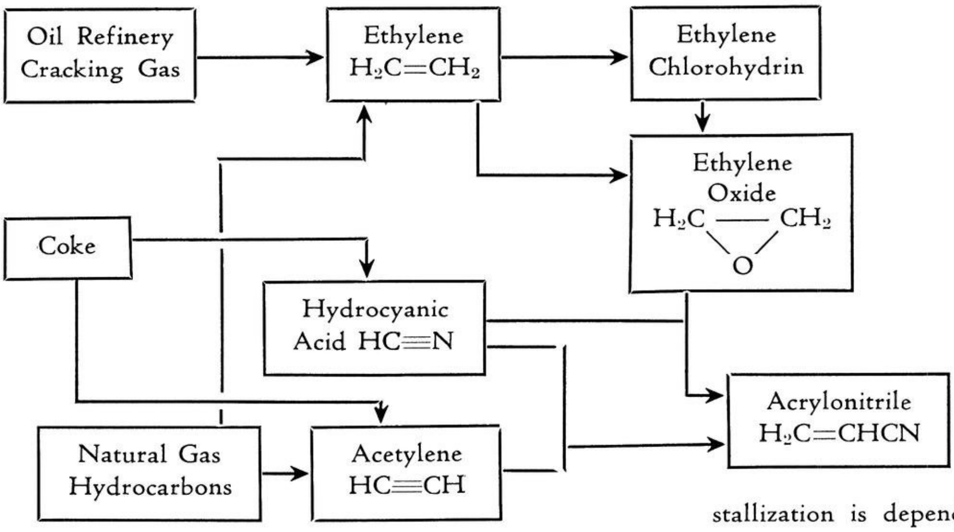


Figure 1: Manufacture of "Orlon" monomer from basic raw materials.

Acrylonitrile can be produced by reacting hydrocyanic acid with either acetylene or ethylene oxide—both heavily produced chemical building materials. There are differences of opinion regarding the relative economies and the purity of products of the two processes for the manufacture of acrylonitrile as indicated. However, each process supplies about one-half the total output.

The polymerization of the acrylonitrile to give "Orlon" is unlike that of dimethyl terephthalate in that there is no loss of water or other basic group in the joining of the monomers. The mechanism of the reaction is the breaking of one of the two bonds of the carbon-to-carbon double bond, and the joining of the two severed ends with broken bonds of other monomers. This type of polymerization is merely an additive reaction in which the molecules always align themselves in the same way.
(Figure 1)
The polymerization product is a hard, ivory-white, resin which is infusible and insoluble in most organic solvents.

Du Pont engineers did not agree with Hook's statement about the easy matter of finding ways to draw out the fiber into threads. They found many obstacles in their paths, the lack of solubility only one of them. The mechanical shaping of the polymer is accomplished by extruding either the melted polymer or a solution of the polymer through tiny orifices in a spinneret. (See Figure —). As the viscous fluid comes out it is instantaneously and continuously solidified into a filament. There are two methods of spinning: "Dacron" is produced by solidifying the fiber as it comes into contact with the atmosphere—this is called dry spinning; "Orlon" is spun by coagulating the polymer in a liquid bath—this is called wet spinning.

The nozzle for spinning fibers contains 15-150 orifices with uniform diameters between 0.07 and 0.10 millimeters. The number of holes fixes the number of separate fibers in the thread or yarn. Their thickness is determined by the ratio of the quantity of polymer supplied per hole and extrusion velocity. This thickness is expressed in deniers, by which is meant the weight in grams of a fiber of 9000 meters.

When a fiber is spun from a polymer melt or solution, the randomly arranged linear molecules of the system assume a certain degree of longitudinal and lateral order.[8] These degrees of order depend upon the degree of polymerization and the degree of stretch applied to the filament during the spinning process. The ase of spinning, or crystallization is dependent upon the degree of symmetry in the arrangement of the molecular chain—crystallization is favored by symmetrical substituents. Also, those molecules having relatively rigid and inflexible chains crystallize more readily than those possessing a high degree of internal flexibility. Both polyacrylonitrile and polyethylene terephthalate have the symmetry and rigidity which favor crystallization.

The spinning of "Orlon" was the result of much investigation to find a suitable solvent and a suitable process. It was found that yarns of high tenacity, elongation, lustrous appearance, and free from voids could be prepared by wet spinning, in which a solution of 10-30% acrylonitrile in a volatile (easily evaporated) solvent such as dimethyl formamide was extruded into a bath at 70-120°F. The bath contained a non-solvent for the polymer, such as a 12-32% solution of sodium thiosulfate.

As a result of further development, it was found that higher tenacity yarns are obtained by extruding the poly-

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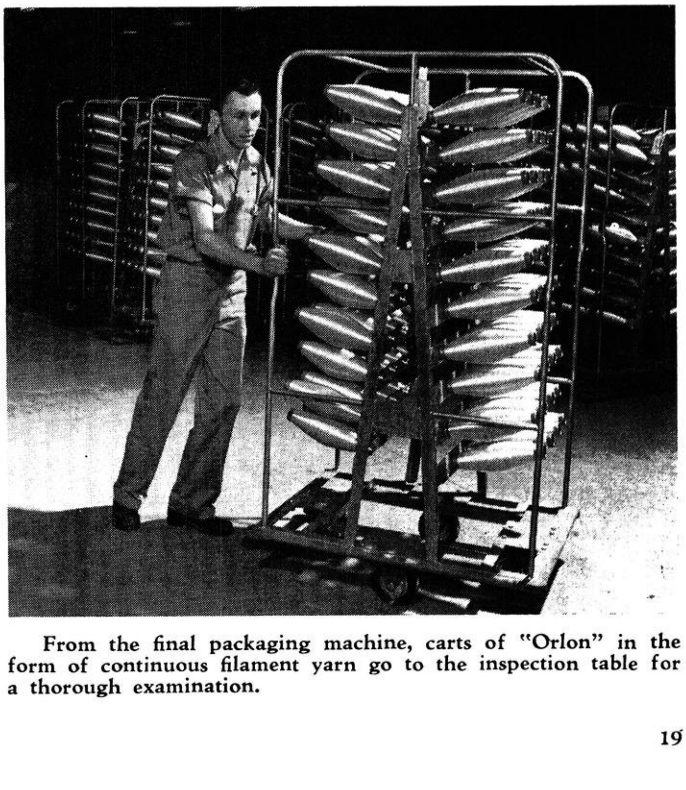

From the final packaging machine, carts of "Orlon" in the form of continuous filament yarn go to the inspection table for a thorough examination.

FREEWAYS—

Are They Economical?

by Richard White, c'55

A Brief History of Our Traffic Problems

During the past decade a great problem has risen in America—that of providing adequate transportation facilities for its millions of automobiles, trucks, and busses. This problem is not restricted to any one state or locality, but is instead felt in practically every section of the country. Fortunately, Americans are finally facing the fact that we need to improve our highways, and many discussions of various remedies are being held at federal, state, and local levels.

Probably the most glaring evidence of the poor condition of our highways is the great death and injury toll that occurs from the thousands of accidents each month. True, many of these accidents are due to carelessness and speeding, but a great majority of them could be prevented if the highways were in the condition they should be. Automobile ownership and use has increased at a tremendous rate during the past 30 years, going from 9,239,000 in 1920 to 54,709,000 in 1953. From 1945 to 1950, automobile registration increased by 18,538,367, an incredible expansion.

The story of highway expansion, however, is something quite different. America's greatest boom in road building came during the period following World War I and continued until the early thirties. A system of highways was developed that was without equal anywhere in the world, and most Americans developed the viewpoint that our road building was completed. People became indifferent toward the planning and construction of new and better highways for the ever-increasing number of vehicles being placed on them, and turned the entire job over to the government.

This was probably one of the most serious mistakes of the last fifty years in highway transportation. After this boom, the depression set in, and not enough work was done on highways to account for the increases in motor vehicle registration. By 1941, highway engineers realized that our widespread highway system was only the beginning of a system adequate to accommodate the demands being placed upon it. Then came World War II, and highway development was stopped almost completely by the nation's mobilization for an all-out effort. After the war was over in 1945, our factories began producing automobiles and trucks by the millions to satisfy the public's demand for new and better transportation. Highway conditions since then have become so bad that critical breakdown has threatened in some sections of the country.

However, there something else was also happening during this same period. Through efforts of state, federal, and local highway officials, motor clubs, and innumerable newspaper and magazine articles, Americans began to realize that our highway system must be expanded if they were to continue riding around in their new and luxurious autos. Tens of thousands of people were being killed on our streets and highways each year, and many more were being injured, crippled, and disfigured. Cities were one gigantic traffic jam; and highways were crowded with a mixture of passenger cars and commercial vehicles. Tempers were short and accident rates grew at an ever-increasing rate. As a result of all these factors, motorists demanded more adequate highways, and many toll roads were constructed and opened to the public. People were happy to pay the toll fees if they could drive on a smooth and relatively safe highway, free of dangerous crossings, intersections, and stop lights. More and more toll roads and superhighways are in the planning or construction process at the present time, and these highways will certainly help to alleviate the problem of getting vehicles from one city to another. However, most of the undesirable conditions listed above still exist. It will be a long, hard, and extremely expensive task to get adequate rural highway systems in America.

Urban Traffic Problems

Now let's turn to the problem of transportation in and near the nation's many metropolitan areas. Some people have suggested banning passenger cars from the busy streets of American cities, but this seems a little too regimental in a free country such as America. The main thing that has been and is being done is the construction of downtown superhighways and freeways. However, there has been great disagreement over the development of urban freeways because of the extremely high cost of constructing them. Since many freeways cost 5 or 6 million dollars per mile, both economic and non-monetary studies of the benefits to the motorist taxpayer were certainly needed. Such a study was recently made for the Los Angeles metropolitan area under the direction of Lamar W. Gardner, civil engineer for the street and parkway design division of the city of Los Angeles. A very complete and detailed analysis was made, and the results given here apply to the more heavily traveled parts of the Hollywood and Arroyo Seco freeways. Minimum benefits within the areas considered are:

Minimum Benefits to Motorists Using Freeways
(Average Savings per Vehicle Mile)

(1) gasoline savings	0.33c
(2) maintenance cost savings due to elimination of stop and go travel	0.24c
(3) accident savings	0.56c
(4) time savings (commercial vehicles only)	0.87c
Total	2.00c

Analysis of Savings

(1) Gasoline savings—Stops in traffic sharply increase gasoline consumption. The Automobile Club of Southern California made some speed and gas consumption studies which revealed the following data:

Speed	Miles per gallon (No stops)	Fuel cost per mile, in cents (No stops)	Mile per gallon (5 stops per mile)	Fuel cost per mile, in cents (5 stops per mile)
25	23.867	1.17	15.748	1.78
30	22.750	1.23	13.600	2.06
45	20.000	1.40	9.685	2.89

Assuming that motorists using the freeway would travel at 45 mph with no stop, the motorists using the average surface arteries would travel at 3 mph with 5 stops per mile, the cost per stop would be (2.06—1.40)÷5=0.13c. Using 2½ stops per mile (this figure was determined in speed and delay studies on the major boulevards paralleling the freeways), the savings to motorists using the freeways would be 2½×0.13=0.33c per vehicle mile.

(2) Savings in tires, brakes, oil, and general maintenance due to elimination of stop and go travel—Checks

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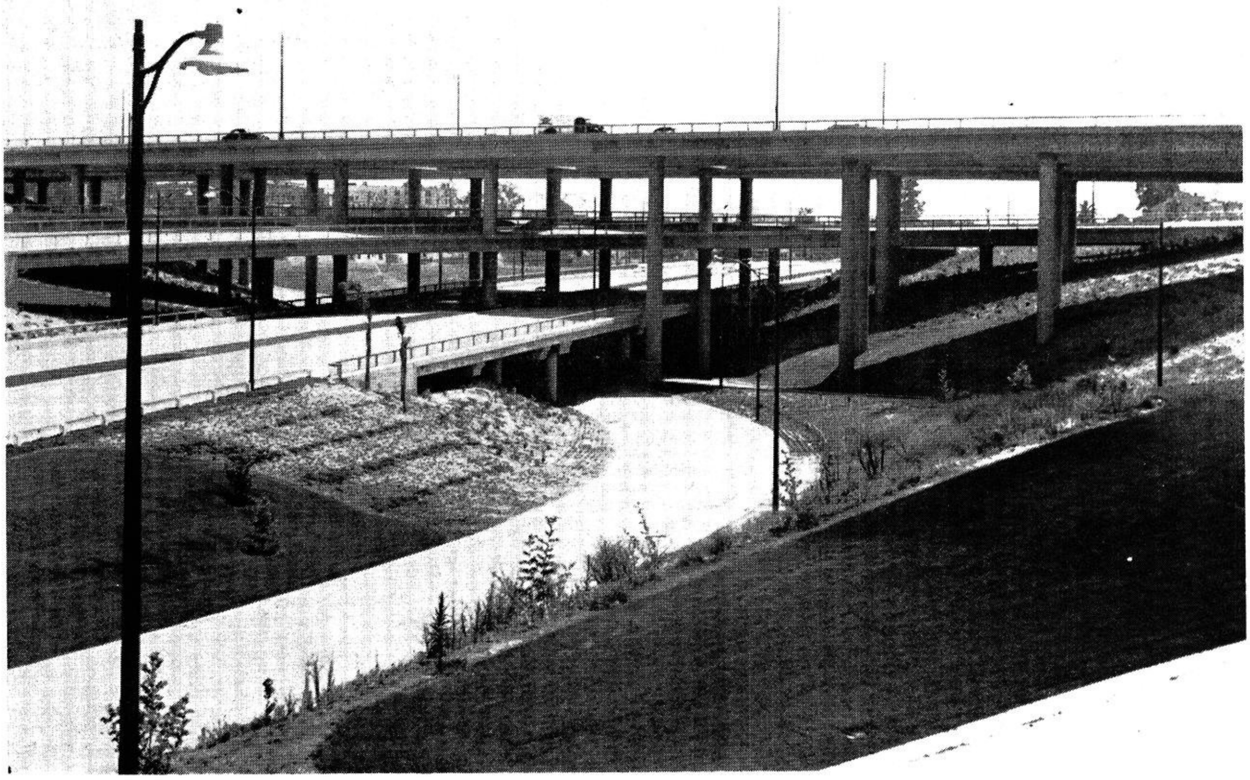

"The Stack"—4 level interchange at the intersection of Harbor Arroyo-Seco, and Hollywood freeways.

Industrial Engineering

an open field

by R. L. Daggett, Assoc. Prof. of Mechanical Engineering

One finds today many titles within the field of engineering given to men who have specialized in a particular phase or interest and as such may call themselves electronics engineers, ceramic engineers, petroleum engineers, heating and ventilating engineers, design engineers or whatever is apropos of their work. It is only natural that with the extension of engineering methods and techniques into these and many other production areas that one finds engineers working under particular titles such as those mentioned above.

The question is frequently asked "What is Industrial Engineering? What does an industrial engineer do? Is this a new field? What courses can a student take if he is interested in this type of work?" The answers to these questions and similar ones should help to explain the scope of this phase of engineering work, its origins and some of its problems. Before specifically answering these direct questions the writer would like to develop some of the background of the industrial engineer from several simple examples. These should help to define it even though indirectly.

When a small industrial plant is started, its principal problem is manufacturing of some product. Most of its initial efforts seem to be directed toward the function of physically making the product. The enterprise soon finds, however, that it has a marketing problem also and in addition an ever present problem of financing its operations, both from the long range investment in facilities of all kinds and from the short range day to day operations. Thus it is typical of small plants that their three problems are production, marketing and finances. Growth of these small concerns brings increasing emphasis on a fourth function which can be called technical or research in a broad way. Such technical effort is directed into two channels, namely product design and equipment development. Actually many smaller organizations can form around the nucleus of these four basic functions headed by an alert management function.

With further growth, problems in the industrial enterprise seem to accumulate faster than the firm can afford to cope with them. One finds a complex group of supporting functions and departments developing within a growing concern in response to the enlarging needs of the business. In other words functions which were secondary or less important in the early phases of the business now become of increasing importance. Work which formerly was of a part-time nature now becomes full time work because of the greatly amplified needs of the enterprise. Supporting functions such as purchasing, personnel, inspection and quality control, materials control, stores, shipping and receiving, materials handling, production planning and similar activities assume increasing importance. In the small plant one finds the production foreman or supervisor able to do materials purchasing, selection of equipment, making decisions as to how parts are to be manufactured, developing tooling and planning the arrangement of his department, all as a normal part of his active supervision of production. But with the enlarged plant, with increasing emphasis on more production, a greater variety of products and all production problems expanded in scope, the foreman as an individual has been badly overloaded. Increasingly apparent to the growing industrial enterprise is the need for both technical assistance and better maufacturing planning. This has been the "area" into which the industrial engineer has fitted in the manufacturing enterprise.

Industrial engineering thus encompasses many technical and planning functions associated with production, internal plant operation and organization not directly covered by the engineering design and development groups working on the product or process equipment. These functions will be clearer with another simple illustration which follows.

Assume for a moment that a group of mechanical engineers are to be assigned to the development and manufacture of a small internal combustion engine. This group will essentially divide into three basic "interests" or types of technical activitiy. One group will be primarily interested in engine performance, operational characteristics, thermal functions, fuels, power output and those elements associated with its effectiveness as a heat power device. These might be the themodynamic specialists within the group.

The second group will be primarily interested in its design for optimum performance and economical manufacture. This will include all of its mechanical elements such as bearings, cranks, piston rods, frame, gears, etc. The kinematic relationship between the various components as well as the proportioning of all engine elements on the basis of strength, wear, cost of manufacture, ease of servicing, etc., are of paramount interest to this group. Engine performance in terms of speeds, vibration, torque characteristics power output all are essential factors in this design for economical manufacture which we term machine design.

The third group whom we might call the industrial engineers will concern themselves with how the engine is to be produced economically. Beginning with a proposed schedule of output this group would determine how every component part is to be manufactured (or if it seems feasible, which are to be purchased,) determination of operations to be performed, equipment and all tooling required to support the schedule, determination of materials quantities, preparation of operation sheets and manufacturing information. Further this group would plan the plant layout, determine area and facilities required for the entire plant, develop the best materials handling methods, determine organization requirements, number of people required, costs of producting each unit and setting up either performance or quality standards on each job.

Thus it is that industrial engineering has sometimes been called "production engineering." Its essential function begins when the engineering design is "frozen," drawings are complete and the product is ready for production. All of these functions mentioned above are technical problems of a high order involving engineering techniques and work but involving a different type of data, information and range of interests than we may normally associate with engineering work.

For purposes of simple illustration the writer has perhaps compartmentized the three phases of mechanical engineering too completely. Suffice it to say, the three areas must overlap and cooperate completely in their respective duties. One cannot define strict boundaries between these groups. Actually mechanical engineers have training in all three areas.

These illustrations might help to define industrial engineering as the application of the engineering approach and methods to any phase of production, plant organization or facilities, procedures or planning for production. As such the industrial engineer may apply the analytical approach to problems of a specific nature (such as a single operation or manufacturing problem) or to studies of plant-wide scope. The engineering approach remains basically the same irrespective of the size of the problem.

Much of the comment to this point revolves around work of the industrial engineer as a plant may be adding new products or production facilities. The reader still may be interested in what an industrial engineering department or group might be assigned to do over a period of years; or let us assume such a group is given free access to find its own list of projects for analysis, recommendations and followup. The following list, by no means complete, but certainly typical, might result.

1. Analyze the problem of plant location, involving the moving of the main plant or establishment of branch plants or warehouses at one or more proposed points. This is a broad problem involving months of research and fact finding, evaluation of prospective locations, analysis of all costs and operating considerations.

2. Objectively analyze all the key jobs in the industrial organization, determine functions, responsibilties and authorities and draft an organization chart followed closely by a complete written manuel outlining each function or job in detail. Objective and unbiased analysis is often the key to internal organization improvement. Too often one finds organizations built up around one or more strong individuals where actually the structure should be developed around functions. This analysis and improvement of organization is a logical area of interest for trained and competent industrial engineers.

3. Develop and install a job evaluation system in the plants as basis for equitable wage rates, increases, range of earnings for each job. Job evaluation is the objective analysis of the factors required in the performance of any job in the plant, the weighing and grading of those factors and the relating of those factors to the proper pay for the work to be done. Its principles are applicable in plants of all sizes.

