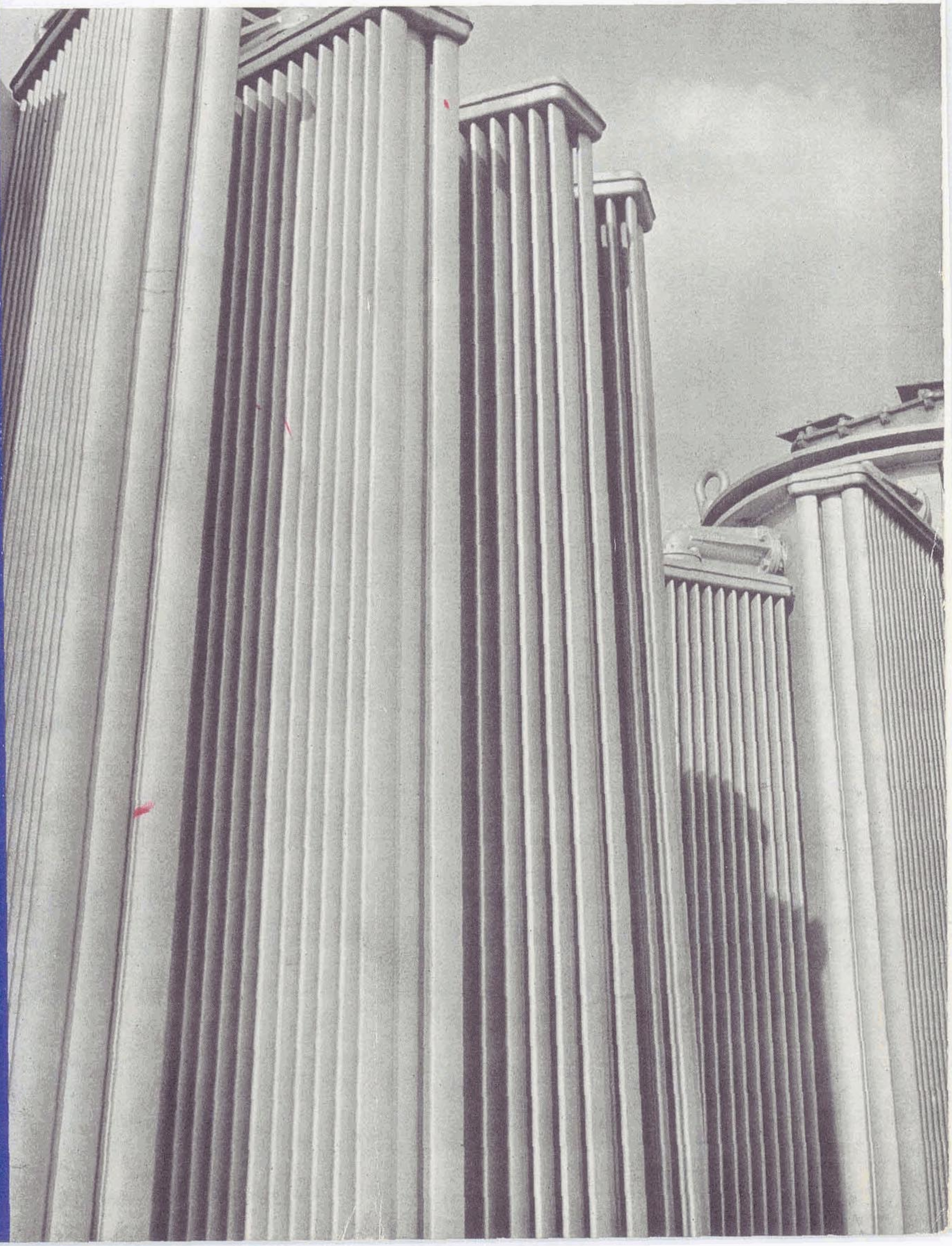
ALUMNI REVIEW

CALIFORNIA INSTITUTE OF TECHNOLOGY

Vol. 5 No. 4

June, 1942



"WHO—ME?"

Not right now, sonny. But you just wait! This whole great country is going to be needing you. Say about 15 years from now, when you've acquired a little algebra, and a best girl, and 100-odd more pounds of bone and muscle.

"What'll it need ME for then?"

For lots of things. For jobs a great deal different and better than today's. You like airplanes, don't you?

"Airplanes? You bet!"

Well, we'll need you to fly them. Better planes than any we have now, flying higher and faster. They'll be safer, and the whole world will be safer, too, when you take to the air. We're determined on that, and we're doing everything in our power to make sure of it. What else do you like to do?

"Well, we're buildin' a clubhouse . . ."

Building! Just the thing! We're going to want your help with a lot of building. Houses, and the things that go into houses. Things like air conditioning, and better heating and lighting, and refrigerators. I tell you, you're going to be busy!

"Bu—but I like to PLAY!"

And you'll have some wonderful things to play with! Radio such as nobody knows today, and television, and the results of new research in electricity and plastics and electronics—things that aren't even imagined yet. Things that you'll have a hand in imagining, and then making real. And you'll find there's no play in all the world that's as much fun as helping to build the world of the future.

Yes, sonny, we're all going to need you. And we're all of us—fathers and mothers, soldiers, men and women of American industry—working and fighting right now to make sure that this world of the future will be a better world. A world in which a young man like you can find the fullest opportunities to work and build and play. *General Electric Company, Schenectady, N. Y.*

★ ★ ★

The volume of General Electric war production is so high and the degree of secrecy required is so great that we cannot tell you about it now. When it can be told we believe that the story of industry's developments during the war years will make one of the most fascinating chapters in the history of industrial progress.