4. Analyze the present arrangement and develop a new layout for one or more manufacturing departments to improve the flow of materials, to reduce in-process inventories of materials, to make supervision easier or to reduce materials handling. Plant layout studies may involve a specific operation, a group of operations, a division, or an entire plant, existing or proposed. Too often "plant layout" involves spotting each machine as it arrives into any space available at the moment. Eventually a plant is filled with equipment bearing no relationship to the daily production flow of materials. Good layout begins with objective analysis of production needs and proceeds to the orderly arrangement of each machine in relation to the others.

5. Develop and present a full economic analysis of a proposed production method (or equipment) versus some present method, evaluating all labor, materials and over-

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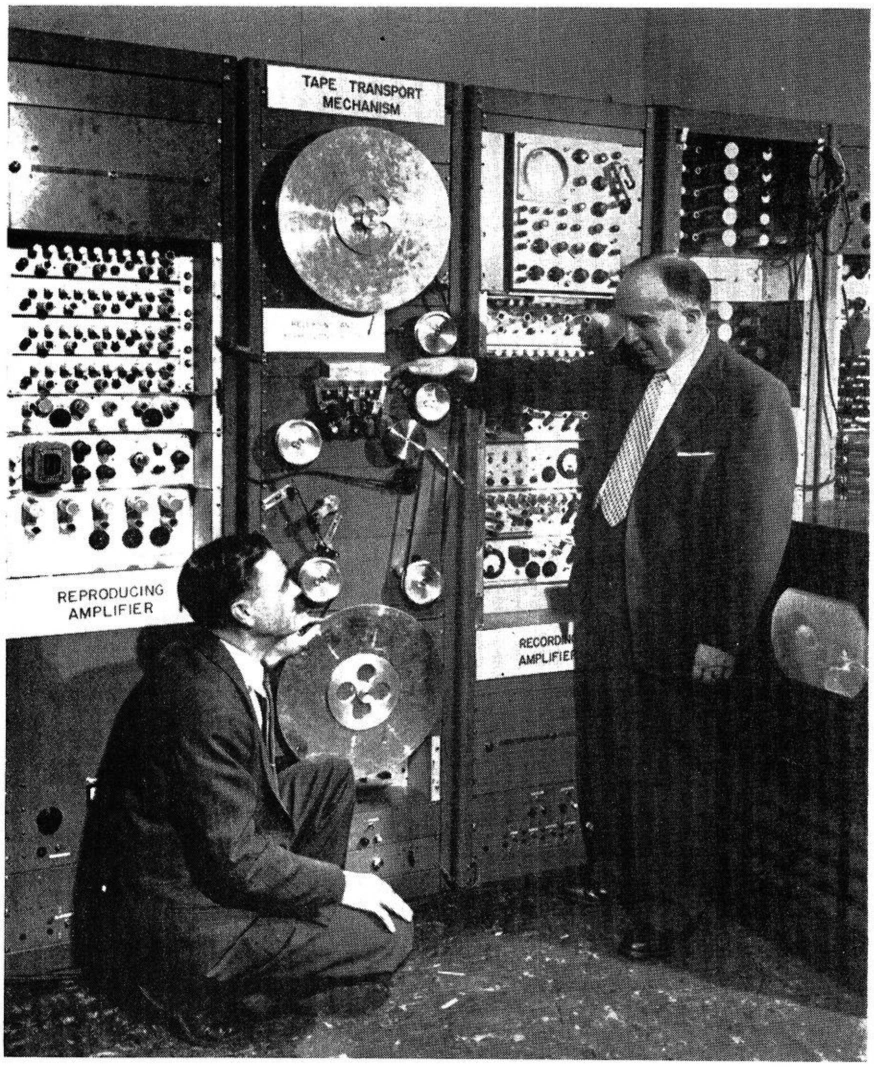
ELECTRONIC PHOTOGRAPHY

by Richard Paske, e'56

Photography without film impossible? Who said that? Recording of television pictures on magnetic tape in color and in black-and-white has already been publicly demonstrated, and that is only a preview of new techniques which will simplify the entire art of making pictures in motion.

How Tape Works

While electronic tape equipment is still in the development stage, its basic principles and principle elements have been tested and confirmed. This new method of recording sight is similar in basic respects, to the techniques used to record speech and music with present day magnetic tape sound equipment. Electrical signals are impressed through a recording head—a small horseshoe electromagnet—onto the magnetically treated surface of a plastic tape. As the tape is drawn across the recording head, the head continuously changes the magnetic polarity of the magnetic oxide particles on the tape so that they become a compact code of the origional signal. For playback, the tape is drawn across the same or a similar head. The magnetic shorthand on the tape causes an alternating current which closely duplicates the origional signal to form in the winding around the recording head.

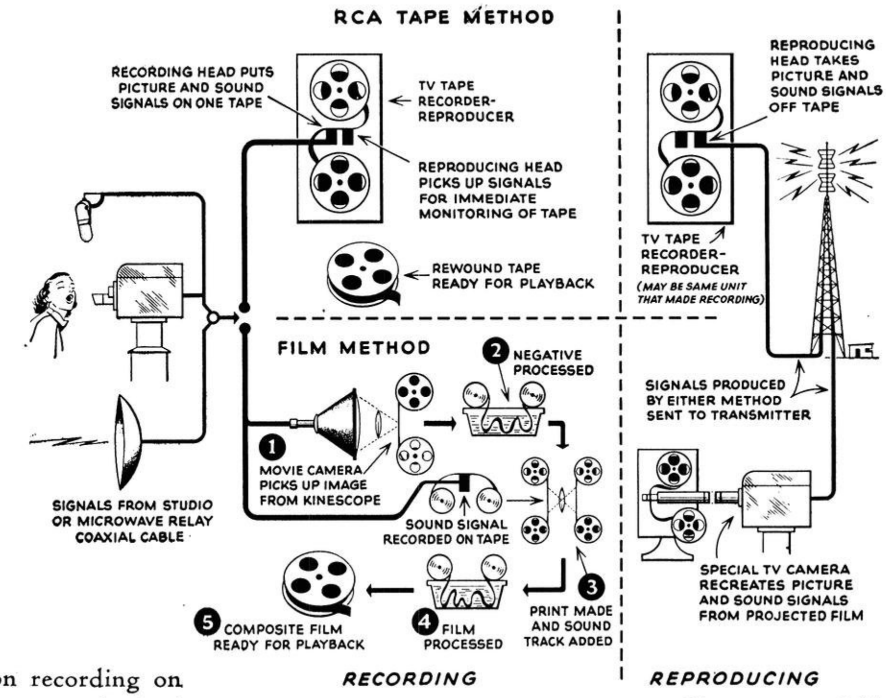


Laboratory equipment on which the first public demonstration of both black-and-white and color television was made. (The last two racks on the right are for test purposes and are not part of the video tape recorder).

Although the principles are similar, the engineering problems are not; audio recording is today an easy task compared with video recording. The reason is that audio signals are in the range of 20 to 20,000 cycles per second, while video signals range up to 4,000,000 cycles per second. However, high-frequency recording heads have already been developed, recording and reproducing heads which respond to frequencies many times above the cut-off point for the recording heads used in sound recording on magnetic tape. This means that the speed of the tape has been brought within manageable limits. The equipment as demonstrated had a tape speed of 30 feet per second, and further reductions of tape speed appear likely.

Since even small variations in the speed of the tape and in the pressure at which it bears on the head can create noticeable effects in the picture, it has been necessary to devise precision apparatus to control accurately the speed of the tape at the recording and producing points. Already video tape equipment controls these many times more accurately than is necessary in magnetic tape recorders for sound, but even greater precision in regulating speed and pressure appears possible through research which is now underway.

For video tape recording of color television, five parallel channels are recorded on a single magnetic tape ½ inch in width. There is one recorded channel for each of the primary color signals (red, green, and blue), for the synchronizing signal, and for the sound signal. For black-and-white recording the tape carries two recorded channels, one for the video signal and the synchronizing signal, and one for the sound signal. For black-and-white television, a ¼-inch wide tape would suffice.



Photos courtesy RCA

In the demonstration of color television recording on magnetic tape, the five recorded channels were obtained from the output of a color television receiver. In reproducing from the recordings, the tape supplied the three primary color signals direct to the three electron guns of a tri-color kinescope. To rebroadcast a color television program from a tape recording as demonstrated, it is necessary to combine the three primary color signals with the synchronizing signal to form a composite signal to send to the transmitter. While this operation is not yet ready for demonstration, it is reported to be the subject of current development that will provide the necessary apparatus to produce this result.

Advantages over Film

Magnetic tape has numerous advantages over ordinary film. It requires no chemical processing, a costly operation, and can be viewed immediately after it is taken. This adds a new flexibility in making motion pictures since, if lighting or camera angles are poor it is noticed immediately, and retakes can be taken while the stage is still set up. An unlimited number of copies of magnetic tape recordings can be made quickly, thus facilitating distribution, especially of newsreels which are soon outdated. Recording tape can be preserved indefinitely for historic reference, or, if desired, can be electronically 'wiped off' and reused again and again.

Savings with Video Tape

Comparative estimates of operating costs (which include payroll, cost of tape or film and amortization of equipment) are highly favorable to tape methods. Although magnetic tape today costs more per minute of program time than 35mm color film, the fact that tape needs no processing before playback compensates for the expense of raw tape. Engineers point out that what makes the savings on tape so great is the fact that the program can be electronically 'wiped off' and the tape reused: in most normal operations it would be reused many times.

Recording black-and-white programs on film is estimated to be at least five times as costly as it would be on ¼-inch magnetic tape, assuming that the tape would be reused many times. Even greater economies are estimated for making the original tape recording of color television programs, which, under normal operating circumstances, could be handled for only five percent of the cost entailed in color film recording. In making copies on tape that is to be used over and over again, a tape recording of a half-hour color program would cost roughly $20.

Thus the importance of video tape recording for the future of the television art can be readily seen. It will give the television industry a practical, low cost solution to program recording, immediate playback and rapid distribution. Video tape will be important for black-and-white broadcasting. It will be essential in the creation of a full color television service.

Future Video Tape Uses

Though the demonstration of magnetic tape was concerned primarily with its adaption to television, its use is in no way restricted to this field. Further development of video tape techniques will open up numerous possibilities. An all electronic chain of portable television camera, video tape recorder and standard television receiver, would make a convenient and versatile system for making amateur as well as professional motion pictures. It will speed the preparation of newsreels and will be a useful tool for news reporters. The tape would not have to be sent away for processing with its attendant delays and extra costs. In the home, the tape equipment could be used for home movies, or connected to the television set to make a personal recording of a favorite television program.

Photography without film impossible! Who said that?

THE END

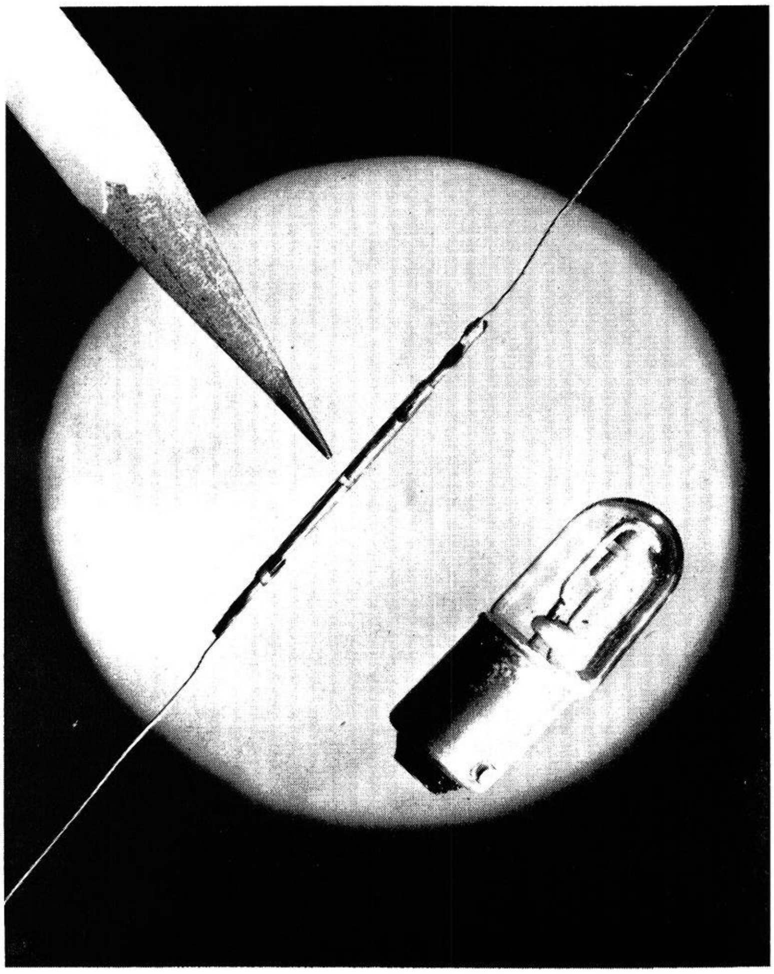
SCIENCE HIGHLIGHTS

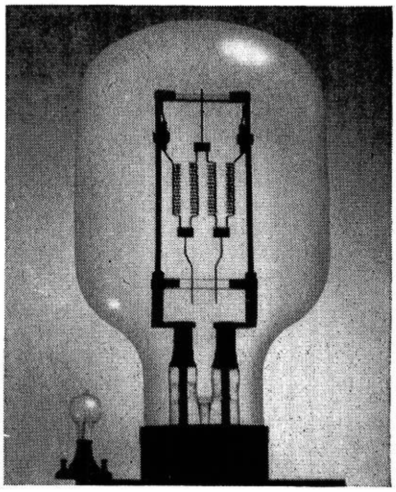
Edited by John DuBois, e'56

MIDGET LAMPS FOR LABORATORY USE

A new Westinghouse light source is smaller than the head of a pin. It is a sub-miniature, neon-argon glow lamp and has a special job to do. Fifty of them are laid out side by side in front of a moving strip of 35-mm film for recording events in laboratory experiments where space is scant. This "lamp" is a slender glass tube 0.05 inch in outside diameter and 1.25 inches long. When a 110-volt, d-c potential is impressed across the lamp, a glow is formed in a gap 1-mm (0.04 inch) long between 0.03-inch diameter Kovar electrodes in the glass cylinder. This lamp is a contender for, if not the holder of the title of the "world's tiniest lamp."

The lamp and a tiny series resister to limit the current—½ milliampere—draw only 1/20 of a watt. The current in the glow is but 1/30 of a watt. One of the problems in making such a tiny glow lamp is that the volume of gas is so small that any slight contaminant has a large effect. Even the seemingly inconsequential volume of gas contained in the bit of glass pinched off the end when the tube is sealed must be taken into account.





WORLD'S LARGEST LIGHT BULB

General Electric announced that it has developed and produced the world's largest and most impressive artificial light source.

A 75,000-watt incandescent lamp bulb, it is half again as large as the previous largest bulb. It was developed as a feature of the observance this year of the 75th birthday of Edison's most famous invention.

Its glass bulb, largest ever made, was hand blown by the Corning Glass Company, first producer of bulbs for Edison.

The lamp produces 2,400,000 lumens, or units of light. To produce this amount of light would require 2,724 60-watt household bulbs, all burning simultaneously. This single light bulb uses enough electric energy to light 83 American homes as they are normally lighted today. Twenty-three of them could illuminate a major league baseball stadium according to modern standards.

The lamp's filament alone weighs

2.7 pounds, which is enough tungsten to make the coiled-coil filaments for 67,500 60-watt lamps. The filament is made of a tungsten ingot, hammered to a diameter of three-sixteenths of an inch. It is 12 and one-half feet long.

The huge lamp is so bright and hot that observers are advised not to look directly at it or stand close to it when it is burning at full brilliance.

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X-RAY CAMERA

An X-ray camera capable of studying materials at temperatures up to 4,000 degrees Fahrenheit has been developed for ceramic research at Oak Ridge National Laboratory.

The camera, designed by Dr. J. R. Johnson, technical advisor on the laboratory staff, has been used successfully to produce diffraction patterns in studies of hafnium oxide, as well as a number of other oxides and metals.

To photograph the diffraction pattern of the material under study, X-rays produced in a standard X-ray tube pass through a tube guide mounted on the film holder, then through a small disk of beryllium and a collimator. The X-rays strike a rotating sample and are diffracted through a beryllium "window" and the pattern image is registered on photographic film.

The camera consists of a base, top cover, and film holder, with all working parts and facilities except the top-cover water leads and the vacuum gauge mounted on the base. The camera is usually operated with a purified helium atmosphere.

When the camera is in operation, the specimen under study is heated by a pair of small tantalum-strip resistance heaters, surrounded by a radiation shield. Constant temperature, i.e., plus or minus 5 degrees Fehrenheit, is maintained by supplying a constant power to the heaters, which require 900 watts at the highest temperature.

It is possible to photograph the X-ray diffraction patterns through a periphery of nearly a half circle. Approximately 8 degrees of the periphery are cut out on either side of the entrance and emergence ports; there is a complete unobstructed picture from 8 degrees to 172 degrees. Another 20 degrees are lost in the shadows of the electric and water leads at the 270-degree position.

BANKED FLOTATION CELLS

One of the largest flotation plant installations in the United States was recently completed when the last of 720 new flotation cells went into service at a large western copper concentrator. The plant is used for the recovery of copper and molybdenum.

A flotation cell is a sectionalized trough which finely ground ore passes, suspended in water. A motor-driven impeller rotates in the trough, agitating and forcing air into the mixture. Before the solution enters the cells, chemical reagents are added, some to help create froth in the mixture, others to coat the desired mineral particles, giving them an affinity for the air bubbles. The mineral-coated bubbles rise to the surface and float off the side of the cells. The drive motors, of the horizontal type, are mounted vertically with the shaft up. Standard drip-proof construction was used, with a special drip-proof end-bell on the top. Each motor powers a single cell through a multiple V-belt drive shrouded for personnel protection.

The cell motors are controlled by 45 Westinghouse motor control centers mounted back-to-back on a balcony overlooking the 720 cells.

ARTIFICIAL SOLAR RAYS

Solar rays found only in the outer atmosphere are being reproduced artificially by a new device which will simplify scientific exploration in a little-know region of fundamental research.

The device, developed by engineers of the General Electric Company, records the reaction of various crystals to vacuum ultra-violet

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WISCONSIN SOCIETY OF PROFESSIONAL ENGINEERS

W. S. P. E.

Edited by Jon Baumgartner, ch'56

NATIONAL ENGINEERS WEEK FEB. 21-27

THE WHITE HOUSE

It is particularly fitting that the National Society of Professional Engineers selected the week of Washington's birthday as the period in which to observe National Engineers' Week. I heartily endorse this recognition of the engineering accomplishments of our nation's first president, and I am delighted to use this occasion to pay compliments to America's engineers.

The nation has long relied on the skill of its engineers. That skill has contributed to our comforts, our welfare, and our security against potential enemies. The responsibilities of our engineers become greater with the passage of each day, and each day we see new evidence of their success in meeting the tremendous challenge of our age.

To American engineers everywhere—to those working in this country and to the many abroad who are contributing to the cause of peace—I extend congratulations and best wishes. May the observance of National Engineers' Week in 1954 serve to remind our citizens once more of the great service performed by America's engineers.

Sincerely,
Dwight D. Eisenhower

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As you may have read in the newspapers or seen or heard over your radio or television sets, February 21-27, was National Engineers Week.

This observance as proclaimed by President Eisenhower has nothing to promote or sell, but is definitely in the field of public service to try to do something about informing people of the thousands and thousands of ways in which engineering affects them and their daily lives in everything from food, sanitation, transportation, etc., all the way up to atomic energy.

Engineers Week is fostered by the National Society of Professional Engineers through its state and local chapters and coincides with Washington's birthday because our first president was not only a great statesman and general, but also a career engineer superintending such public works as roads, canals, fortifications, etc.

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The Southwest chapter was particularly active in publicizing Engineers Week. The following clubs cooperated in the observance, with announcements being delivered by WSPE members as indicated:

Optomists, Madison, L. M. Abrahamson

Rotary, Madison, John R. Frederick

Kiwanis, Madison, Dr. J. G. Woodburn

Y's mens club, Madison, Homer Vick

Lions, Madison, L. W. Stockner

Lions, Monroe, R. H. Richardson

In addition, several radio programs and one television show on stations in the Madison area featured discussions on engineering and associated topics. A summary of these programs and the participants follows.