GENERAL ELECTRIC

952-317C-211

ALUMNI REVIEW

ALUMNI ASSOCIATION, INC.
CALIFORNIA INSTITUTE OF TECHNOLOGY

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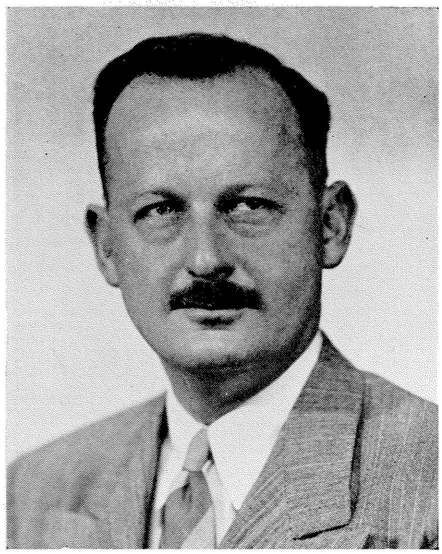


Photo by Dave Meiklejohn

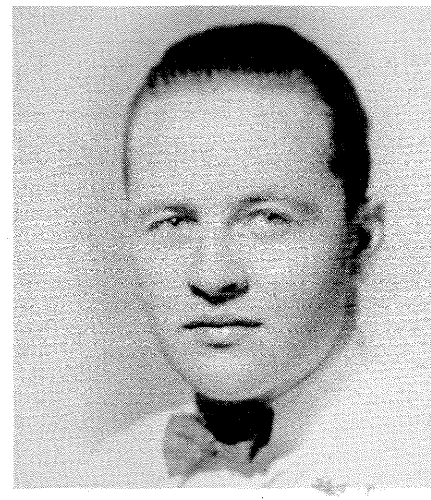
FRED HOUGH

The important problem of maintaining and increasing gas utility service in the present emergency is discussed in this issue by Alumnus Fred Hough. Mr. Hough has been with the Southern Counties Gas Company since 1925. He has worked in both Research and Distribution Engineering, and is now Executive Engineer.

Photograph by Harter

PROF. W. H. PICKERING

William H. Pickering contributed the article on cosmic ray research to this issue. Dr. Pickering is nationally famous for the cosmic ray research he has done in conjunction with Dr. R. A. Millikan and Dr. H. V. Neher; but the press of his many other academic activities in addition to his cosmic ray work leaves him little time to write articles for the Review. We were happy indeed to receive his interesting article. Dr. Pickering's rapid rise to Assistant Professor of Electrical Engineering dates from his graduation from Caltech in 1932. Since then he has become known to many students and alumni as a very capable and interesting instructor in physics, electronics radio. electrical engineering and many other subjects.



ERNEST R. HOWARD

Thermostatic Bimetal is the subject of Mr. Howard's article in this issue of the Review. Mr. Howard received his M.S. degree at the Institute in 1935, presenting as his thesis a study of bimetal behavior. After leaving Caltech, he worked on bimetal problems for General Electric at Ontario, before going to the H. A. Wilson Company where he is now carrying on similar studies.

Photograph by Harter

PROF. J. E. WALLACE STERLING

One of Caltech's most popular lecturers is Dr. Sterling. Students and alumni alike have never failed to listen attentively to his carefully prepared and carefully delivered talks on history old and current. It is with a great deal of pleasure that we present the first of a series of articles Prof. Sterling has consented to write dealing with aspects of the present war.

Current events are changing so rapidly, and often so surprisingly, that Dr. Sterling has, so far as we know, formulated no definite plans for his future articles other than that they shall deal with aspects of current history which will be of interest to readers of the Review. If you have any suggestions, or if you have a subject in mind you would like to see discussed, pass your ideas along by writing to the Alumni Review.

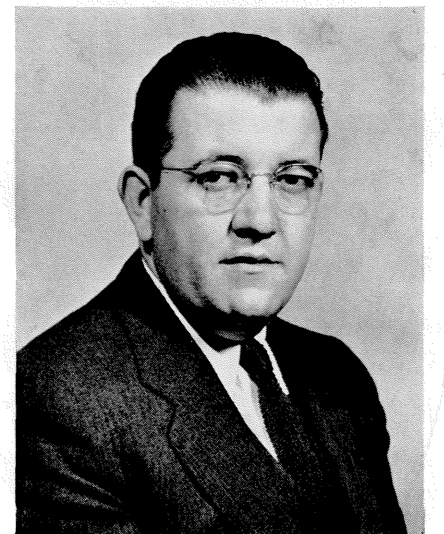
Dr. Sterling received his B.A. from the University of Toronto in 1927. In 1938 he was awarded a Ph.D. by Stanford University. An assistant professor at Tech in 1939, Dr. Sterling has served as Associate Professor of History since 1940.

Photo Herbert Matter, New York, 1941

ANTONIN HEYTHUM

Antonin Heythum received his Certificate in Architecture in 1922. After working as Art Director and Stage Designer for National Theatre and Opera House in Prague and other theatres, he graduated as Engineer Architect, Dipl.Ing.Arch., from Prague Institute of Technology, 1934. Then followed other activities, including extensive practice in residential and exhibition architecture, in commercial and industrial design; advisor for Czechoslovak Glass Research Institute and Industrial Arts Museum; Grand Prix, Brussells 1935; Officer de L'Odre Leopold II, King of Belgium.

Heythum came to the United States as architect for the Czechoslovak Government, San Francisco Exposition 1939, and New York World's Fair 1940. In 1940-41 he worked with the New School for Social Research, New York, as Associate Professor of Design. In 1941 he came to the Institute to organize Industrial Design Department and lecture in Industrial Design.