WSPE—Engineers Week Publicity Program

WMTV, Sunday, February 21st, 2:30-3:00 p.m., "Engineering in Industry," Fay Morgan, Wisconsin Telephone Co.; Page Johnson, Portland Cement Association; Hen-

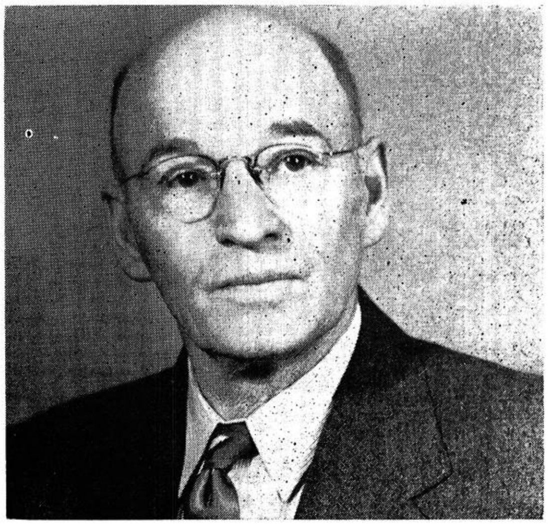
Meet the Presidents

Wisconsin Valley Chapter

Mr. Henry Olk of Antigo, Wisconsin, is currently serving as president of the Wisconsin Valley Chapter of WSPE. Since 1914 he has conducted his private engineering practice and has been employed as Antigo city engineer. Prior to that time, he worked on the Gogebic iron range after receiving an EM degree from the Michigan College of Mines.

Mr. Olk was born January 26, 1887 in Antigo. A second important date was June 9, 1914 when he married Mrs. Helen Ruth Olk. Their three sons, Henry Jr., Rolland, and James are now employed as Major Judge Advocates, Dept. of the U.S. Army, Captain in the U.S. Air Force, and mining engineer for the Hanna Iron Co. of Hibbing, Minn., respectively.

In a lighter vein, Mr. Olk enjoys travel and golf as his principal avocations.



Henry Olk

Wisconsin Valley Chapter

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ry Hunt, consulting engineer; Kurt F. Wendt, dean of engineering, U. of Wisconsin.

WIBA, Sunday, February 21st, 9:00-9:15 p.m., subject: "Engineering," Harold W. Mead, Mead & Hunt, consulting engineers; W. Seger, Gisholt Machine Co.; W. G. Youngquist, Forest Products Laboratory; E. J. Kallevang, chief eng., Wisconsin Power and Light Company; George W. Washa, mechanics, U. of Wisconsin.

WHA-FM, Wednesday, February 24th, 8:00-8:30 p.m., subject, "Engineers in Civil Defense," Lloyd F. Rader, prof. civil engineering, U. of Wisconsin; Alva F. Ahearn, supt. bldg. and grds., U. of Wisconsin; Glenn Koehler, prof. E.E., U. of Wisconsin.

WHA, Monday, February 22, 5:15-5:30 p.m., subject, "What's New in Engineering," Prof. Thomas J. Higgins, moderator; Harold A. Peterson, E.E., U. of Wisconsin; Olaf A. Hougen, chemical engineering, U. of Wisconsin; Ben G. Elliott, mechanical engineering, U. of Wisconsin; James G. Woodburn, civil engineering, U. of Wisconsin; Edwin R. Shorey, mining and metalurgy, U. of Wisconsin; Paul J. Grogan, engineering institute, Extension Division.

WHA, Saturday, February 27th, 1:15-1:30 p.m., subject, "Engineers in Manufacturing," Frank Nordeen, W. T. Stephens, Fred Agthe.

NSPE ANNUAL MEETING

The 20th annual meeting of the NSPE will be held in Milwaukee on June 9-12. This meeting will be substituted for the regular summer meeting of WSPE, which will not be held this year. Therefore, all members are urged to attend this convention of our national society.

We in Wisconsin have been honored tremendously by the more than 32,000 members of the National Society of Professional Engineers, because they have selected us as the hosts for the 20th annual meeting, to be held in Milwaukee June 9, 10, 11, 12 at the Schroeder Hotel.

It is important at this time that you know of the plans being made so that you can assist where possible to make this annual meeting the most successful ever held and thereby gain recognition for the state society, your profession and our wonderful state of Wisconsin. First of all most of you should and will want to be present, and you can make your plans now since this meeting will **take the place of** the regular summer meeting of WSPE held in September, therefore, adjust your plans to be together with your fellow members to graciously

(please turn to page 50)

Left: FOUR-TON DOOR — Moving this four-ton door into the "closed" position is no easy task and requires the use of an electric motor which transmits "rolling" power to the geared wheels. Measuring four feet square at its large end and seven feet through its center, the door, or plug, is one of six of equal size through which Westinghouse scientists may enter the "hot cell" at the Atomic Energy Commission test site. A seventh door is much larger and weighs about 25 tons. Like the smaller ones, it is made of steel and concrete. The hot cell is used to handle and test radio-active materials and equipment. Its seven-foot thick walls afford protection from the deadly radioactivity.

Below: LAND-LOCKED ATOMIC SUBMARINE ENGINE—The first atomic submarine engine, contained in the land-based submarine hull shown here, was generating power when this picture was taken inside the main building at the submarine thermal reactor test site. The large sea tank is about 50 feet in diameter and almost 40 feet high. The hull passes through the tank so that the reactor compartment is located within the tank and completely submerged in water. The tank's water capacity is about 385,000 gallons. The Mark I power plant, with its associated propulsion equipment, has been assembled in this hull in much the same way the Mark II engine is installed in the Nautilus. Installation of both atomic engines in the submarine hulls was done by Electric Boat Division of General Dynamics Corporation, builder of the Nautilus.

DRY LAND
ATOMIC

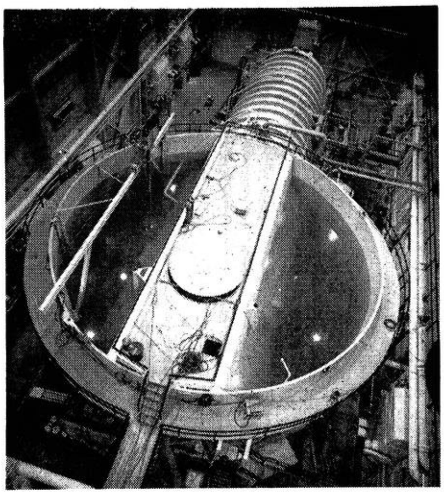
On May 31, 1953, the first atomic engine in the nation's history turned the propeller shaft of a "dry land submarine" built in the middle of an Idaho desert.

This history-making engine, built by Westinghouse, was the land-based prototype or experimental model (Mark I) of the nuclear power plant (Mark II) that propels the first atomic submarine, U.S.S. Nautilus. The Nautilus was launched on January 21, 1954.

The accompanying pictures, taken at the Atomic Energy Commission's National Reactor Testing Station on a southeastern Idaho desert, provide a good look at this installation where the first nuclear power plant ever to produce power in substantial quantities now is in test operation.

The desert-bound atomic engine is a full sized power plant installed inside two sections of a submarine hull. The reactor compartment is surrounded by its own private ocean—a large sea tank full of water.

The second atomic engine, Mark II, also built by Westinghouse, will make the Nautilus an around-the-world submarine, capable of cruising submerged great distances at speeds above 20 knots.

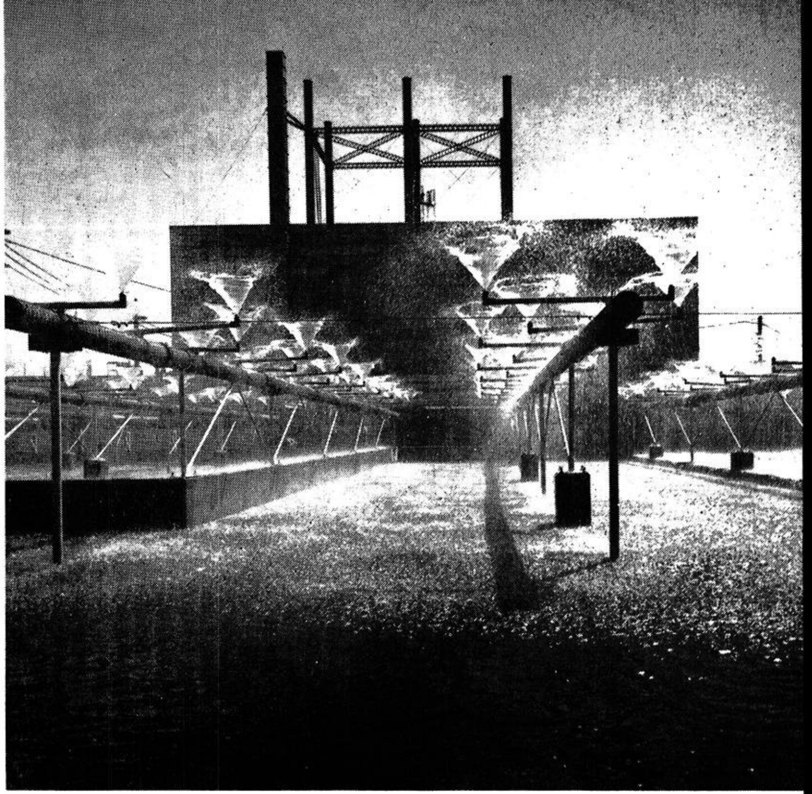


Cuts courtesy Westinghouse

Right: DESERT "LAKE" COOLS WATER FOR ATOMIC SUB ENGINE—This 2,000,000-gallon "lake" in the middle of a southeastern Idaho desert is used to cool water heated by the world's first atomic submarine engine. Designed to carry off heat which, in an ocean-going sub, would be dissipated at sea, the "lake" is actually a spray pond. Shown in the background is the steel and concrete building housing the atomic engine. The pond is equipped with 288 nozzles and can cool 22,500 gallons of water per minute. The pond also provides cooling water for steam condensers, for the "water brake," which absorbs power developed in the atomic engine, and other heat producing equipment.

Below Right: "HOT CELL" — One of the most unique tools of the atomic age is the "hot cell." This one has concrete walls seven feet thick and will enable scientists to work on radioactive materials and equipment without danger. General purpose manipulators, with mechanical claw-like hands, are operated by remote control from outside the cell. When this picture was taken, Westinghouse technicians were preparing a component for installation in the Mark I power plant. The hot cell facilities were used for this purpose mainly because its ventilation system kept the air in the room "hospital clean." If this component were radioactive, the manipulators would take over. The cell is linked to the deep water pit by means of a connecting elevator. The floor of the elevator becomes part of the floor of the cell when it is in the "up" position.

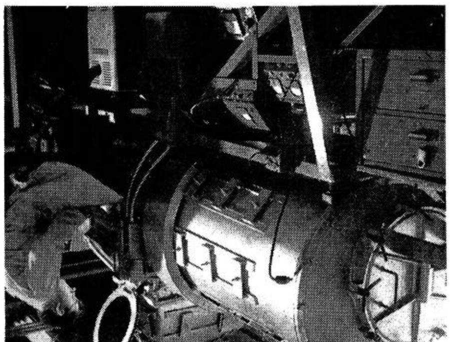
Below Left: "IRON LUNG" SPEEDS FIRST ATOMIC SUB ENGINE—The welding of such metals as zirconium was one of the major problems encountered by Westinghouse Electric Corporation engineers in constructing the nuclear power plant for the world's first atomic submarine. Zirconium is well suited for use in the nuclear reactor because it does not absorb neutrons as do other metals. But it tends to catch fire if it is welded in open air. For this reason, Westinghouse engineers at the Bettis plant in Pittsburgh, Pa., used this specially designed machine, which looks like an iron lung, but is actually a giant vacuum tank. The operator at the right controls the position of both the welding electrode and the part to be welded.

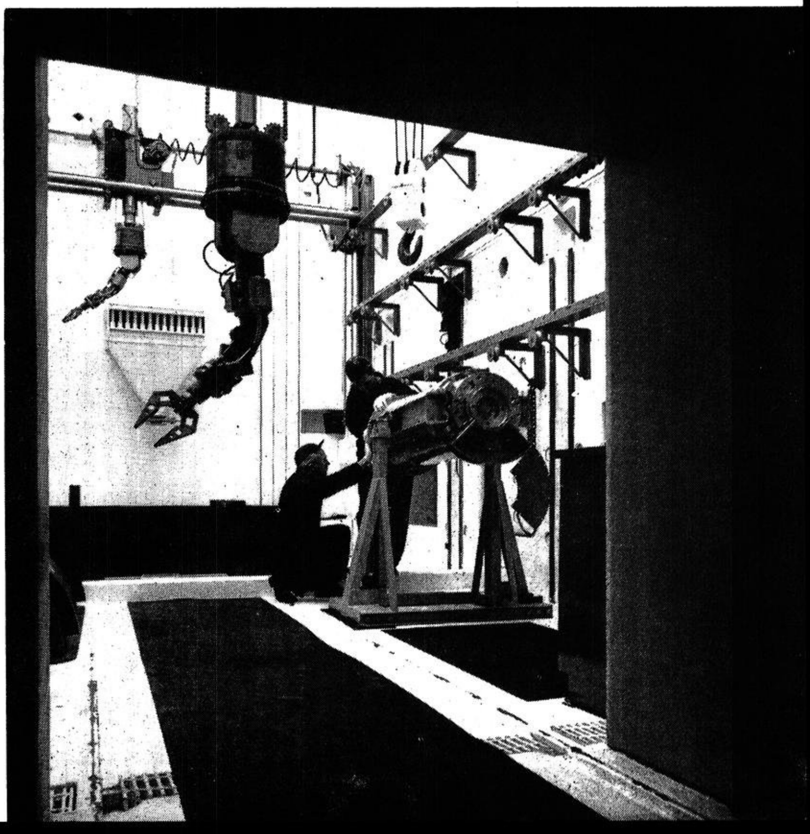


SUBMARINE

POWERED

Edited by Gene Worscheck





Cable specifications anc

THE POSSIBILITY of fires and personal injury connected with distribution of electricity by means of wires and cables, means that such wires must conform to certain minimum requirements. This was recognized in 1881 by New York's Board of Fire Underwriters, when it outlawed the use of bare or uncovered wires for the distribution of electricity in buildings and adopted "A standard for Electric Light Wires, Lamps, etc." This standard contained five rules, one for the conductivity of the conductor, one describing the insulation and the other three dealing with installation of electrical equipment. The rules for the conductor and insulation read as follows:

"1. Wires to have 50 percent excess conductivity above the amount calculated as necessary for the number of lights to be supplied by the wire.

"2. Wires to be thoroughly insulated and doubly coated with some insulating material." These two rules constitute the first effort to set up limits or to be specific with regard to insulated wire for power distribution. In other words, they constitute the first specification for insulated wires and cables for the distribution of electricity.

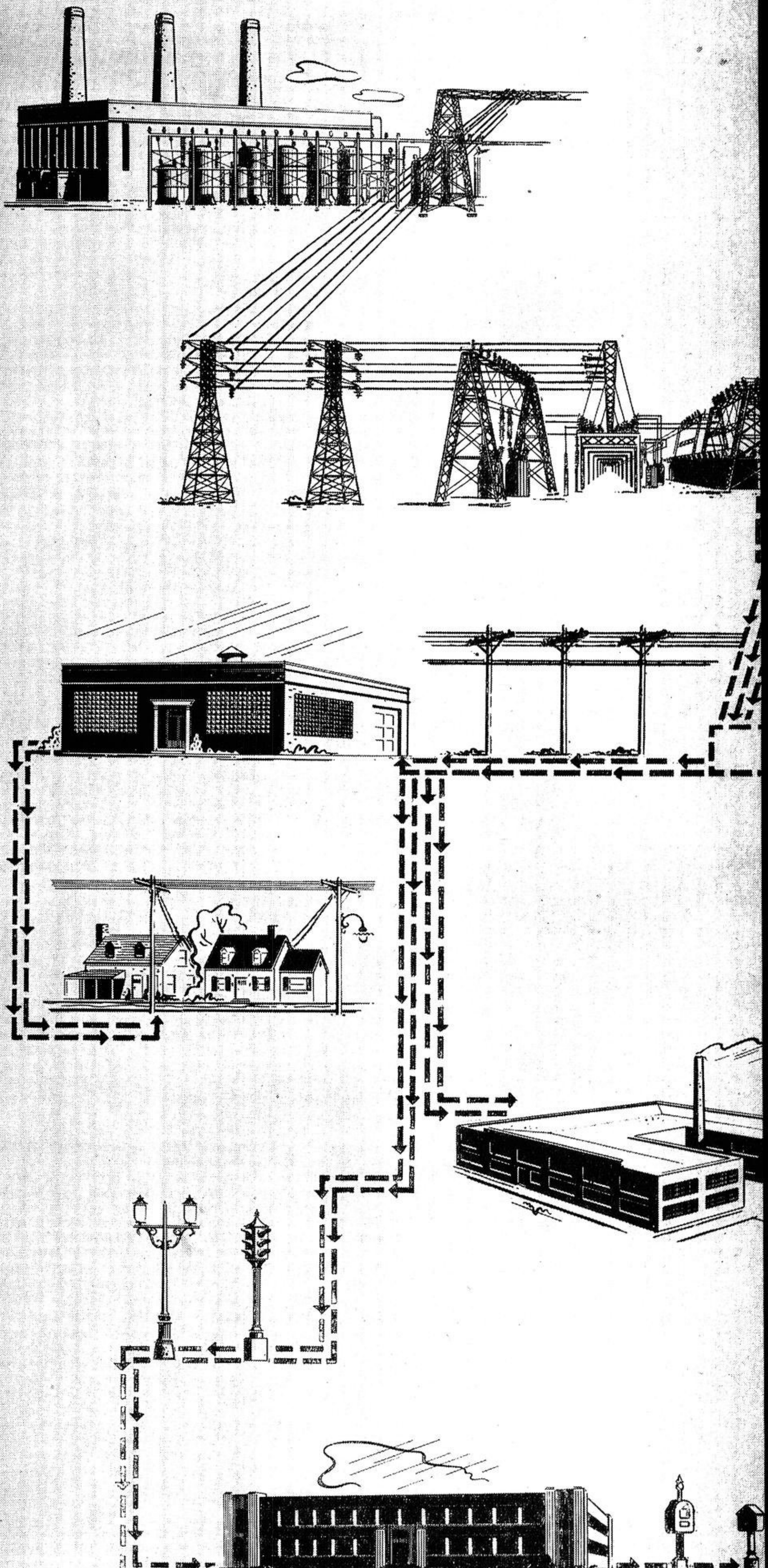
Historically, the next important concept concerning the covering was that of its insulating properties or its ability to confine the potential to the conductor. This was established by setting up minimum thickness of the insulation for the various conductor sizes and providing requirements for test voltages and insulation resistances for these thicknesses. Such requirements were included for the first time in the National Electrical Code for 1899. The insulation thickness for rubber insulation for a given voltage service and conductor size was essentially the same as that used today, namely, 3/64" on size 14 Awg. for 600 volt cable. The test voltage requirement was 3000 volts per 1/64" of insulation thickness, after immersion in water, distinctly more severe than present requirements. The insulation resistance requirement for 600 volt wire was 100 megohms per mile. The 1899 code also contained requirements for the dimensions of copper conductors and for tinning of conductors for rubber insulated cables. There appeared here, for the first time, a requirement for braids.

This was followed by the establishment of minimum requirements for tensile strength and elongation of rubber insulations in the original specification of the Association of American Railroads in 1905 and Underwriters' Laboratories, Inc. Standard about 1911. The 1905 specification of A.A.R. also included requirements for the chemical composition of thirty percent rubber insulation. These requirements were later adopted by Underwriters' Laboratories, Inc. and the American Society for Testing Materials.

Although aging requirements for rubber insulation were proposed in connection with the first specification of the Association of American Railroads, it was not until 1933 issue of Specification D 27 of the American Society of Testing Materials that aging became an industry specification requirement for rubber insulations. The requirements for heat-resisting rubber were included for the first time in A.S.T.M. specifications for 1937. The requirements for moisture resisting rubber insulation were established about this time. The requirements for Polyvinyl Chloride and Laytex insulations were established in the National Electrical Code of 1940. Since then the requirements for the various synthetic rubber insulations have been set up.