Photograph by O. K. Harter

LUIS HERNÁN TEJADA-FLORES

In his paper, Bolivia: Shangri-La of South America, Mr. Tejada paints a clear and interesting picture of his native land. Mr. Tejada, son of a former President of Bolivia, spent his undergraduate years at Tech as a member of Dabney House, majoring in Electrical Engineering. After graduation he returned to Bolivia; but the desire to go on with advanced studies soon brought him back to the Institute, where he is now working for his Master's Degree.

COVER

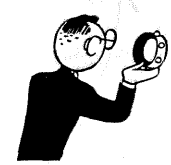
The striking photograph which appears on the cover of this issue was taken by Mr. W. Ellis Teas. It was displayed in the Pacific Photo Show where it won a Special Award, and it has appeared in several other photographic exhibitions.

PHOTO FINISH

Oxy's George Jennings and Tech's Bob Densmore, pictured in the remarkable shot below, are shown at the finish of their 880-yard race in the all-conference meet. The Tiger hit the tape with his teeth, but lost the race, the Beaver's foot having crossed the line first. This unusual photograph was given a full page in a recent issue of Life Magazine.

in other words

by JOHN CLINTON



It's been a long empty while since *Rags* departed this world. We had the house painted and there aren't even any paw marks left. Even the old divan where *Rags* slept out on the porch is gone. Yet—it hasn't been a year!

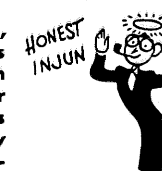
* * *

Time has suddenly gone crazy like the world. You can't measure it with clocks any more, but in ships, guns, tanks and the probable length of your automobile's life. And today lubrication of the family car is almost as important as Junior's vitamins.

* * *

Now I've never kidded anyone in these columns. They may have been dull here and there, but they've been sincere. And I was never more sincere than I am now when I recommend Stop-Wear Lubrication at Union Oil stations.

* * *



Stop-Wear, first of all, is guaranteed in writing for 1000 miles against faulty chassis lubrication — a guarantee good anywhere in the West. Moreover Stop-Wear is done with special tools and a minimum of 9 *exclusive* lubricants developed by Union Oil engineers.

* * *

The Minute Men have to graduate from a lubrication school before they can perform any Stop-Wear service. They follow factory specification charts, and they give you written reports on the condition of your car.

* * *

When you get it back you can see the difference in how it looks—you can *hear* the difference in the quiet-as-a-mouse way it runs, and you can *feel* the difference in the way it handles. Try guaranteed Stop-Wear, today.

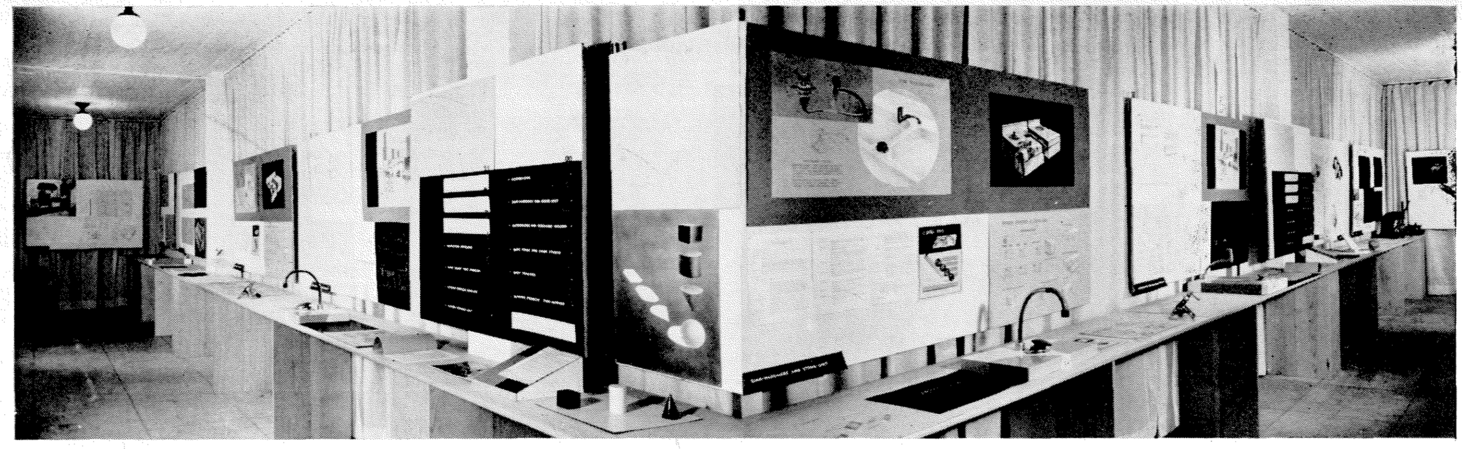


Fig. 1. Exhibition of the work done by the students of Industrial Design Section in 1941-1942. Photograph by O. K. Harter

INDUSTRIAL DESIGN

AT THE CALIFORNIA INSTITUTE OF TECHNOLOGY

FRANKLIN THOMAS, Chairman

Division of Civil and Mechanical Engineering, Aeronautics, and Meteorology

With the opening of the college year of 1941-1942 the training in Industrial Design previously given at the California Graduate School of Design in Pasadena was taken over by the California Institute of Technology. This relationship was undertaken following consideration by the faculty of the Institute and with the conclusion that a satisfactory two-year graduate course in Industrial Design could be coordinated with the four-year undergraduate engineering curricula of the Institute.

It is believed that a correlation of design factors with the materials and processes of production is as vital in the manufacturing field as it is essential for the designer of engineering structures or machines to be fully informed in regard to the possibilities and limitations of methods of fabrication and construction. The objective of the industrial designer is to visualize and outline the form of articles which will be attractive in appearance and correspondingly suitable in their functional aspects.