During this period, other types of insulations such as paper, varnished cambric and asbestos and many types of sheaths and coverings for wires and cables were developed. More detailed requirements for conductors were also established. There are today, therefore, a wide variety of cables for use in the distribution of electricity for power and control purposes.

Practically every element of these wires and cables is covered by detailed specification requirements or standards. There are specifications for bare or uninsulated wires and cables, for covered wires, such as weatherproof wire and all insulated wires and cables, regardless of the type of insulation or coverings. Such specifications cover, in detail, the construction and requirements for the conductor, the thickness, physical, aging, electrical, moisture



ENGINEERING INSTITUTES

Mathematical Methods — **April 14, 15, and 16, 1954**

The several new techniques in the solution of engineering problems will be discussed in this institute. Probability, series, theory of equations, advanced calculus, operators, transforms, and approximation methods will all be surveyed. Particular application of these methods to engineering problems will be shown.
Fee: $20

CLAY R. JACKSON
Institute Coordinator

* * *

Engineering Organization — **April 27 and 28, 1954**

Engineering and technical manpower shortages make high performance of engineering departments a necessity. Your engineering department problems differ only in detail from the problems of other departments. The methods of good management will often improve the performance of a given department. This institute incorporates the best available methods of organizing, operating, and controlling an engineering department and presents them for your information.
Fee: $15

RAY C. TEGTMEYER
Institute Coordinator

* * *

Fleet Supervisors — **May 3, 4, 5, 6, and 7, 1954**

This intensive course in the training and supervision of the driver will be of value to driver-trainers, supervisors, training directors, safety directors, and fleet owners or operators. Typical subjects are getting and training good drivers, elements of efficient operation, reduction of accidents, and elements of good foremanship.
Fee: $30

Institute Coordinator
GEORGE R. SELL

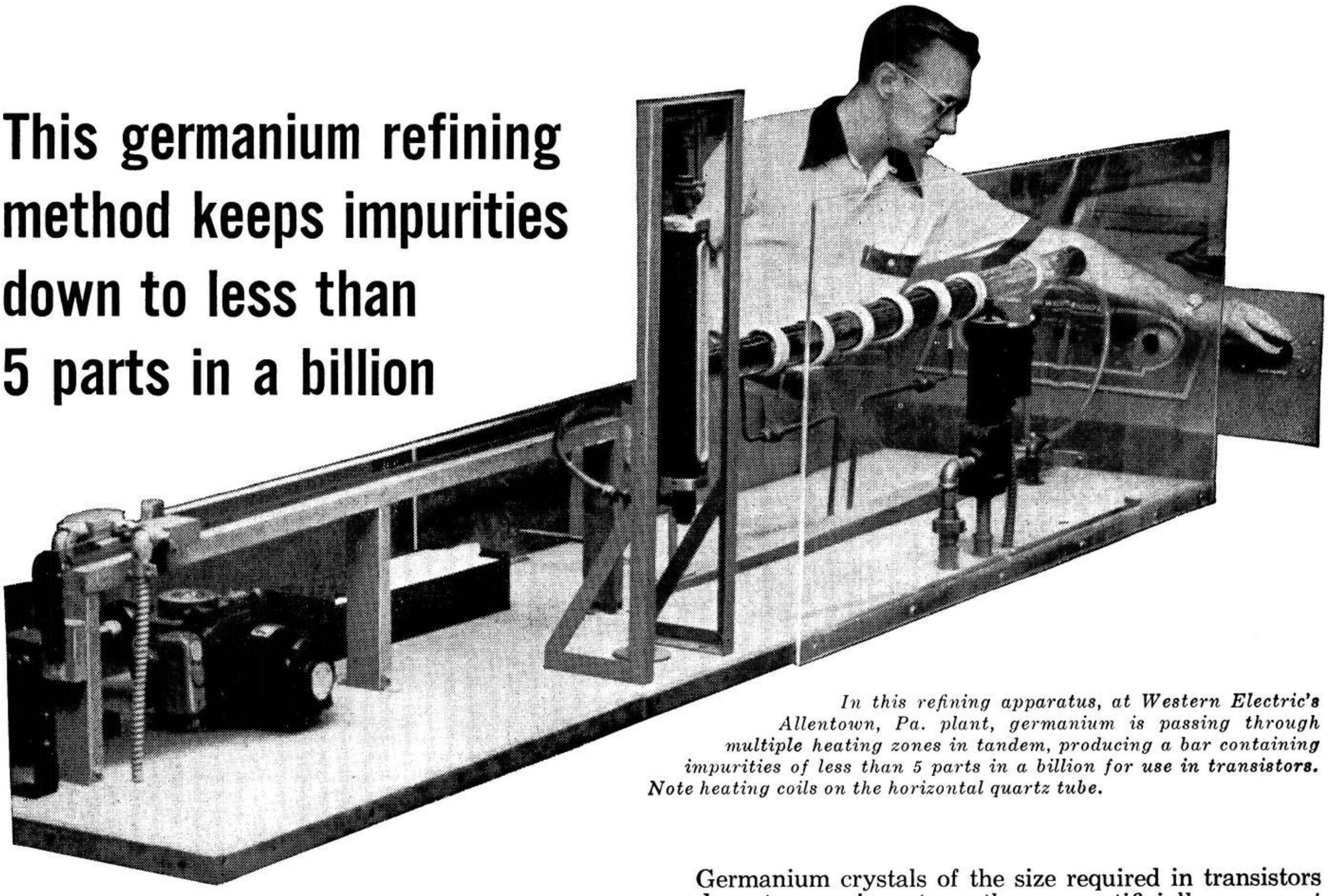
* * *

Power System Protection — **May 12, 13, and 14, 1954**

This institute is planned for chief electrical engineers, relay and protection engineers, and persons in utility and industrial distribution applications responsible for the transmission and distribution of electrical energy. Topics to be included are sources of overvoltage and overvoltage protection, switching surges, open conductors, and ferro-resonance—all as effecting transmission and distribution systems.
Fee: $20

CLAY R. JACKSON
Institute Coordinator

This germanium refining method keeps impurities down to less than 5 parts in a billion



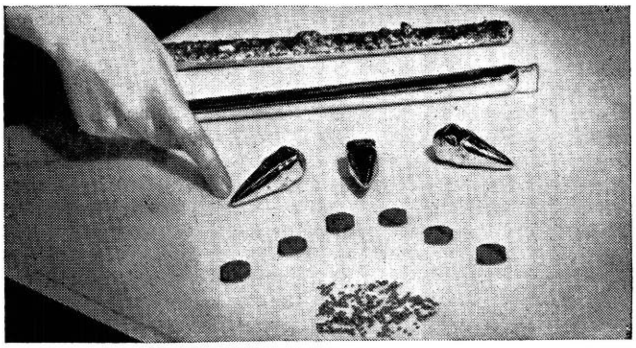
In this refining apparatus, at Western Electric's Allentown, Pa. plant, germanium is passing through multiple heating zones in tandem, producing a bar containing impurities of less than 5 parts in a billion for use in ***transistors.*** *Note heating coils on the horizontal quartz tube.*

A new method of metal refining, currently in use at the Western Electric plant at Allentown, results in the production of germanium that is better than 99.9999995% pure — the highest degree of purity ever attained in a manufactured product.

The need for germanium of such exceptional purity came about when research by Bell Telephone Laboratories in the field of semi-conductors led to the development of transistors, which are manufactured by Western Electric.

The transistor is a tiny crystal device which can amplify and oscillate. It reduces space requirements and power consumption to a minimum.

Various forms which germanium takes before being used in transistors are shown in this photo. Bar at top is an ingot of germanium after reduction from germanium dioxide. Next is shown the germanium ingot after the zone refining process used by Western Electric. Below the ingots are shown 3 germanium crystals grown by machine, 6 slices cut from these crystals, and several hundred germanium wafers ready for assembly into transistors.



Germanium crystals of the size required in transistors do not occur in nature; they are artificially grown at Western Electric. At this stage in transistor manufacture, other elements are introduced in microscopic quantities to aid in controlling the flow of electrons through the germanium. But before these elements can be introduced, it is necessary to start with germanium of exceptional purity, so that the impurities will not interfere with the elements that are deliberately added.

So Bell Telephone Laboratories devised an entirely new method of purification, known as zone refining, which was developed to a high-production stage by Western Electric engineers.

In zone refining a bar of germanium is passed through a heat zone so that a molten section traverses the length of the bar carrying the impurities with it and leaving behind a solidified section of higher purity. By the use of multiple heating zones in tandem, a number of molten sections traverse the bar. Each reduces the impurity content thus producing a bar which contains impurities in the amount of less than five parts per billion.

Because of the importance of the transistor in electronics, the zone refining process — like so many other Western Electric developments — has been made available to companies licensed by Western Electric to manufacture transistors.

This is one more example of creative engineering by Western Electric men. Engineers of all skills — mechanical, electrical, chemical, industrial, metallurgical, and civil — are needed to help us show the way in fundamental manufacturing techniques.

Western Electric

A UNIT OF THE BELL SYSTEM SINCE 1882

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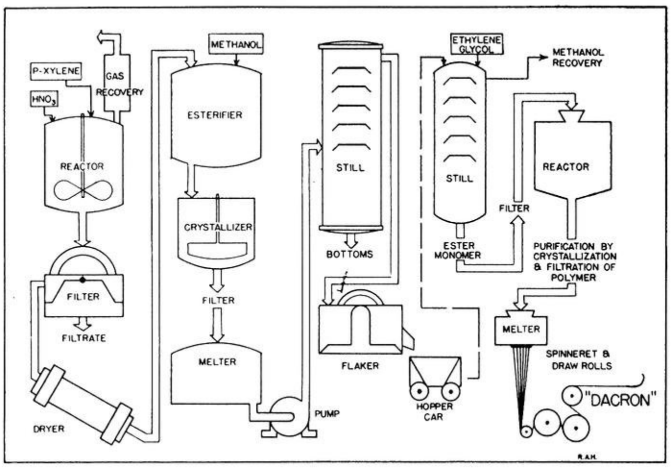
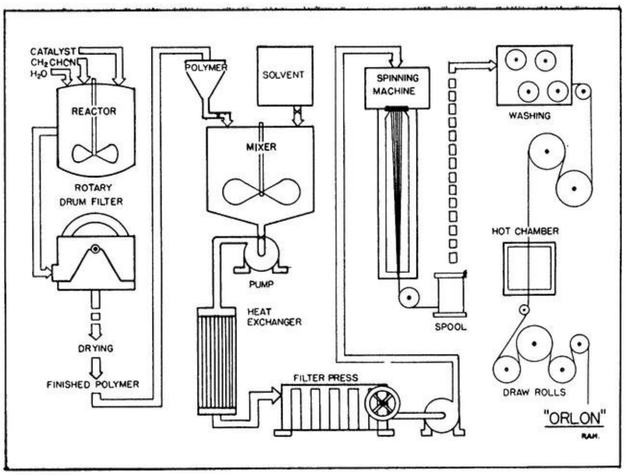




Orlon and Dacron - -

(continued from page 19)

mer solution, acrylonitrile in tetramethylene sulfone, into a hot glycerol or other non-aqueous coagulating bath, then passing the yarn through a water dip or a second glycerol bath to increase the rate of coagulation. For effective spinning of these solutions, a nickel spinneret with a very fine coating of chromium on the orifice walls is used.

Another difficulty was encountered after the filaments were spun, for it was found that they could not be drawn at room temperature. A special piece of equipment had to be devised to draw continuous threads of fiber at elevated temperatures. This piece of equipment, which required three years to perfect, is represented schematically on the accompanying flow diagram as the hot chamber. As explained previously, the purpose of the further stretching is to align the molecules and increase the tensile strength of the fiber. Initial drawing is done as the polymer crystallizes, and then after passing through the series of coagulating baths, it is further drawn to about four times its original length before final processing and spooling for delivery to the textile mills.

The development of "Dacron" polyester fiber met with many of the same problems encountered with "Orlon." Like polyacrilonitrile, polyethylene terephthalate was insoluble in organic solvents, and drawing was difficult.

Unlike the raw materials used in the manufacture of "Orlon," those used in the preparation of "Dacron" are expensive. Polyethlene terephthalate is derived from p-xylene, methyl alcohol, and ethylene glycol, which are originally obtained from natural gas and petroleum.

The problem of obtaining pure p-xylene from mixed xylenes is the major factor in high material costs—the three isomers (compounds with the same chemical composition, but different arrangement of the atoms in the molecules) of exylene, m-, o-, and p-xylene, have very nearly the same chemical and physical properties, and are difficult to separate. The petroleum industry makes the product available to Du Pont in a special process from natural gas hydrocarbons.

In the synthesis of polyethylene terephthalate, p-xylene is first oxidized to terephthalic acid and then esterfied with methyl alcohol. (Esterification is the replacement of the available hydrogen ion of the acid with a hydrocarbon group. It is comparable to the neutralization of an inorganic acid by a base to form a salt.) The ester is then separated from the reaction products by crystallization, filtered, remelted, and then passed through a rectifying still for further purification. Ethylene glycol is prepared by the hydration (i.e., reacting with water) of ethylene oxide, or by a high pressure process from formaldehyde.

The purified dimethyl terephthalate is reacted with the ethylene glycol at 140-220°F. with 0.005-1% lead oxide. The polymerization is then carried out at 265°F. in a vacuum with a special catalyst until the desired viscosity is reached. The polymer produced is a symmetrical molecular chain having the basic repeating structure:

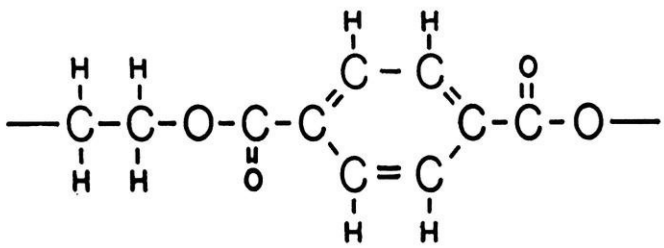


Figure:

This structure is the clue to its fiber-forming properties; it can be seen that six carbon atoms are held together in one plane—an extremely rigid structure, and as J. R. Whinfield called it, ". . . a very sound piece of molecular engineering." Furthermore, this ring helps to impart a high melting point to the polymer—it melts at approximately 480° F. Also, the polymer is very resistant to mineral acids which could conceivably destroy the ester linkages.

Like acrylonitrile, however, the polymer is very insoluble, but its high melting point makes melt spinning readily applicable. The process, which had already been established for nylon, was modified slightly for the spinning of "Dacron," for both operate in the same temperature range. The spinning process is simple; the melt solution is extruded through the spinneret into the atmosphere, just as in the nylon process, except that heat is applied to "Dacron" in the drawing process. (See Figure —.)

These synthetic fibers are available in two forms. One is continuous multi-filament formed directly from the spinneret; the other form consists of short lengths cut from the continuous filament material—this form is called staple. The small bundles of short fibers of a certain staple length look like cotton and are spun into thread in a manner similar to that of cotton.

"Orlon" acrylic staple, known as Type 41, is produced in 1½, 3, 4½, and 6 denier stock sizes, and 1½, 2 2½, 3, and 4½ inch staple lengths. "Orlon" continuous filament is known as type 81 and is produced in deniers ranging from 75 to 400. Depending upon the end use of the fiber. "Dacron" is available in continuous filament or staple form, each having different tenacities and percentages of elongation.

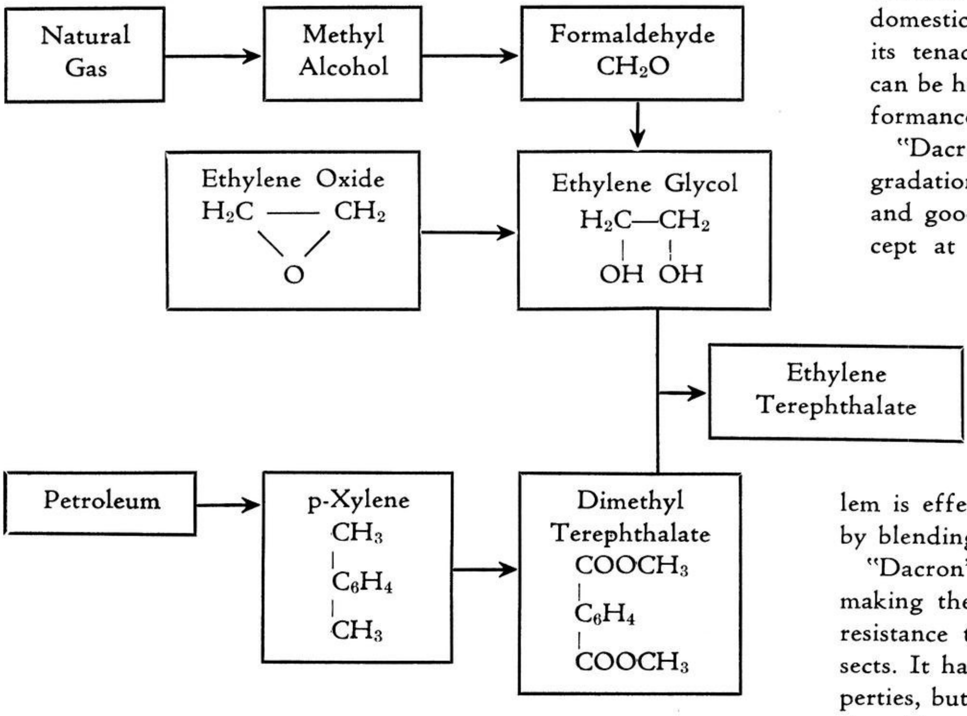


Figure 4: Manufacture of "Dacron" monomer from basic raw materials.

PART III: PROPERTIES AND USES

An important fact to note when considering the properties and uses of both "Orlon" acrylic fiber and "Dacron" polester fiber is that they were not primarily developed to replace other fibers, both natural and synthetic, but that the distinctive combination of properties of both of them provided answers to needs not met by the others. Because each of the natural and synthetic fibers on the market today has some combination of properties which is unique, it should be used alone or in complementary plends with other fibers to suit the needs of the ultimate end-use.

The tenacity, or strength of "Orlon" is considered excellent. Its elastic properties are good, but not as outstanding as nylon. It has good abrasion resistance and its shrinkage in boiling water is very low—only about 2½%. "Orlon" stands in a class by itself in outdoor resistance; for example, in exposure tests conducted by Du Pont, involving "Orlon," nylon, silk, linen, cotton, and viscose rayon, "Orlon" retained 77% of its strength at the end of 1½ years **after** all the other fibers had completely failed. It has promising industrial potential because of its excellent resistance to ultraviolet light, mildew, molds, and degradation.

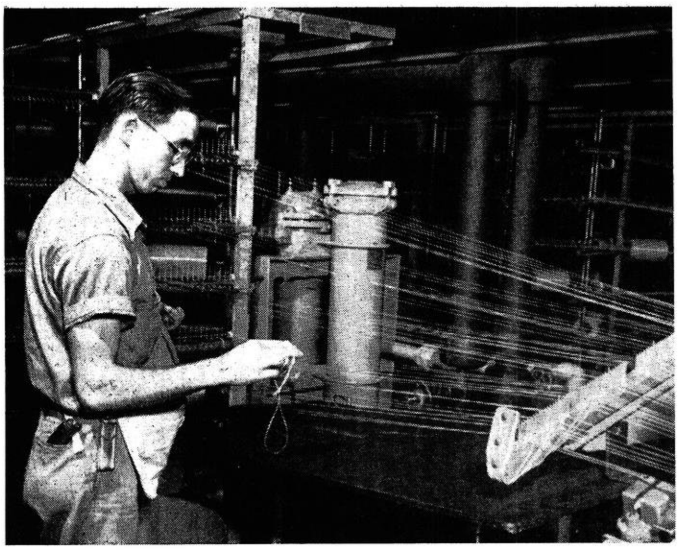
"Orlon" has a low moisture absorbency, good-to-excellent resistance to mineral acids, fair resistance to weak alkalies, and is not harmed by common solvents, oils, or greases. Its stability to bleaching is outstanding in comparison with rayons, cotton, and nylon, and its resistance to degradation by heat is excellent up to 300°F., even over long exposure periods.