Under the conditions which appear likely to exist in the manufacturing industry of this country when normal production is again resumed following the war, former methods and processes will be largely displaced and there will be opportunities for innovations such as have rarely existed before. There will be enormous demand for new articles. The opportunity will exist for the employment of new processes and the array of new materials available for utilization will all combine to challenge the resourcefulness and initiative of the industrial designer

Economic condition under which the new industrial era will become established will probably be characterized by competition in the adaptation of the then-available new processes and materials. For successful industrial design it would be highly essential that the designer's ability to evolve concepts of articles satisfying the requirements of form and color be founded on the basic knowledge of mechanics and materials, so that his products may be physically capable of serving the purposes for which they are made.

In view of these qualifications which seem to fit the successful industrial designer of the future, it appears that there are large opportunities awaiting those students who possess the rather unique and diversified combination of qualities to be found in the engineer who also has some of the talents of the practical artist and who correlates these talents into the field of industrial design.

INDUSTRIAL DESIGN SECTION OF THE CALIFORNIA INSTITUTE OF TECHNOLOGY

REPORT OF ACTIVITIES, 1941-1942

By ANTONIN HEYTHUM

Mr. Heythum presents a comprehensive review of progress in the Institute's new and active Industrial Design Section. Numerous photographs show interesting examples of the work of design students.

PRINCIPLES OF INSTRUCTION

In recognition of the complexity of the tasks which confront those who choose the profession of designer, instruction in the Industrial Design Section emphasizes the development of basic faculties. It schools the sense for relationships, trains ability to organize and plan design on the basis of sound technical and technological knowledge, cultivates aesthetic judgment, and guides the creative imagination toward disciplined formal expression.

While part of the instruction program is defined theoretically and determined in advance, the choice of some of the practical problems given to the students is occasionally influenced by field trips, discussions with experts, and other daily actualities. These influences, which are appreciated as a means of keeping away from the dangers of pure academism, are, of course, always subordinated to the one decisive purpose of teaching the student a lesson of basic importance.

Men of letters and men of practice have come to agree that designing means always a number of things, never an isolated act or action; that it means planning, organizing, coordinating, unifying, shaping; that no design is ever good if it is unrelated or superficial; that form as a product of design is, or rather should be, the result of balancing such factors and relationships as the purpose which the object is meant to serve, the conditions under which it is to serve, the physical and aesthetical functions which it has to fulfill, and the technological means and production methods which will best suit to answer purpose, condition, and function.

It needs experience in addition to knowledge to develop a sound judgment for the right balance of all these factors. To shorten a designer's trial and error period, the best that school training can offer him in addition to specified instruction is to provide opportunity and guidance for the solution of a number of actual and practical problems. In all design problems given to the students, one of the prescribed requirements is that the solution shall offer some technical improvement, not mere superficial restyling.

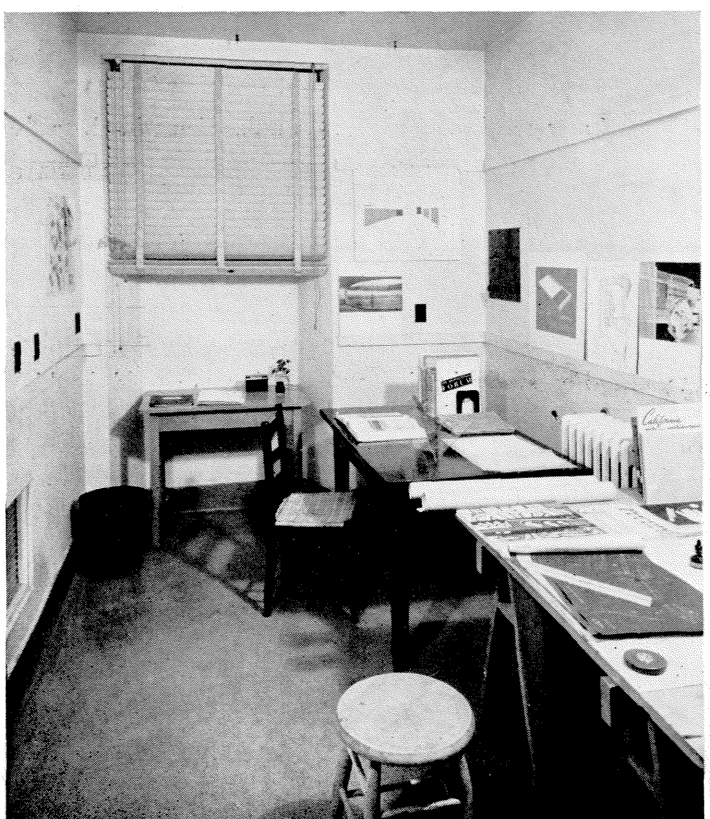


Fig. 2. Before

Fig. 3. After Photograph by O. K. Harter

Office of Antonin Heythum, designed and executed in the Industrial Design Section.

ADAPTATION OF WORKING QUARTERS

The present quarters of the Industrial Design Section are in the Astrophysics Laboratory, Room 10. This space was originally designed for other purposes; hence, it had to be adapted to the needs of the Section. These adaption problems offered the students a good opportunity to study fitness of formal design in relation to purpose and practical conditions, under definite restrictions of construction methods, materials, and costs.

The first study concerned the approach to the Section. The design of D. Welch proposed to transform the corridor, leading to the entrance, into an exhibition hall. Along the walls he provided panels for the installation of exhibit material such as drawings, blueprints, photographs, and so forth. (Illustration 4).