"Dacron" polyester fiber is available in different forms having different tensile properties, depending upon the end-use. It has good tensile strength for domestic uses, but for industrial uses, where its tenacity may be inadequate, the yarns can be hot stretched for more favorable performances.

"Dacron" has excellent resistance to degradation by bleaches and common solvents, and good resistance to acids and alkali, except at boiling. Its heat resistance is remarkable—high temperatures cause little discoloration or degradation, although at 460° F. the fiber begins to soften. Burning cigarettes, for example, will melt holes in pure "Dacron" fabric; this problem is effectively minimized for apparell uses by blending the fiber with wool or rayon.

"Dacron" has a low moisture absorbency, making the fabric quick drying. It has good resistance to sunlight, molds, moths, and insects. It has excellent electrical insulating properties, but is subject to accumulation of static electricity.

Static is an undesirable property found not only in "Dacron," but also to lesser extents in "Orlon" and other synthetic fibers. In fact, static was not a problem in the textile industries until true synthetic fibers were introduced. The low moisture absorption of these fibers is the primary couse, for moisture serves to alleviate the build-up of static charges. The solution to this problem is in the application of anti-static agents, which can function in three general ways: 1) they can improve the surface conditions of the fiber, thereby helping to dissipate static charges; 2) they can increase the surface absorption of water; and 3) they may be helpful by generating a static charge of the opposite polarity to that generated by the fiber. The best anti-static agents operate in all three ways to some extent. They may be applied immediately after spinning, or can be applied to the fabric by spraying or



Hundreds of individual ends of continuous filament yarn feed from the creel in the processing operation for manufacturing "Orlon" acrylic fiber.

rinsing with a solution of the agent. However, no anti-static agent yet found has a permanent effect, though much research has been, and is being done.

Like many of the synthetic fibers, the dyeing properties of both "Orlon" and "Dacron" were problems to the development engineers. However, because of the highly technical nature of the chemistry of dyestuffs and dyeing, only a brief discription of the processes used will be presented.

In consequence of the low water absorbency and little swelling of the fibers in water, special dyeing techniques had to be studied and evaluated. At temperatures below 84°C., "Orlon" is unstained by all dyes, and at raised temperatures, only three classes of colors exhibit reasonable affinity: the acetate, basic, and vat dyes. The staple form exhibits much greater affinity for dyes than the filament fiber. However, swelling the fiber with steam under pressure and the use of dye bath carrying agents make it possible to apply heavy shades. Carrying agents are substances which increase the absorption of the dyes in the fiber: their function is readily grasped by the straightforwardness of the name.

The two processes which are considered the best available are the Thermosol method and the copper ion method. In the Thermosol method· the name is derived from the fact that the selected dye is printed on the fiber, which is then heated to a high temperature for a short time. Under these conditions, the dye seems to dissolve in the fiber, hence the name—Thermo-sol(ution). In the copper ion technique, acid dyes can be applied in a full range of shades at temperatures near boiling. The cuprous ions used probably form some complex structure with the —C≅N groups in the acrylonitrile chain, and thereby cause an attraction for the acid dye molecule.

The problem in dyeing "Dacron" fiber results from the compactness of the structure, which prevents dyes from diffusing through it rapidly. On the other hand, this brings a high degree of wash fastness once the dye has been successfully applied. Dye molecules can be induced to travel rapidly from the dyebath to the interior of the fibers by means of carriers, use of high temperatures, or by forming the final dye molecule within the fiber. The Thermosol process brings complete penetration of colors into the fiber with good fastness. The selected dyes are printed onto the fiber, which is then exposed to high temperatures—around 400°F.—for a short time, depending upon the fabric, and the proposed use.

The use of "Dacron" in blends is of great significance in the garment industries, for Dacron makes significant contributions to the strength, abrasion resistance, press retention, dimensional stability· and crease recovery of wool, rayon, and acetate. "Orlon," too, shows contributions to the properties of blends with acetate and to a minor extent, wool.

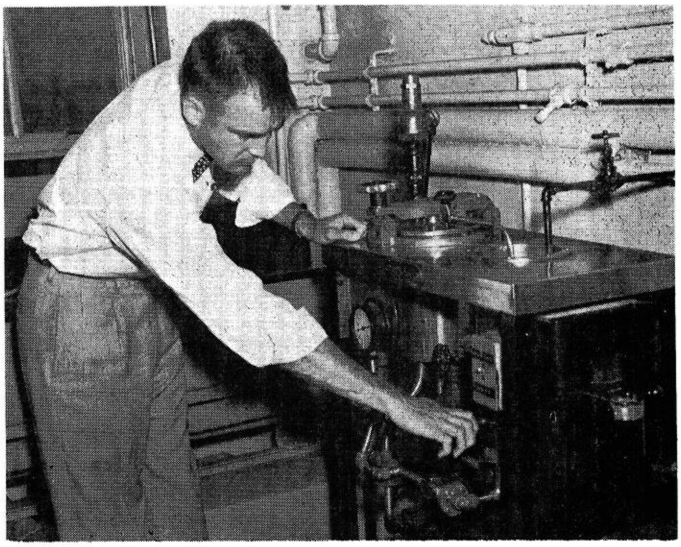
The industrial applications of "Orlon" acrylic fiber and "Dacron" polyester fiber are yet to be fully realized. Both fibers, because of their high strength, outdoor durability, chemical and heat resistance, electrical properties, and dimensional stability, already contribute to: filter fabrics, awnings, auto-tops, tarpaulins, fire house· agricultural and mine belting, outdoor furniture, electrical insulation, diaphragm fabrics, nets, and others.

Differing with the quotation from Robert Hooke, the benefits which accrued to the finders of "Orlon," "Dacron," and the many other synthetic fiber are not nearly as important as the benefits that have been reaped by the consumers of their products. Hooke believed the benefits derived from these man-made fibers would be sufficiently obvious, but the applications of these fibers surpassed all his expectations.

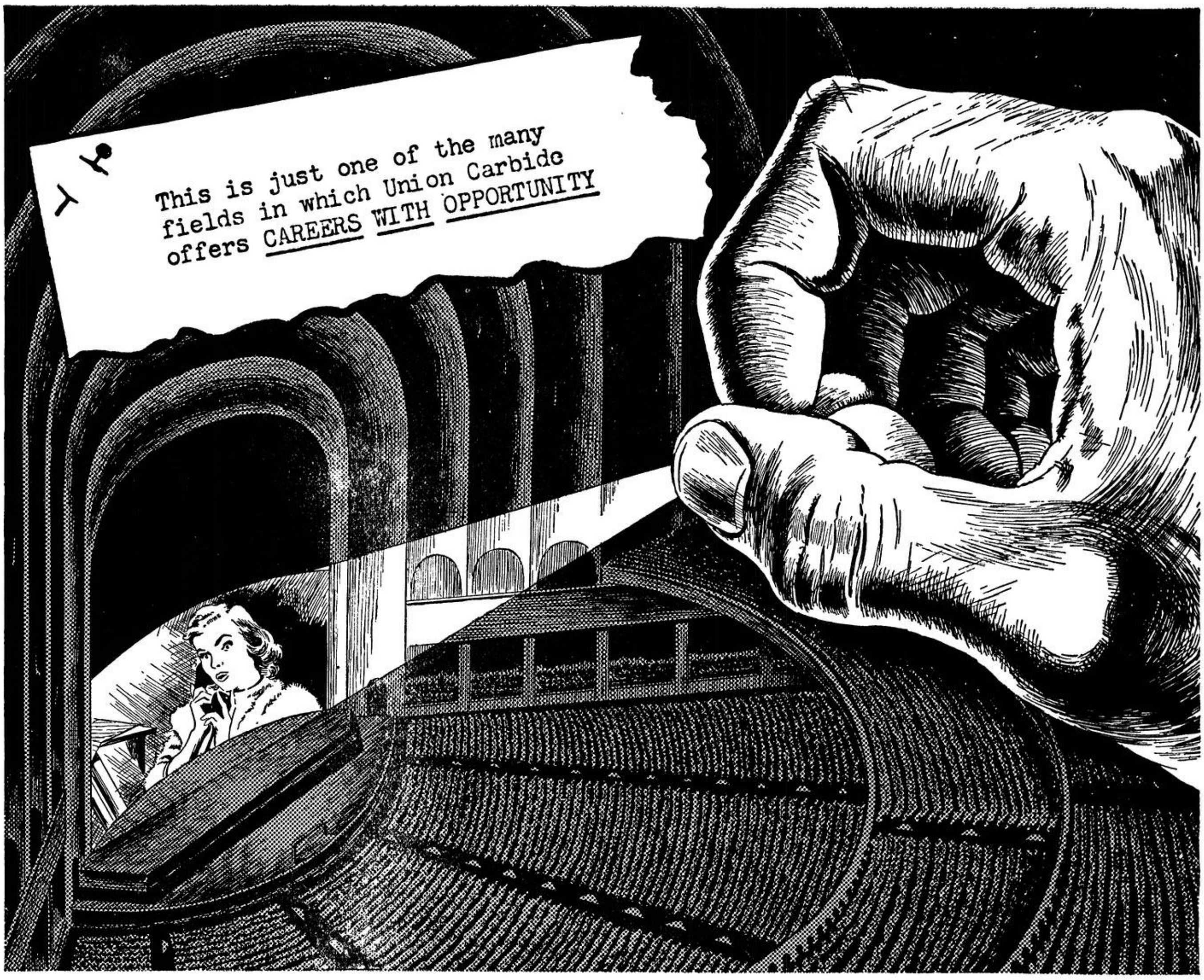
* * *

ACKNOWLEDGEMENTS

We wish to acknowledge the assistance rendered by the E. I. du Pont de Nemours & Company, Incorporated, for technical reference material, reference aids, and illustrations provided; and the MODERN TEXTILES MAGAZINE for reference material supplied.



As part of the research program undertaken to develop fast dyes for synthetic materials, test-dyeing of "Orlon" and Fiber V yarns is shown above. The dyeing is done in chambers in which pressure is developed in order to raise the boiling point of the dye solution to drive the color into the yarn.



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McCormick's

Engine-Ears

by Larry McCormick, ch'55

"I'm afraid my boy, that you have a triple fracture of the third metacarpal of the right hand." Tears of joy crept into my tired slide-rule blinded eyes. "You won't be able to write for at least three weeks," continued the doctor, winking at the twenty eager young interns who stood with machetes poised. Three cheers for our blood-stained infirmary! Joy was short-lived; for my editor produced a bull-whip, coiled menacingly in his iron hand, when I entered his office to show him my excuse.

So here's some LEFT HANDED NEWS:

Notice to the "revenooers" (another semi-colon)

'Way down in the basement unit-operations lab of the new chemical engineering building, is a shiny new copper still; (19 small spigots extend from 19 small bubble-plates, allowing the operator to tap, at will, proofs ranging from 5 to 190. The 190 to be drawn from the top of the still. The faculty has greased the ladder leading to the upper levels.), but the start of operations has been delayed due to the problem of hiding the mash cookers.

Dies Irae! Dies Illa! The Profession has received a low blow. One dark, cloudy day that foretold the coming catastrophe, forty stout engineers gathered on the basketball floor of the University's medieval armory. Of this crew, five normal (not over 6'10") American men were chosen to do battle with the lawyers. Then from the lawyers' dressing room came Goliath, followed by four more Goliaths, all of whom have been cover girls for the American Medical Journal's special issues on glandular freaks and monstrosities. At one point in the fray, Goliath No. 3 had to be replaced when he suffered a dislocated knee. This injury occurred when his foot became entangled in the net. Obviously, this was no basketball game; therefore no score was kept.

There has been another revolution in the ranks of the Badger Auto Club. Viva la Hanson! In a planned coup, the Hansonites overthrew the old regime by using underhanded methods: an election. Fritz Hanson is now president, with his fellow insurrectionist, Kent Kelly holding down the V.P. position. Tuesday, March 9, saw the clubbers watching movies depicting the construction and performance of the Cummings Diesel sport car. The Club is again planning a reliability run. This run will be held later in the spring. Watch for announcements!

A. I. Ch. E. held a section meeting Wednesday, March 24th in the Topflight Room of the Memorial Union. Highlighting the meeting was a talk by Leslie G. Janett, newly appointed vice-president of the Ross Engineering Corporation. "Sales Engineering; a Profession Combining Challenge, Drudgery, and Romance," was the theme of his entertaining and informative discourse. Mr. Janett is an old, old grad from Wisconsin, (Class of '35).

Chaunce Reider, my spy in TRIANGLE, forwarded his monthly report with a touching plea for mercy: "Have a heart Mac, our house isn't as bad as you make it out to be." Okay, Chaunce, here is your report verbatim:

Verily forsooth, We proclaim unto you . . . Hi!, from the boys at 438 N. Frances.

Seems as if another semester is here, so we had another initiation. The banquet was held at the Hoffman House on February 27, with Professor Don Leskohier as the main speaker. The products of that week are new initiates Arland Cap, James Cherwinka, and Earl Erickson.

The second semester also suggests spring, and since spring is springing, plans are being formulated for a house tennis tournament. Also the season reminds us of our half painted house which, at the risk of sounding repititious, will be painted by the members this spring.

Throughout this semester, please do us a favor and keep your eye peeled for items on our new bulletin board in the Mechanical Engineering Building Lobby. Thanks.

Brig. General David Sarnoff, Chairman of the Board, Radio Corporation of America

Industrial Engineering - -

(*continued from page 23*)

head costs and setting up a critical comparison of proposed and present methods for management study.

6. Establish a full new process or operation in the plant, developing it to the production stage, then turning it over to the production department. A strong potential area of work for industrial engineers lies in the development of new processes, new methods, or techniques into production use.

7. Develop improved bench assembly methods within a high labor cost department through work analysis, motion study, micromotion (filming) techniques, developing improved workplace layouts, better work balance, etc. Many techniques are available for this type of analysis and the industrial engineer draws upon those which best fit the problem at hand or else devises his own approach to a solution. Many such problems while appearing simple at first glance involve long hours of analysis and experimental work to develop improved methods. Once installed these usually result in significant savings to the concern.

8. Install an improved materials handling system within a plant extending from receiving through stores, manufacturing and on through to shipping. Materials handling costs are one of the largest potential savings areas in present plants wherein improved methods and equipment frequently pay for themselves in a very short period of time. Too frequently "spot" or local solutions are developed to solve a particular odious handling problem without regard to the overall problem. Industrial engineering offers objective analysis of such problems in the light of all known facts and available equipment.

9. Study all present warehousing methods, inventory levels and costs with a view to reduction of storage expense, lessened damage to materials, and higher acessibility of all stored materials.

10. Analyze all operations and set time standards for each operation, determining allowed times for jobs, proper rest and delay allowances and providing a basis for an incentive type of payment within the department or plant, if it appears feasible.

11. Analyze all paperwork in a plant or department, its forms, uses, purposes and relationship to the requirements of the plant. Many present day systems are the result of adding a form here or there, multiplying paperwork indefinitely without serious thought to the whole needs of the plant and its management. Such work has been termed "systems analysis" and is an important area in which the industrial engineer can logically operate.

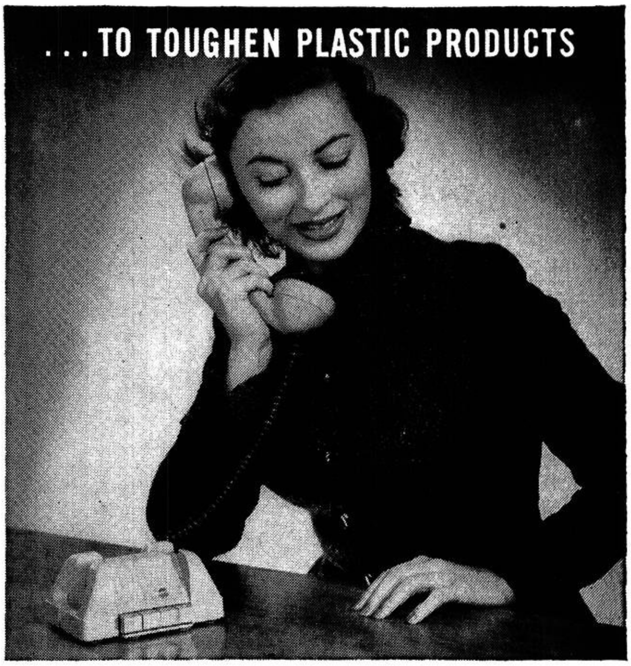
12. Establish a complete, or partial, production planning and control system to fit the demonstrated needs of the plant. This may involve use of newer scheduling systems, fewer forms, changes in manufacturing procedures, or many other possible elements.

13. Analyze the inspection methods and procedures in the plant. This might lead to the setting up of improved

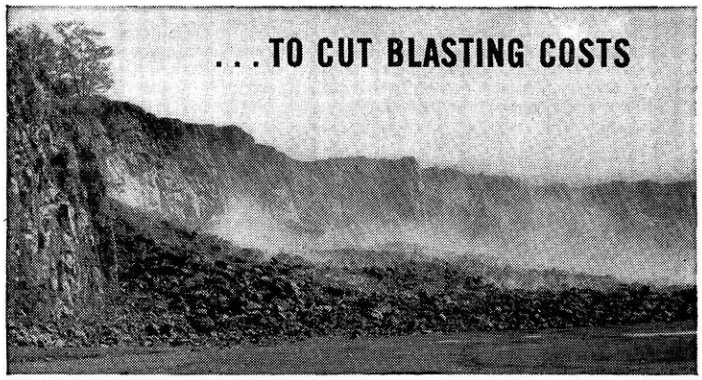
(*please turn to page 54*)

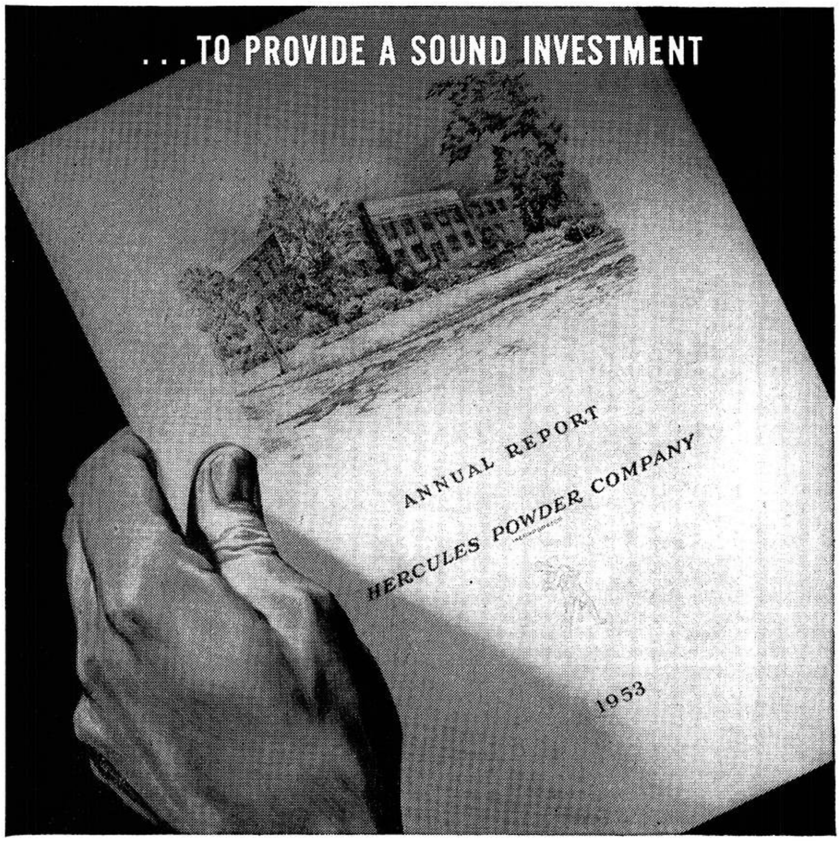
HOW HERCULES HELPS...

Hercocel®, a Hercules cellulosic plastic, is durable, lightweight, colorful, and quickly and economically molded into intricate or thin-walled shapes. It is used for hundreds of industrial and consumer products, one of which is Connecticut Telephone & Electric's new interoffice telephone shown here.



In quarrying, as in metal mining, coal mining, and construction, proper blasting with the proper explosives promotes higher production . . . easier work for men and machines. Hercules' 40 years of experience in the development, manufacture, and use of explosives mean top efficiency and economy.