Other adaptation problems involved the interior of the department. Partitions had to be built to subdivide one large room into a drafting room, a library, and a workshop with machinery. One small room adjoining the library was furnished as the head office. Existing light conditions were tested and experiments were made for more suitable light for the drafting room. Available drafting tables were too small and of the wrong height for the type of work done by the Section. Working process tests were made and tables were designed to satisfy needs. These new tables were constructed in the workshop under the direction of Mr. Morant. (Illustration 5).

In connection with these larger adaptations, the design and execution of a subdivided drawer tray for drafting utensils was a smaller detail problem given to the students. A survey was made of drafting, including the handling and placing of tools as a time and motion study.

On a pictorial diagram of the working process the importance of various tools used for drafting, sketching, painting and mounting was indicated. After questioning and observing fellow students, a drawer tray design was developed and a model was made. (Illustration 6). One of D. Welch's ideas for the tray unit will be of interest to designers and draftsmen. He placed a piece of corrugated cardboard in the bottom of the drawer where pencils, brushes, and other small tools are kept. The corrugated paper holds them in place and it may be easily replaced as often as necessary. This comparatively simple design problem, which dealt with a process thoroughly familiar to the students, provided a fine study of basic methods of approach adaptable to any given design problem.

CONTACTS WITH OTHER DEPARTMENTS OF THE INSTITUTE

During the course of these working-process studies, Trevor Gardner of Industrial Relations Section, gave a lecture on "Time and Motion Studies", in which he included an illustrated demonstration of the influence of working conditions upon the efficiency of labor and its products. This lesson strongly influenced the later work on the standardized kitchen equipment problem; it marked, at the same time, the first of a number of beneficial contacts made with other departments of the Institute. The Physics, Geology, and Aeronautics departments, the department of Humanities, and the department of Mechanical and Structural Engineering are others with which an exchange of ideas and advice has developed.

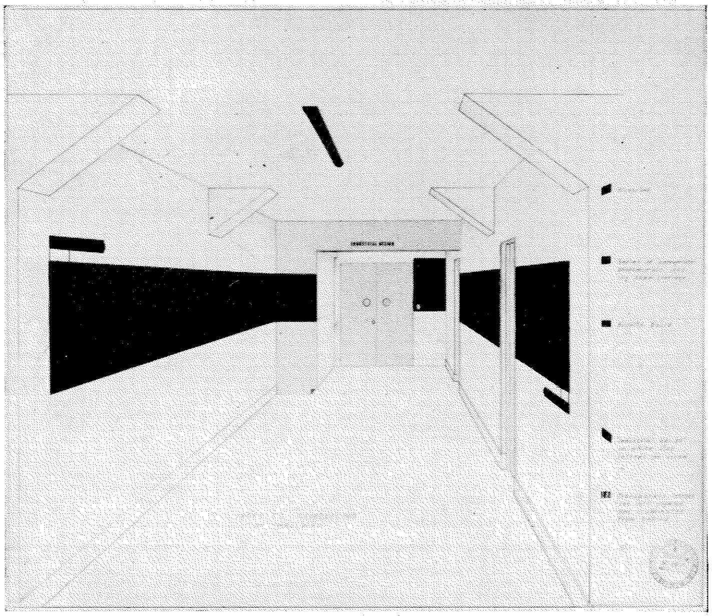


Fig. 4. Proposed remodeling of hallway leading to the entrance of the Industrial Design Section (First year work)
Photograph by O. K. Harter

Fig. 5. Workshop of Industrial Design Section.
Photograph by O. K. Harter

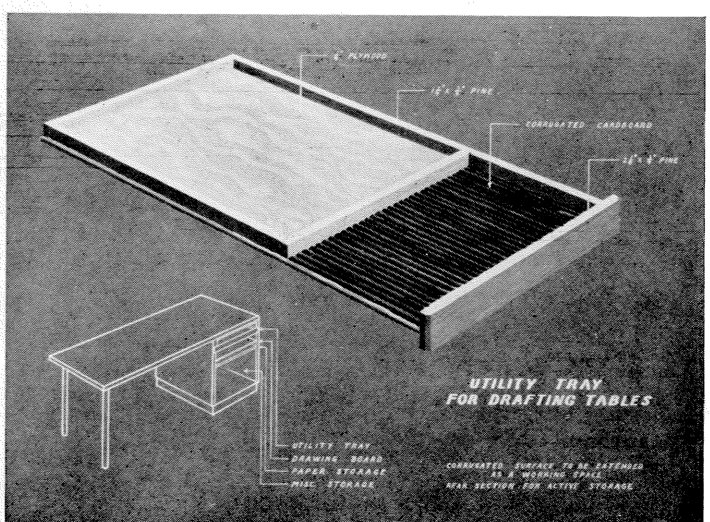


Fig. 6. Drawer-tray for drafting utensils designed for students' tables. (First year work)
Photograph by O. K. Harter