Hercules' continuing creative research in chemical materials is reflected in an increase in sales from $7,640,741 in 1913 to $190,202,417 in 1953; more than 10,000 employees; and a history of 162 consecutive dividends since Hercules' organization in 1913. Send for your copy of our 1953 annual report.

Hercules' business today helps almost everyone's business. It embraces the production of synthetic resins, cellulose products, chemical cotton, terpene chemicals, rosin and rosin derivatives, chlorinated products, and many other chemical processing materials—as well as explosives. Through close cooperative research with its customers, Hercules helps improve the processing or performance of many industrial and consumer products.

EC54-3

HERCULES

HERCULES POWDER COMPANY INCORPORATED *Wilmington 99, Delaware*

So You're Smart

A Few Brain-Crackers For Your Spare Time . . . Try Some!

ANSWERS NEXT MONTH

Here is a problem for all the boys in ROTC. There are two points 1000 miles apart on the desert with nothing between them. At one point there is a man and a jeep with an unlimited supply of gasoline. The man wants to get to the other point but he can only carry enough gas in the jeep to take him five hundred miles. It is obvious that the man will have to spend some time in building up stocks of gasoline between the two points if he is to ever drive the jeep across to the other point. Since the man wishes to do as little traveling as possible to reach his destination, what is the minimum number of miles that he would travel in alternately building up his supply of gasoline at way points along the route?

We have been given twelve coins with the giver telling us that eleven are the same and one is counterfeit. The counterfeit coin has a different weight than the genuine. We are asked if the counterfeit coin can be found in their weighings. What procedure would you follow?

* * *

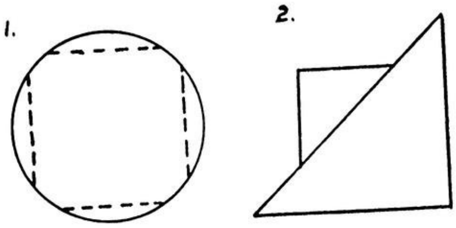
Turn back the pages of time to your high school geometry class. Show how to construct a circle tangent to any three circles. If you can find eight different solutions consider yourself an expert.

LAST MONTH'S ANSWERS

DILL PICKLES

The most recent of the empirical data indicates that theoretical calculations agree with the actual to within tolerable limits established by modern statistical and dimensional analysis. Mathematical computations point out a probable time of 3749.84 seconds. Experimental tests carried out with a duck (domesticated black mallard) in the primate lab at 37°C, relative humidity of 57%, result in a solution of 3750 seconds. The relatively large percentage error involved is in all probability due to the indeterminate stretching of the rubber bill.

GEOMETRY



MORRA

Beats us, but the experts claim that a random strategy of showing one finger five times, two fingers four times and three fingers three times out of twelve games is a sure winner at least 50% of the time if you guess 4 on your turns.

LOGIC

Bet your math didn't help much on this one. The guy was a midget and could only reach high enough to push the button for the eighth floor.

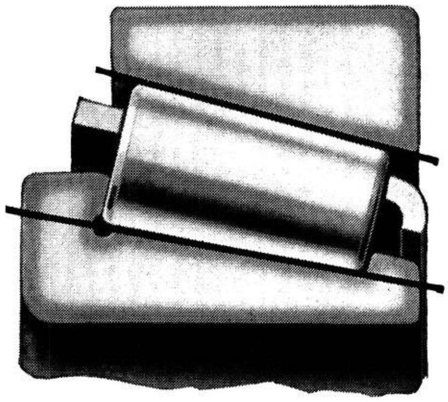
Another page for **YOUR BEARING NOTEBOOK**

Jet's wheel bearings have to take three kinds of forces

When the F86-D Sabre Jet lands—the wheel bearings take a triple beating. There's the initial landing shock, an almost instantaneous acceleration; and, if there's a crosswind, heavy thrust loads. Bendix and North American solved this triple punch problem by using Timken® tapered roller bearings for all three landing wheels. Their tapered design enables them to take radial and thrust loads in any combination. And Timken bearings' true rolling motion and incredibly smooth surface finish practically eliminate friction permitting rapid acceleration.

Line contact helps TIMKEN® bearings take jet landing load

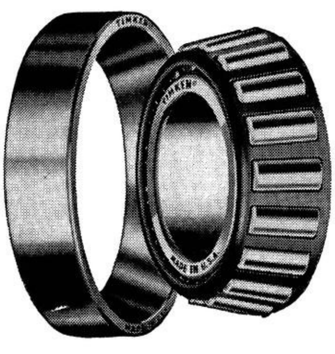
This cross-section drawing shows one reason Timken bearings are ideal for taking the heavy landing load of the plane itself. Note the full line of contact between rollers and races. This gives Timken bearings high load capacity. It's a basic advantage of roller bearings.



TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS



Want to learn more about bearings or job opportunities?

Some of the engineering problems you'll face after graduation will involve bearing applications. For help in learning more about bearings, write for the 270-page General Information Manual on Timken bearings. And for information about the excellent job opportunities at the Timken Company, write for a copy of "This Is Timken". The Timken Roller Bearing Company, Canton 6, Ohio.

NOT JUST A BALL NOT JUST A ROLLER THE TIMKEN TAPERED ROLLER BEARING TAKES RADIAL AND THRUST LOADS OR ANY COMBINATION

Science Highlights - -

(continued from page 27)

radiation, the more powerful cousin of ordinary ultra-violet rays that cause sunburn.

The characteristic peculiar to vacuum ultra-violet light is its rapid absorption by air, with the result that the rays never penetrate the earth's layer of atmosphere.

Scientists say that although it produces radiation found only at altitudes of 150 to 200 miles, the new research tool is not intended as a means of studying the problems of space travel.

They say the extensive basic research made possible by the device may lead instead to such developments as an improved phosphor for television picture tubes, better fluorescent lamps, new electronic devices, and a better device for measuring the exposure of human beings to the damaging radiation from atomic bomb blasts.

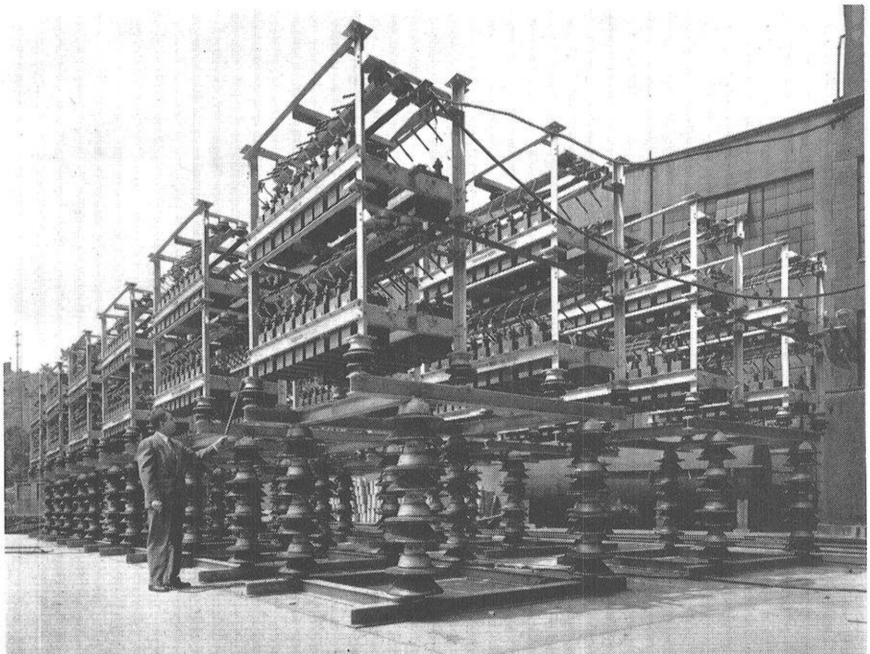
•

"PINT SIZE" LINEAR ACCELERATOR

A powerful new tool of nuclear research — Stanford University's billion-volt, super-h i g h-frequency, 200-foot-long electron linear accelerator — is going to be made in junior sizes for cancer therapy and inspection of industrial products.

The "toned down" accelerators will be manufactured and sold by the X-ray Department of General Electric Company under a 10-year agreement with the University, according to a joint announcement. They should be on the market within the next few years.

Stanford - designed accelerators "shoot" electrons in a straight line through a copper tube at almost the speed of light — approximately 186,000 miles per second.



CAPACITOR BANK FOR HIGH-POWER LABORATORY

This 21,600-kva, 60-cycle bank of capacitors at the Westinghouse Electric Corporation's high-power laboratory can be operated at 1.7 times normal voltage to give it 65,000 kva, the largest amount of reactive kva for test purposes at any industrial laboratory. This can be used to simulate the capacitance of long transmission lines or cables for circuit-breaker evalution or for tests on switching of shunt or series capacitor banks. The bank is insulated for operation at voltages as high as 198 kv, line-to-ground (345 kv line-to-line).

THE END

Freeways - -

(continued from page 21)

with Los Angeles metropolitan area repair garages revealed a minimum of 0.20c per vehicle mile repair charges on brake relining and adjustment and clutch repair. Since practically all of this is due to the stop and go races at intersections, non-stop travel on freeways would eliminate about 90% of this cost, or 0.18c per vehicle mile would be saved.

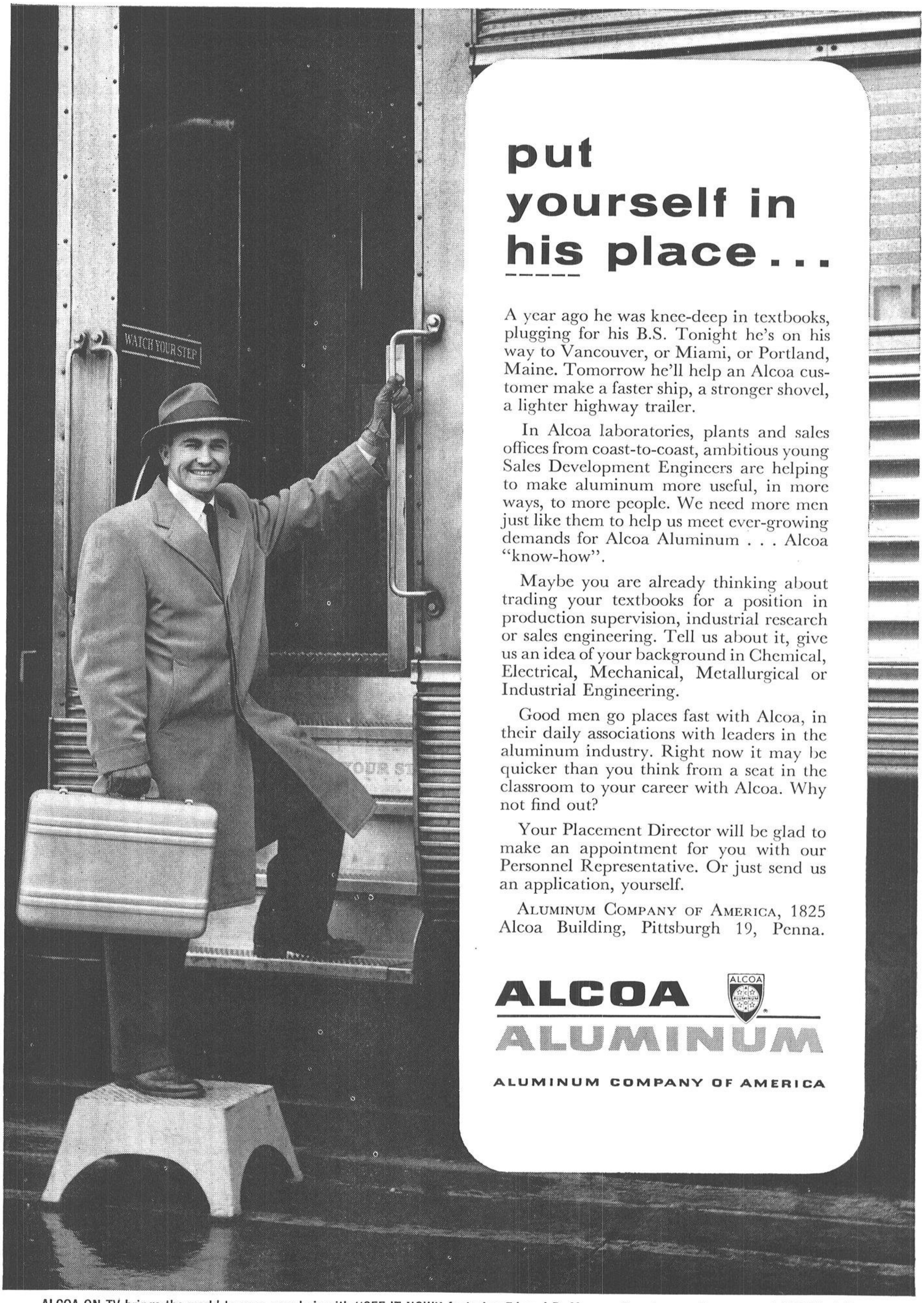
Assuming that only 1/8 of the cost of tires ($80÷30,000 =0.27c) and the cost of moving parts repair, excluding clutch and brakes, (0.25c, according to surveys of fleet operations) are caused by stops, there is an additional savings of 0.06c per vehicle mile. Thus the total extra cost caused by stops is 0.24c per vehicle mile, a figure less than the amount estimated by other engineering analyses.

(3) Accident savings—Using figures and advices from the Association of Casualty and Surety Companies, based on monthly reports received from the insurance commissioner of California, the accident cost per vehicle mile in California in 1950 would average 0.70c. Utilizing results of a previous report on completed sections of freeways, the accident rate is 1/5 that of typical surface routes. Therefore, the savings would be 4/5×0.70c=0.56c per mile of freeway travel. Accident rates would also go down on surface routes if most of the traffic was shifted to freeways, and thus people who continued to use these routes would have safer driving conditions.

(4) Time savings—This was computed by completely neglecting the value of the time of a non-commercial driver, which is certainly appreciable, and considering only the time of commercial operators as reported by the Highway Research Board "Abstracts." Studies made in New York indicate that the non-commercial drivers' time alone was worth more than the value assigned to time of commercial drivers (0.87c per mile), but since it is quite difficult to compute, it will be neglected. Thus, the benefit is certainly conservative.

Besides this basic figure of 2c per mile of freeway operations savings, there are many direct and indirect benefits to the motorist and the citizen whose property is in the vicinity of the freeways. Among these are stabilization of property values, relief of overburdened surface arteries, doubling of the practical radius of real estate development on a travel time basis. increased access to recreational or cultural facilities, increased mobility in times of disaster emergencies, increased tourist travel, reduction of strain of driving, and the many benefits to the motorists who continue to use the old arteries after the freeway is built. It is easy to recognize that the sum of these benefits is worth a great deal, perhaps even greater than the direct cash savings that every motorist using the freeway realizes.

(please turn to page 60)



ALCOA ON TV brings the world to your armchair with "SEE IT NOW" featuring Edward R. Murrow. Tuesday evenings on most CBS-TV stations.

(continued from page 29)
fulfill our obligation, as host to engineers throughout the nation.

Detailed information for registration will be in your hands shortly. The March issue of the "American Engineer" is evidence of the first effort to reach all of the NSPE members. The succeeding issues will carry additional information. We are contacting each of the members of NSPE through a separate mailing piece which will be mailed during the first week of April, so that everyone will have the opportunity to request detailed information and make plans to be here.

We must all be sure to understand that the annual meeting of NSPE is intended for all members, and is not solely for the officers and directors for conducting business of the society. Since the greatness of the National Society of Professional Engineers stems from the fact that it is a "grass-root" organization, all members are invited to the many professional sessions scheduled throughout the meeting at which actual society business is conducted. You will find the program, being organized by Mr. Orrin E. Andrus, of great interest and entertainment value. His plans are co-ordinated with Mr. Paul Robbins, executive secretary of NSPE, who is supplementing the program with nationally known personalities.

Special attention is being given to organized tours through our diversified nationally known industries, to our educational institutions, and to our utility and municipal installations. Plans include reserved tickets for the Braves game on June 11th, and a steak dinner banquet at the Elks Club. Time and space will not permit covering all details but the plans are terrific.

Naturally a meeting of this proportion can not support itself by money received from registrants. We ask therefore that each of us assist the finance committee under the chairmanship of Mr. Guy V. Woody where possible, so that they can identify and contact all organizations and members who would make contributions to the meeting fund. Each and every contribution will be acknowledged and the donor will be recognized as a **sponsor** of the meeting. This is a privilege which no one should be denied.

We all are familiar with the great strides being made by the National Society of Professional Engineers and that the 20th annual meeting in Milwaukee is definitely a step in the direction of making more people and organizations aware of professional engineering. Better general knowledge of the profession will enable the engineer to fulfill his obligations to society in our fast growing economy which constantly requires more engineering talent.

Reserve June 9, 10, 11, 12 on your schedule now.

At the January 28th meeting of the board of directors, a sum not to exceed $500 was appropriated for the use of the NSPE 1954 convention committee. Mr. Guy Woody was instructed to provide a copy of the budget for the NSPE convention, said budget incorporated as a part of the minutes. Mr. Woody was authorized to make direct contact with the national chapter for the purpose of raising funds for the NSPE convention.

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BOARD OF DIRECTORS MEETING

At the January 28th meeting, the proposed organization of a joint committee on interprofessional relations of architects and engineers was discussed but final action was postponed to the March 13th meeting. This committee, to consist of six each of engineers and architects, would attempt to "coordinate the efforts of the Wisconsin Architects Association and WSPE in protecting the public health, welfare and safety, cooperate in activities which will stimulate and protect the two professions in the proper performance of their duties, and support each other in activities which may benefit one or both and reduce annoying friction in the border of over-lapping activities."

There was considerable discussion from the floor concerning the registration law. As a result of the discussion it was suggested by Mr. Harold Trester that the board of directors screen the work of the various committees that are working on the registration law, in order that this work may be better coordinated.

Mr. George Steinmetz, chairman of the by-laws committee, reported for that group. He pointed out that the proposed change of the by-laws which would make the fiscal year of the society coincide with the administrative year would work extreme hardships and cause considerable confusion in the bookkeeping of the national society, and therefore recommended that the members vote "no" on this proposed change. He supported the recommended change which would combine the office of secretary and treasurer at the board's discretion. The board supported both recommendations.

MEMBERSHIP REPORT
March 15, 1954

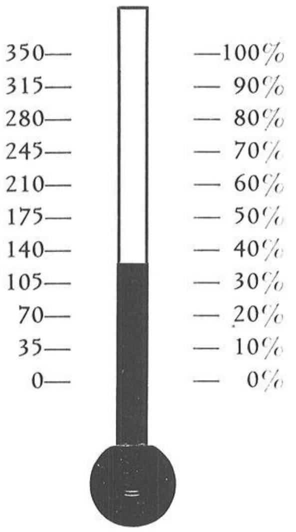
While Western Chapter is resting in first place, Fox River Valley moved from FOURTH to SECOND place. Wisconsin Valley and Northwest are also in there with over 50%.

Let there be no doubt about our objective—check your quotas again—the quotas are there if you want them. With the same effort that was put into the preliminary work now directed to the follow-up you can fill the quota in the last quarter of our administrative year. Don't forget to invite your new members to the NSPE national meeting in Milwaukee in June, 1954.

Chapter	Members & Affiliates as of 7/1/53
W is 1st	55
FRV is 2nd	117
WV is 3rd	41
NW is 4th	51
SW is 5th	199
M is 6th	342
SE is 7th	64
Out of state is 8th	45
	914

Quota	3/13/54	% Quota
10	8	80.0
41	22	53.6
15	8	53.3
17	9	53.2
53	26	49.0
141	38	26.2
41	10	24.3
32	5	15.6
350	126	36.0

THE SCORE!
FIRST QUARTER OF '54



Can be filled from 4000 P.E.'s and E-I-T's not yet "in".

NEW MEMBERS

Name	Chapter	Sponsors
Plaehn, Louis C.	M	Ray E. Behrens
Maersch, Robert E.	M	E. C. Koerper
Morrison, Gordon J.	FRV	L. H. Kingston
Takle, Carl K.	SW	L. W. Stockner
Hamilton, John Wm.	SW	L. W. Stockner
Weiss, Leonard A.	SW	W. F. Turner
Arnold, Charles E.	SW	Harold N. Kingsbury
Ashton, Clay G.	SW	J. L. Von Gunten
Sparr, Stanley N.	SW	Harold N. Kingsbury
Birch, John R.	SW	John Gammell
Ritchie, Earl A.	M	H. J. Durst
Hotchkiss, Clifford	M	V. R. Tate
Heth, Sherman C.	SE	Rudolph R. Gocht
Hall, George H.	FRV	Wayne G. Bryan
Gibb, John William	M	Ray E. Behrens
Zeller, Josef J.	M	Geo. A. Sievers
Lukey, John B.	M	Geo. A. Sievers
Nygren, Ernest J.	M	R. L. Perlewitz
Daggett, Ronald L.	SW	D. W. Nelson
Anderson, Robert I.	SE	Rudolph R. Gocht
Neff, Charles Wm.	SW	J. A. Gage
Pflug, Robert C.	SW	John R. Frederick
Jacobsen, Paul W.	FRV	Wayne G. Bryan
La Chappelle, Harris A.	FRV	E. C. Wagner
Brown, Robert L.	FRV	Gordon Mercer
Mercen, Donald E.	M	J. R. Meyer
Krohn, John M.	M	Lawrence E. Kaap
Vander Wall, Clifford C.	FRV	Frank Carlson
Kuckuck, Francis D.	NW	Neal Bartholomew W. F. Baumgartner
Anderson, Clarence V.	NW	R. G. Cooper W. F. Baumgartner
Sampson, Maurice W.	M	H. J. Zibble
Kurtzweil, Terrence J.	OS	Harry Gute
Schlies, Edward L.	FRV	Wayne G. Bryan
Pedersen, Robert Wm.	FRV	C. W. Rollman
Knop, Gerhardt Ernst	M	Rudolph R. Gocht
Ertz, Eugene J.	NW	L. Schmidt W. F. Baumgartner

FOX RIVER VALLEY CHAPTER

R. E. LEE
Reporter

No chapter news submitted.

The Fox River Valley Chapter of Wisconsin Society of Professional Engineers activities have been of interest to the members in their get-to-gether meetings. On December 3, 1953 a dinner with the ladies was held. The Christmas motif was followed through on the decorations and was held at the Elks Club at Kaukauna. A "country style" turkey dinner was served. The principal speaker was John C. Burke, warden of the state prison at Waupun. He gave an interesting talk on the problems and outlined the rehabilitation program that is carried on. He stated that cleanliness is a program in itself and has had a good moral effect on the inmates while in prison and also after being released. Examples were stated where the men became more interested in their future by study and learning a trade while in prison.

An executive board meeting was held January 21, at Appleton. The future program and work of the chapter was outlined. Engineers Week was discussed and a program to be followed through. Gordon Meyrick, Green Bay, is chairman of Engineers Week, Wayne Bryan, Neenah, being chairman of the membership committee, outlined his program for obtaining new members and E.I.T.'s. Membership in the chapter as of January 1, was 123. The next meeting was held at West DePere, February 3, at Club Nicolet. The topic was "Green Bay's New Water Supply" and was presented by W. H. MacDonald, president of the water commission and H. W. Gochnaver, chairman of the water commission's engineering committee. This was an interesting subject as the city will be getting its water from Lake Michigan approximately 40 miles distant from Green Bay.

WISCONSIN VALLEY CHAPTER

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J. M. ABERNATHY
Reporter

Next meeting at Wausau, March 20. Meetings scheduled for the year are: Antigo, June 19; Wisconsin Rapids, Sept. 18; Rhinelander, Dec. 11.

NORTHWEST CHAPTER

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R. N. MORRIS
Reporter

1954

Officers

President—M. R. Charlson
97 W. Madison St., Eau Claire
Vice President—R. F. Bott
916 High St., Chippewa Falls
Sec.-Treas.—W. E. Hestekin
716 Third Ave., Eau Claire
Past President—W. T. Gohn
218 S. Barstow St., Eau Claire

Directors

W. T. Gohn
218 S. Barstow St., Eau Claire
F. J. Hoeppner
631 E. Madison St., Eau Claire
E. R. Holm
105 E. Grand Ave., Eau Claire

Committee Chairmen

Civic Affairs—F. D. Kuckuck
514 Ripley St., Eau Claire
Education—T. E. Thoreson
715 S. Main St., River Falls
Ethics & Practice—H. T. Hagestad
513 E. Elm St., River Falls
Finance—S. V. Willson
2 S. Barstow St., Eau Claire
Legislative—A. V. Lokken
1809 Hoover Ave., Eau Claire
Membership—W. F. Baumgartner
909 Fifth Ave., Eau Claire
Program—V. M. Dufeck
618 S. Farwell Ave., Eau Claire
Public Relations—W. A. Rosenkranz
P.O. Box 344, Chippewa Falls
Publicity—P. F. McKinnon
546 Churchill St., Eau Claire
Registration Promotion—
R. G. Cooper
1122 Orchard Beach Dr.,
Rice Lake
Fees and Classifications—
W. T. Gohn
218 S. Barstow St., Eau Claire

MILWAUKEE CHAPTER

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CLYDE R. ETHIER
Reporter

On March 9th, 1954, over 100 engineers and ladies attended the annual ladies night of the Milwaukee Chapter of WSPE, which this year was held at the University Club of Milwaukee. The entertainment committee had planned cocktails and dinner, without giving a thought to the fact that March 9th was an election day. Because of this, the pre-dinner entertainment was consequently "dry."

After an excellent dinner, the new officers for the 1954-55 term were introduced by President Larson. Their terms in office will begin in June. Mr. Larson then introduced the speaker of the evening, Mr. Howard Van Zandt. Mr. Van Zandt is an internationally known engineer, author, and lecturer who has spent years in the Orient. He has a master's degree in oriental history, and speaks Japanese fluently. He is author of over 100 magazine articles on East Asia, 22 of which were written in the Japanese language. He has on numerous occasions lectured to native audiences on their own customs and history. In December, 1952, he made a formal address in Japanese before the Diet in Tokyo. He is considered an authority, even by the Japanese, on all phases of Japanese life, customs, and religions.

His experiences and observations in Japan were presented in a fascinating lecture of many quaint, many odd, and many almost unbelievable facts about these sometimes unfathomable orientals. But he did not criticize or poke fun at them. In fact, he concluded his lecture with a selection from Ella Wheeler Wilcox:

"I know there are no errors
In the great eternal plan
And all things work together
For the final good of man.
And I know as my soul speeds onward
In its great eternal quest
I shall say as I look earthward
Whatever is—is best."

WESTERN CHAPTER

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D. W. GRUNDITZ
Reporter

A color-slide illustrated talk on an Alaskan Highway trip highlighted the Ladies Night pre-Engineers' Week dinner meeting of Western Chapter WSPE, Tuesday, February 16 at the New Villa, La Crosse.

Professor Carlin Dahler of La Crosse State College presented a

WSPE

most interesting and informative slide lecture on his motor trip over the Alaskan (formerly the Alcan) Highway to Alaska, aerial views of the Anchorage area including a recently erupted volcano, and on the return trip to the United States by rail and ship.

Reports on the annual meeting in Milwaukee were made by chapter president L. F. Kehoe and state membership chairman F. L. Carlson.

Plans for Engineers' Week in La Crosse were discussed by President Kehoe and public relations chairman, D. W. Grunditz.

The next meeting was held jointly with the La Crosse ASME committee on Wednesday, March 24, at the Cerise Club, La Crosse. Dr. Francis Tatnall of Baldwin-Lima-Hamilton spoke on "Making Things Stronger by Making Them Lighter." Dinner was at 6:30 p.m. and the technical session at 8:00 p.m.

SOUTHWEST CHAPTER

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C. H. GAUSEWITZ
Reporter

SOUTHWEST CHAPTER NEWS

The regular meeting of the Southwest Chapter occurred during National Engineers' Week on Tuesday, February 23, at the Nakoma Country Club, Madison.

The speaker of the evening was Dr. Clifford Lord, who is the director of the State Historical Society of Wisconsin. Dr. Lord's subject was "The Presence of Our Past." The first portion of his program was a talk relative to the history of engineering in our state as revealed by research of the society, and thus tied in the theme of the second portion which was a 30 minute documentary film. "The Presence of Our Past" dramatized the story and character of Wisconsin people, their traditions and heritage.

NOTE: Our chapter has eleven new members since the last meeting. Can we do as well before the next meeting?

THE END

Industrial Engineering - -

(continued from page 42)

methods, statistical control techniques and lowered inspection costs.

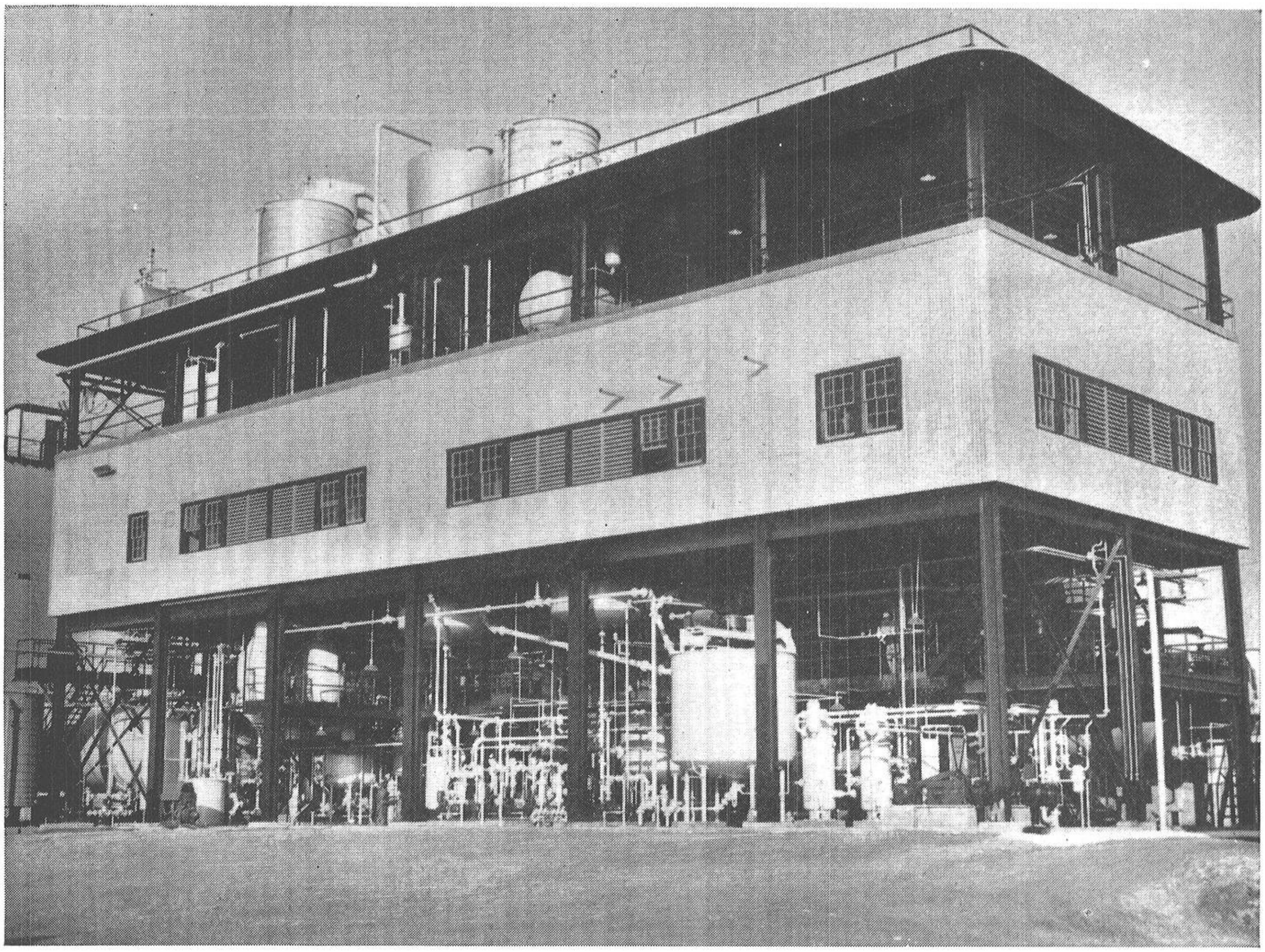
Examples of the industrial engineering function do not end with this listing. It is but a typical cross section of the type of problem which these men are assigned to work on. The scope and importance of work assigned to a particular man or group of men may vary widely with the type of concern, its size or its type of product but the same range of problems exist regardless of the specific form they may take. Problems exist regardless of company size, the small concern may need only one industrial engineer while the large producer needs a staff of large size where within the department men will specialize on particular phases of industrial engineering such as time study, plant layout, methods, processing, or others.

Industrial engineering is not new. Its roots were developed by the early 1900's, but between then and now it has grown beyond the "speed up" or "efficiency expert" stage which blossomed in the 1920's. Only in the past 15 years has industrial engineering matured fully to the stature and scope which it occupies today. Occasionally people still refer to industrial engineers as "efficiency experts" but within the field itself this term disappeared long ago. Today one finds industrial engineering occupying an increasingly important technical function which cuts clear across the industrial enterprise, usually at the staff or planning and analytical level. Its varied interests have been mentioned earlier. Nor has its development in any way stopped. Today's interest lies increasingly in the statistical analysis area of operations research and in the growing area of automatic factories commonly called "Automation."

A student interested in this field of work can specialize in industrial engineering within the mechanical engineering framework of courses, either at the undergraduate or at the graduate level here at the University of Wisconsin. Within the regular mechanical engineering program 3 options exist, namely (1) heat power, (2) design, and (3) industrial. A student can, if he desires, utilize all of his free elective courses toward his major interest. Many students extend their special interests into a fifth year of graduate level work and are able to considerably broaden their scope of training through the Master's degree work.

Within the industrial engineering group of courses there are available offerings in industrial organization, time study, plant design, inspection and quality control, tooling, materials handling, cost analysis, production processes, plant layout and a number of other courses. In addition the interested student can draw upon numerous offerings from other departments and can thus achieve a reasonably complete background. Whether we call this work industrial, production, or mechanical engineering there exists a real future challange to the student who chooses to pursue this expanding field.

THE END



EXCESS HYDROCHLORIC ACID is put to work in this catalyst plant of the Morton Salt Company at Weeks Island, Louisiana. The acid is used in a process developed by a Standard Oil scientist to produce a top-quality catalyst.

What the scientist saw in the sandpile!

This story starts with a child's sandpile and a scientist's curiosity. It ends eight years later with a new top-quality catalyst—the result of a scientist's ingenuity.

One day a Standard Oil chemist took home some granular blast furnace slag from a neighboring steel mill for his children's sandpile. Suspecting that it had properties of potential value, he took a pailful back to his quarters in the Whiting Laboratory the next day.

Treating the slag with hydrochloric acid and then drying it in an oven produced 30 cc's of powder that proved to be an effective and active catalyst. However, commercial production of the catalyst was uneconomic because of the market price of hydrochloric acid. To overcome this obstacle, Standard Oil contacted the Bay Chemical Company, a salt cake producer which, at times, had difficulty marketing hydrochloric acid—a co-product of salt cake.

The Bay Company, of Weeks Island, Louisiana, now merged with Morton Salt Company, became interested in the new catalyst and built a plant with the aid of Standard Oil scientists. The output of this plant is a top-quality catalyst with unlimited new sources of raw materials.

This is only one example of what Standard Oil scientists accomplish in an atmosphere of independent research. In our constantly expanding laboratories, our scientists are free to investigate and pursue ideas, for Standard Oil knows that one of a scientist's greatest assets is his curiosity.

Standard Oil Company

STANDARD

910 South Michigan Avenue, Chicago 80, Illinois

ALUMNI NOTES

Neef, John H., c'04, has bequeathed $1,400 to the University of Wisconsin to establish the Grace Bradley Neef Trust Fund, in memory of his wife, to be used to assist in rehabilitation and education of UW students who served in any branch of the U.S. Armed Forces in World War II. Mr. Neef passed away at Salem, Oregon, last October 14.

Thelin, Carl F., m'53, publicity editor of the "Wisconsin Engineer" last year, is now a junior engineer for the Line Material Company, Milwaukee, Wisconsin.

Koenecke, Merlin M., ch'51, recently addressed the University of Wisconsin chapter of the American Institute of Chemical Engineers on the subject "How to do a better job in industry". Mr. Koenecke is a chemical engineer with the Ethyl Corporation, and is working at the Baton Rouge, Louisiana, plant.

Hoekstra, I. Arthur, ch'43, is a project leader in charge of flow sheets, equipment design and specifications, layouts, job estimates, and materials requisitions for the Niagara Alkali Company, Niagara Falls, N.Y. He also follows the erection of the equipment and instructs the operators. Mr. Hoekstra is secretary of the Niagara Falls Junior Chamber of Commerce and vice-president of the Electron Society.

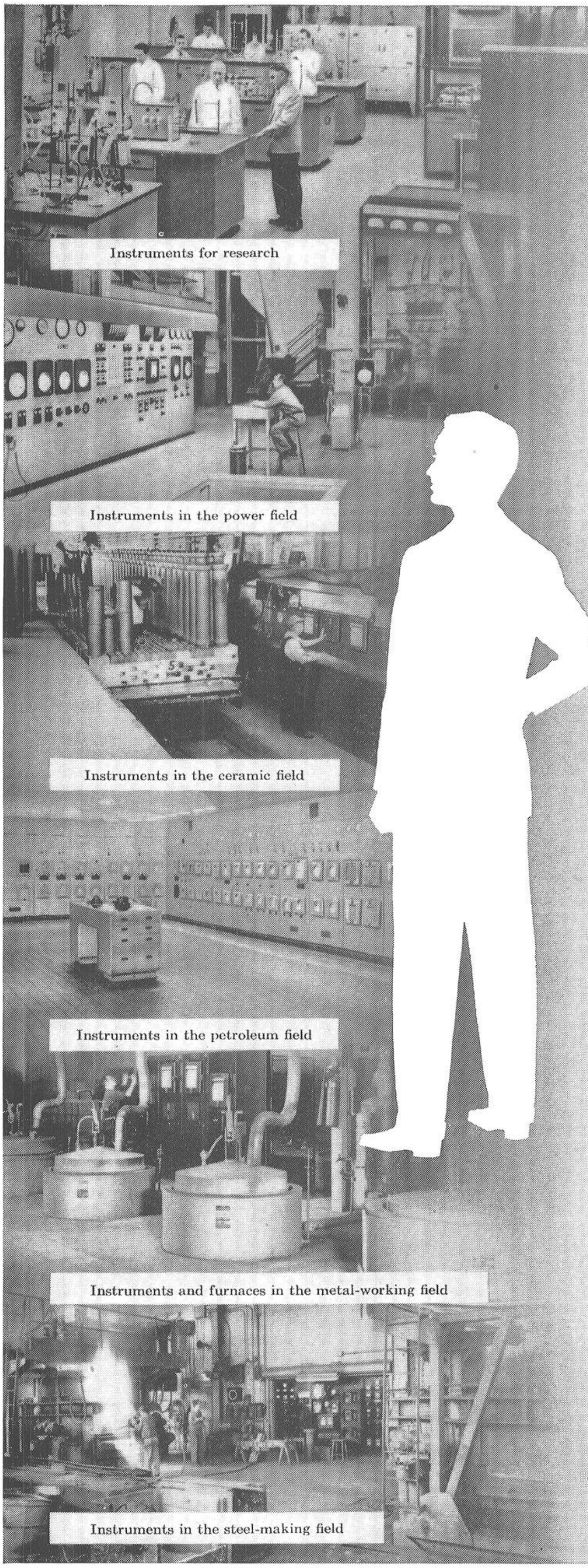
Janett, Leslie G. ch'35, has recently been promoted to the position of vice-president of the J. O. Ross Engineering Corporation. Mr. Janett, editor of the "Wisconsin Engineer" in 1933-34, succeeds **Alvin E. Montgomery,** ch'21, as vice-president, and his new position involves being general manager of the Chicago office of the company. This office handles the sales, engineering, field erection, and design of equipment that is sold throughout the middle-west and southern gulf states. The J. O. Ross Engineering Corporation is primarily engaged in the chemical engineering applications involving control of drying and production processes, and has branches in many cities in the U. S. and Canada. It is also affiliated with the Ross-Carrier Corporation, Ltd., in London, England, thus giving it world-wide coverage in supplying equipment to the process industries.