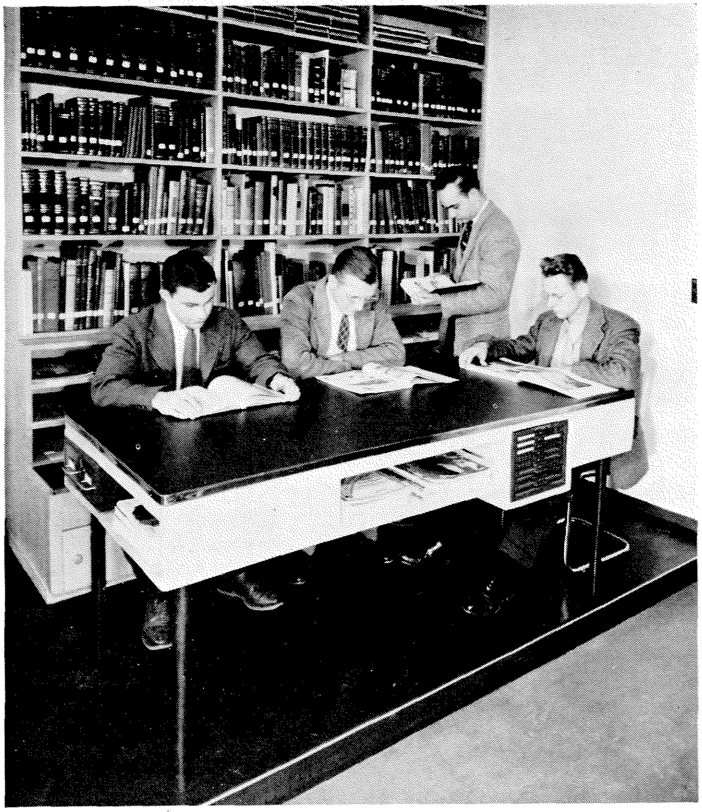


Fig. 7. Library designed and executed in the Industrial Design Section. Photograph by O. K. Harter

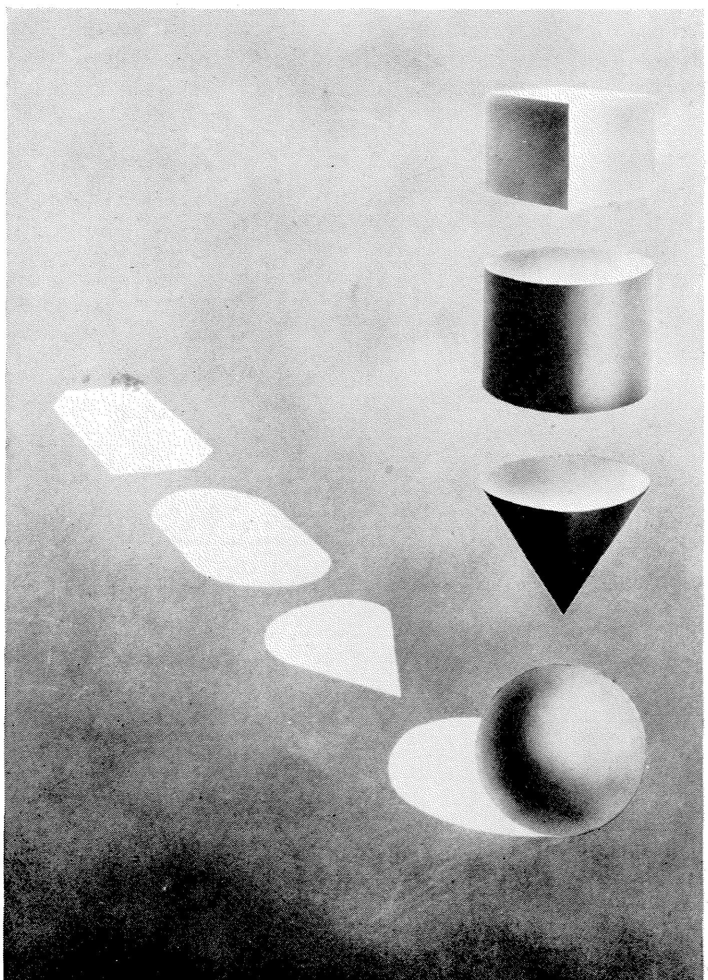


Fig. 9. Study of basic forms in basic colors. (First year work) Photograph by O. K. Harter

LIBRARY

During the period of adaptations in the working quarters, which is still in progress, students also assisted in planning equipment for the reference library and sample collection. (Illustration 7). Shelving units of white pine were constructed with the lower, deeper shelves providing a place for current magazines. Since space was restricted, the support of the shelving was designed as a chest unit which serves for a seat as well as a storage space for drawings.

Some data about the contents of the reference library may be of interest. We subscribe to twenty-one periodicals and an additional twelve are sent to us without charge. The stock of the library was acquired from the California Graduate School of Design. It is being enlarged by an average of three books every week, plus a considerable number of governmental publications, booklets, reprints, year books, and catalogs. The library is on the mailing list of many firms and industrial plants and receives their circulars, publications, samples, and other informative material. It is constantly increasing its stock of slides for lecture demonstrations, and is building up a collection of sample materials.

The file registers of all documentary material and of contacts with more than two hundred firms, designers, research institutions, and so forth, are cross indexed in the same manner as the books of the libary. Great care is taken to keep this documentary file up to date. This library constitutes a rich source of information on Industrial Design and its manifold technical and artistic implications, not only for the teaching staff and students of the Section, but for all members, students, and alumni of the Institute.

OUTSIDE CO-OPERATION

Personal contacts with local manufacturing and sales centers, as well as with experts and prominent colleagues, are constantly being widened. The most generous co-operation has been received from all these groups, from experts, designers, architects, and artists, in the form of guest lectures and informal talks, from industry in the form of criticism and advice during work on practical problems, and in tours through plants, often followed by instructive discussions with production managers and other experts.

DESIGN PROBLEMS

One of the early practical problems which was given to the students called for re-design of door and cupboard handles and knobs. The assignment of this problem followed a discussion with an architect as to which standardized parts in house furnishing he considered in need of re-designing. This problem served as a study in fitness to use with special regard to fitness for touch, efficient function, easy installation, and upkeep.

The problem of redesigning automobile bumpers—the reproduced solution is a pre-rubber shortage design (Illustration 8)—grew out of a guest lecture by Dr. Radl, journalist and owner of a driving school, who talked on automobile design and safety. The problem presented the task, common in industrial design practice, of redesigning only a part of a larger object. Such a problem showed the students the necessity of studying the whole object in order to be able to decide on the design of one particular part.