Cromer, Orville C., m'30, MS'31, ME'38, authored a recent magazine article for "The Military Engineer" entitled "Liquefied Petroleum Gas for Engine Fuel." Mr. Cromer once taught heat-power engineering at the University of Wisconsin and is now in charge of courses in the automotive branch of mechanical engineering at Purdue University.

Wright, John F., ch'36, is now in charge of the petrochemical plant operations on the east coast for Esso Standard Oil Company. Some of the products made in these eastern plants include lube oil additives, gasoline additives, synthetic resins, methyl ethyl ketone, and isopropyl alcohol.

Price, Reginald C., c'35, left early in March for Bangkok, Thailand, where he will be on the staff of the Bureau of Flood Control of the United Nations. The bureau assists various governments in that area in controlling and developing rivers.

Wisconsin engineers who attended the annual meeting of the Technician Association of the Pulp and Paper Industry and the American Pulpwood Association in New York City to present results of research on pulpwood and pulping methods included: **John N. McGovern,** ch-29, MS '30, PhD'36; and **Wayne C. Lewis,** c'36, both of the U.S. Forest Products Laboratory in Madison.



TAKE YOUR PLACE IN A FIELD WITH A FUTURE . . .

Instrumentation

Is there still some question in your mind as to just where you fit into the engineering picture? If there is . . . and you want to apply your ability to a wide scope of industrial and scientific activity . . . consider the expanding field of instrumentation.

The increasing use of instruments to control production lines . . . to test products . . . to solve research problems is reflected in the spectacular growth of the field. In recent years, sales of electrical measuring instruments have risen 455% and sales of scientific instruments 655%.

Here at Leeds & Northrup, we help to meet these demands for more and better instrumentation. We are a leading supplier of automatic, high precision, balance-type electrical instruments for many segments of industry. Our automatic and manual laboratory-type instruments for the worker in science and research are recognized throughout the world. In addition, we are among the leading makers of furnaces for heat treating.

Perhaps your opportunity is in our sales engineering division—helping to analyze and to solve the instrumentation problems of our customers. Or, as a market development engineer, you would be concerned with fitting L&N instruments to new groups of applications. Your interest may lie in the design and manufacturing of L&N products. If so, you may qualify for an opening in product engineering, industrial engineering, research, inspection or elsewhere among our 3000 people.

Decide now to investigate your place in the field of instrumentation. Ask your placement officer for a copy of our booklet, "Career Opportunities" which describes the highlights about L&N. Or, write to the Industrial Relations Department, 4850 Stenton Ave., Philadelphia 44, Pa.

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Patents - -

(continued from page 16)

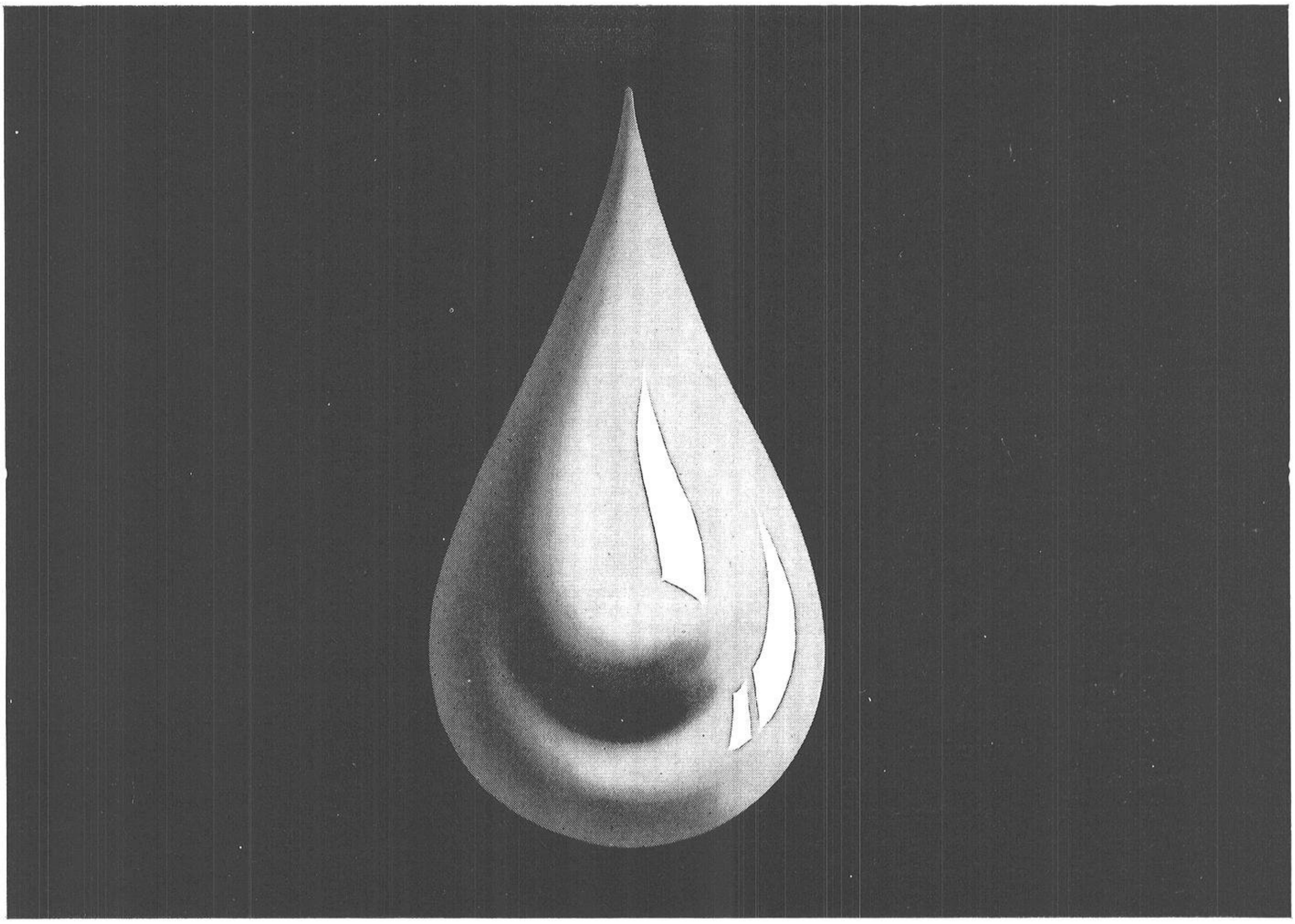
Prosecuting the Application

When the complete application has been filed in the patent office, it is classified according to subject matter and referred to an examiner in the proper division. In his first action, the examiner points out any errors of form and insufficiency of disclosure. He may require division on his finding that the application covers two or more inventions, as, for example, a process and a product that in his opinion, do not truly constitute a single invention. He may reject some or all of the claims on the basis of insufficiency of disclosure in the specification, or of lack of utility of the device or of lack of novelty over previous knowledge, or disclosures in previous patents. He may find that some or all of the claims are in conflict with those of a copending application of another inventor. In any action in which a claim is rejected on the basis of a prior patent or publication, the reference must be cited. The applicant is usually allowed six months in which to reply to an action by the patent office. The commissioner may, on notice, require reply in a shorter time but not in less than thirty days. In his reply the applicant must respond fully to each ruling and to each reference against the claims. The replies to the actions are submitted to the examiner and considered by him. If the amended claims are satisfactory, or the arguments in favor of the original wording are convincing, the claims are allowed; if not, the claims at issue are "finally rejected."

Issuance of the Patent

When, by action of the examiner, it has been found the claims as revised are allowable, the application is put into final form, and notice of allowance is sent to the applicant. Upon payment of the final fee, the patent is issued.

THE END



MOLECULE MAGIC . . .

This tiny drop of oil, say the chemists, contains hydrocarbons—the raw material for hundreds of thousands of organic chemicals . . . the makings for tires and textiles, for dyes, detergents and deodorants, for paints, plastics and polishes, for agricultural and industrial chemicals.

Oil—the ointment of the ancients and preservative for mummies—is old. It's Nature's billion-year alchemy that changed fish and lizard leftovers into black gold . . . chemical "gold" that is just now being developed.

DREAMLAND IN A DROP . . .

It wasn't until this century that the chemical and petroleum industries began the molecular magic that transformed a drop of oil into a two-and-a-half billion dollar enterprise.

How did it happen? Principally because of the way we Americans work. Every art, science and branch of engineering has the opportunity and the incentive to add its drop of genius to the pool of progress. Here cooperation and competition bring benefits of better living to people everywhere.

And lighting the way toward the brighter future is America's all-seeing, all-hearing and reporting Inter-Communications System.

THE AMERICAN INTER-COM SYSTEM . . .

Complete communication is the function, the unique contribution of the American business press . . . a great group of specially edited magazines devoted to the specialized work areas of men who want to manage better, research better, sell better, buy better.

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Freeways - -

(continued from page 48)

Applying the above listed benefits to the record of vehicle mileage on presently completed sections of freeways, we find that, on the conservative basis used, in the three year period 776,100,000 vehicle miles of travel at 2.00c per mile savings resulted in a savings of $15,522,000. The original cost of the 16.57 miles of freeways under study was $42,026,683. If these savings could be applied to payment for the freeways, their cost would be amortized in less than ten years. If the savings over the rest of the life of the projects were capitalized, this section of freeways would be worth over $100,000,000 in benefits to the motorists, besides paying for the initial cost of the freeways.

To be sure, these heavily traveled and high priced freeways give a much greater return than do outlying freeways which cost less but carry lower volumes. This is due to the slowness and many stops on the surface streets in congested areas. The traffic carried by a typical high volume freeway will be three times as great, the unit benefits twice as much, and the cost twice as much as for a low volume freeway in outlying areas.

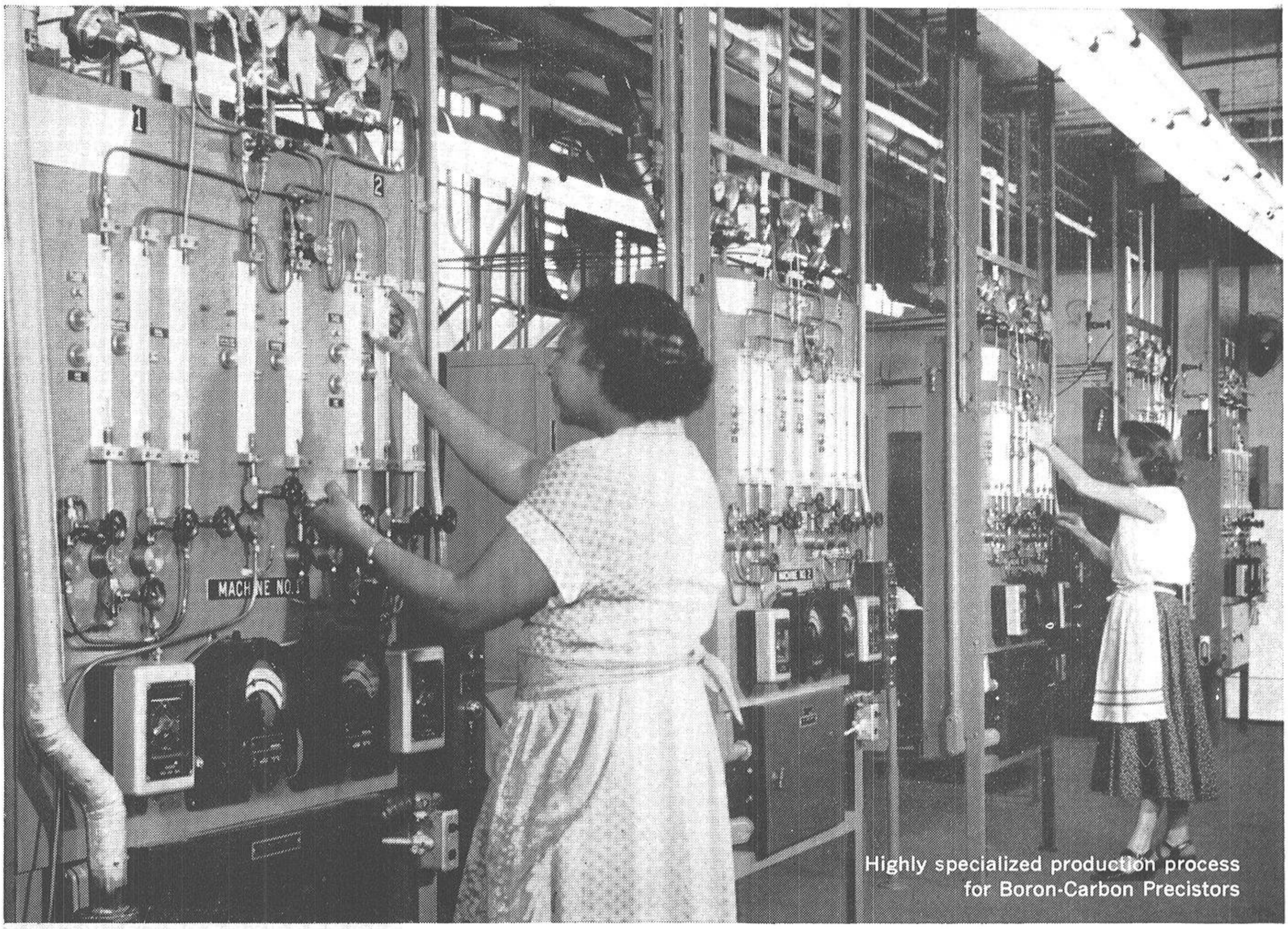
Conclusions

(1) The economic benefits to the motorist from his investment in freeways are direct and substantial; conservative minimum savings are shown to be 2c per vehicle mile; (2) There are large benefits to the region which are as real, though hard to evaluate; (3) Heavily used freeways in congested urban areas, while costing much more, pay for themselves more quickly than lower cost freeways in areas of less intense traffic demand.

Thus we can see that freeways are a good solution, despite their high prices, to traffic problems in metropolitan areas. One all-important principle must be remembered, however, if freeways are to be successful. Each of them has a certain maximum capacity that it can accommodate, and going over this maximum defeats many of the benefits offered to motorists by freeways. This has happened on some freeways, and it will happen on more unless facilities are increased. A good example of a really large increase in facilities is the present construction of the Congress Street Super-highway in Chicago. An eight mile long artery cutting east-west across the city, it will cost $11,500,000 per mile when completed, and pass **through** the 13 story U.S. Post Office building. Four lanes of traffic will be carried in each direction, with an additional four lanes for mass transportation facilities on the median strip separating the highways. Many other large cities of the country are engaged in the same type of construction, and thus some of our many traffic problems are being solved.

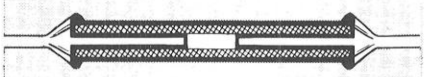
(Some of the information for this story was taken from the Dec. 1953 issue of "Traffic Engineering" and the Jan. 1954 issue of the "Traffic Quarterly.")

THE END



Highly specialized production process for Boron-Carbon Precistors

ONLY FILM TYPE RESISTORS MEET HIGHER STABILITY STANDARDS



BASIC TECHNIQUE

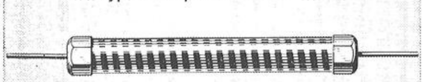
A thin coating of pre-cured and stabilized resistance material is bonded to special glass or an inorganic core to form IRC's exclusive filament type element. This is in contrast to the carbon pill or slug principle of construction. Its uniformity and stability have proved superior since the earliest days of radio.

SPECIFIC EXAMPLES

IRC Type BOC Boron-Carbon Precistors

IRC Filament Type BT Resistors

IRC Type DC Deposited Carbon Resistors



IRC Type MV High Voltage Resistors

. . . another reason why engineers prefer IRC Resistors

Advancing requirements of instrumentation, military electronics and television focus emphasis on greater stability for non-wire wound resistors. IRC believes its filament type construction offers the best answer to more exacting standards. For over 28 years the film type resistance element has proved its superior stability—even in today's newest IRC Boron-Carbon Precistor.

IRC

Wherever the Circuit Says —∿∿—

INTERNATIONAL RESISTANCE CO.

401 N. Broad St., Phila. 8, Pa.

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STATIC

BY I. R. DROPS

Fie upon thee, little man
With thy slide rule in thy hand;
Seated at your work all day
While your roommates drink and play;
Throw away your cams and charts
Now's the time to switch to arts.

* * *

A true music lover is a guy who, hearing a blonde soprano singing in the bathtub, puts his ear to the keyhole.

* * *

Daughter: "I took Henry into the loving room last night, and . . ."
Mother: "That's LIVING dear."
Daughter: "You're telling me!"

* * *

Legs are appendages that are extremely necessary to basketball players and to girls who are trying to get to first base.

* * *

A father and his young son who carefully held in his lap a shoe box punctured with air holes, were seated in a bus. When the bus stopped for a red light, the lad was heard to ask, "Daddy, is my kitten a man kitten or a lady kitten?"

"A man kitten," said the father promptly.

"How do you know?" the boy continued.

Every passenger within earshot waited expectantly for the reply.

"Well," explained the father, "he's got whiskers, hasn't he?"

* * *

Two editors gazed admiringly at the beautiful dress of the chorus girl.

"Who made her dress?" one asked his companion.

"I'm not sure, but I think it was the police."

* * *

We have read so much about the bad effects of drink that we have decided to give up reading.

Visitor addressing an employee at a large government plant: "What do you make here?"

Employee: "Horses' heads."

Visitor: "That's interesting. What do you do with them?"

Employee: "Send them to Washington for final assembly."

* * *

The ship was sinking, and the captain called all hands aft. "Who among you can pray?" he asked.

"I can," replied the ensign.

"Then pray, shipmate," ordered the captain. "The rest of you put on life jackets, we're one short."

* * *

The reason for the amber light on the traffic signal has finally been revealed: It gives the Scotchmen a chance to start their engines.

* * *

He: "I bet I know what you're thinking about."

She: "Well, you don't act like it."

* * *

My slide rule is my sheperd, I shall not want.

He maketh me to set down to the third place; and leadeth me to interpolate to the fourth.

He restoreth my average; and leadeth me along the paths of correct answers for his name's sake.

Yea, though I walk through the valley of the shadow of pop quizzes, I will fear no professor; for my slide rule is with me.

His log scales and trig scales they comfort me.

Thou preparest an answer for me in the presence of my professors, thou annointest my paper with right answers and my brain relaxes—

Surely Quality and Accuracy shall follow me all the days of my life.

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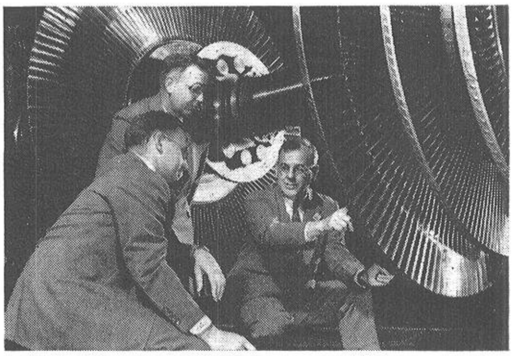
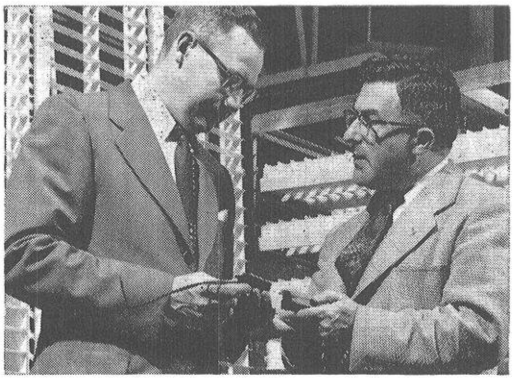
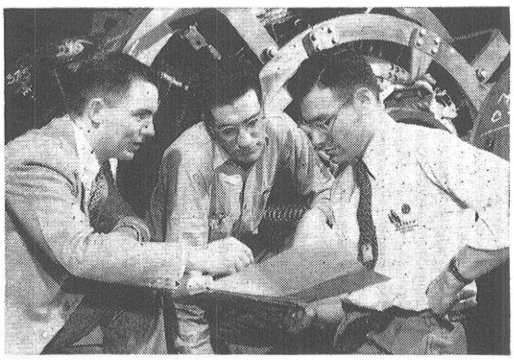


A Sales Program man learns how good design makes sales easier.



As a specialty salesman you'll have a chance to work with young companies, to help them grow to be leaders in their field.



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