Other practical problems given included design of a soldier's kit, a food warmer, Christmas packaging, gauze packaging, lighting fixtures, and a low-cost chair.

By way of variety, abstract design problems were also set. These served both to train the novice designer's free imaginative abilities, and to ease the strain which sometimes results from concentration on strictly limited and defined practical problems.

The themes of these abstract problems are two and three dimensional compositions of basic form and color values, in various mediums and materials, or abstract mechanical gadgets, montages, collages, and so forth (Illustration 9). The illustrated model (Illustration 10), shows D. Welch's solution to the problem of demonstrating the fundamentals of perspective construction in a visualization in space. Among others, the purpose of this problem was to test and train the sense for the relationship between the three dimensionality of things and their two dimensional image, as expressed in orthographic and in perspective projection.

REDESIGNING OF KITCHEN EQUIPMENT

The major problem scheduled for the second year students' second term was the redesigning of kitchen equipment. This problem gave an opportunity for studying and demonstrating the importance of co-ordinated design. The assignment was large in scope, but had the advantage that it could be given to the students as a group, not as individuals, thus developing in them the sense and abilitiy for cooperation, which is an essential part of the general training of designers.

To define clearly all the implications of this complex problem, the work was prescribed to start with the analysis of an actual kitchen best known to the student. Everyone was allowed three hours for a sketch and plan of his own or his mother's kitchen, to be accompanied by a critical analysis. The second step was to sketch and outline individual suggestions for improved kitchen planning and equipment. This was done in order to have a record of creative ideas and intuitions developed in a mind still more or less undisturbed by restrictions which in the course of serious research and during occupation with technical details are often imprisoning to the spirit of creative imagination.

These preliminary individual steps were followed by several weeks of group research and discussions, including visits to, and experiments with, any conceivable kitchen type, including trailer and dining car kitchens. In the course of this experimenting, purchases of food supplies were analyzed and recorded; the supplies were divided for storage in cooler, refrigerator, shelves, bins, etc. A dinner was prepared, the table set, and dinner served, followed by dishwashing and the whole process of kitchen cleaning. Every action detail was thoroughly analyzed; all working processes were tested in regard to efficinency, time and motion economy, etc. Then plans were worked out which provided for minimum waste of energy. Heights were ascertained which could eliminate unnecessary stretching or stooping. Essential and most often needed supplies and utensils were placed in proper relation to the working processes. All findings were submitted for discussion in informal talks with a number of housewives, as well as with experts of firms selling or manufacturing kitchen equipment. All data were compared with similar studies published by the United States Department of Agriculture.

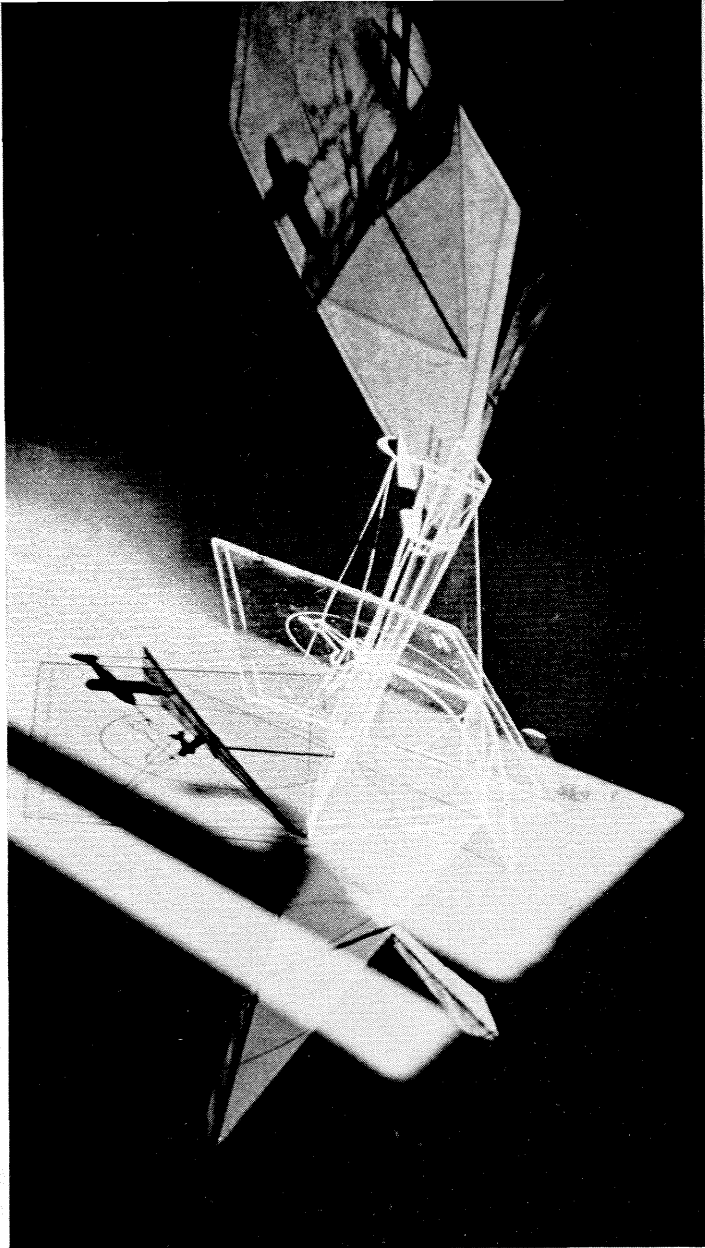


Fig. 10. Fundamentals of perspective construction demonstrated in an abstract composition in glass and wire. (First year work)
Photograph by A. Heythum

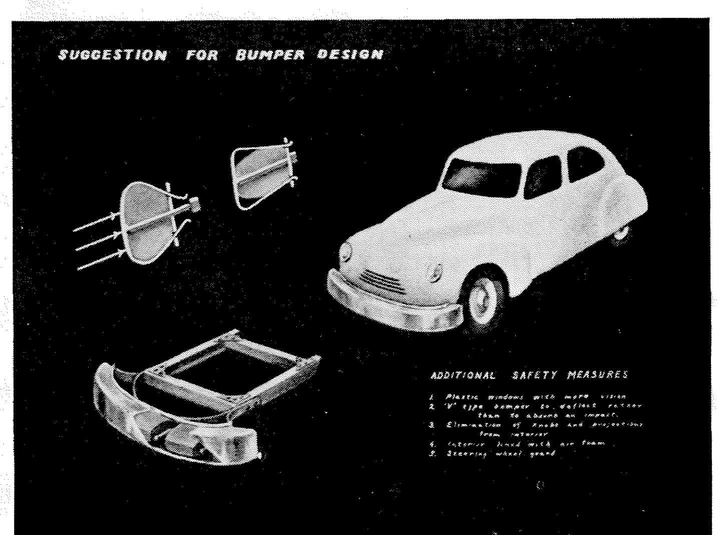


Fig. 8. Suggestion for bumper design. (First year work)
Photograph by O. K. Harter

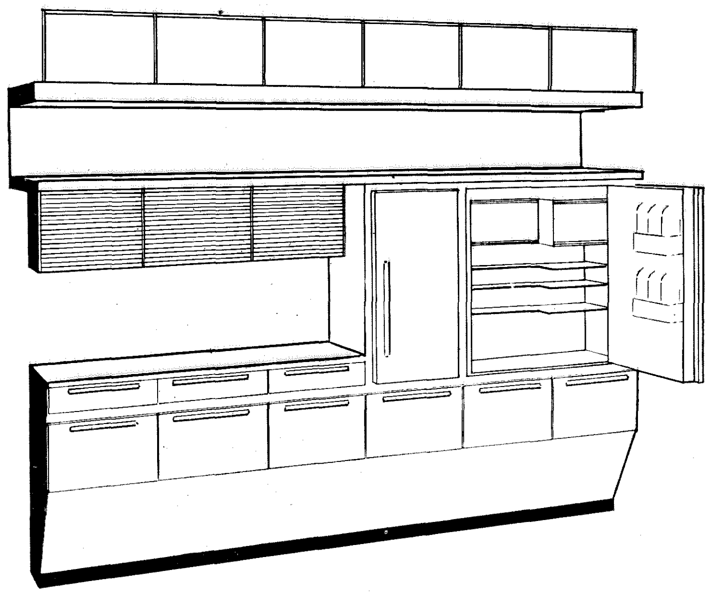


Fig. 11. Part of kitchen equipment showing the cupboard unit and refrigerator combined with cooler. (Second year work)

Photograph by O. K. Harter

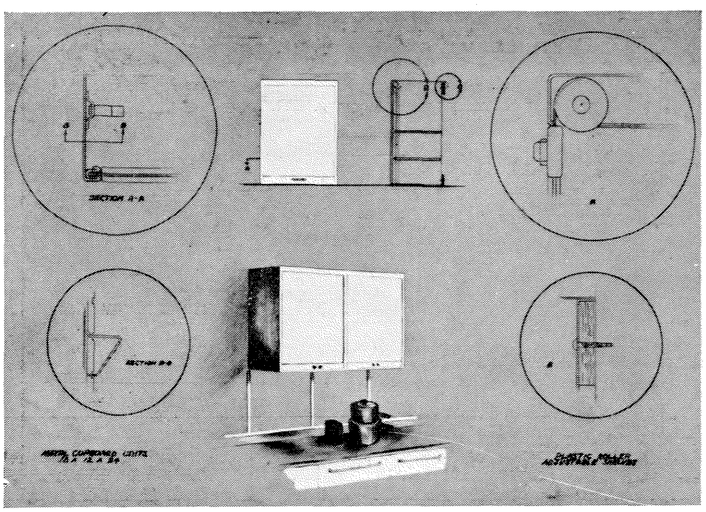


Fig. 12. Metal cupboard units with plastic rollers, designed for collective project of kitchen equipment. (Second year work)

Photograph by O. K. Harter

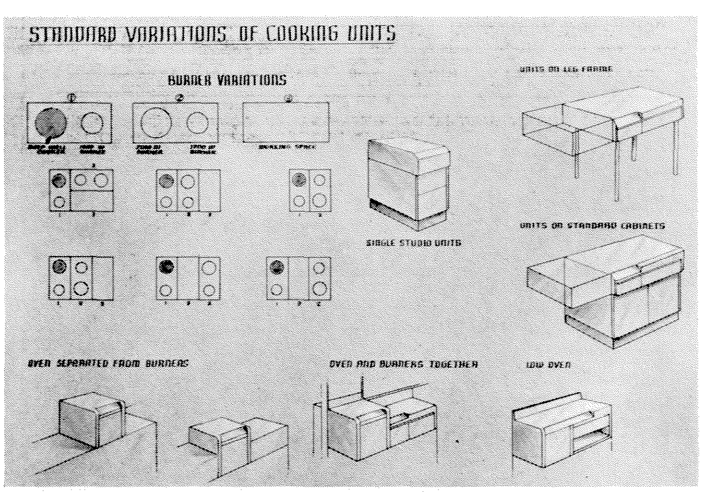


Fig. 13. Standard variations of cooking units designed for collective project of kitchen equipment. (Second year work)

Photograph by O. K. Harter

This period of research and discussion led finally to an outline of directives for the students' collective answer to the problem. It was, however, decided that from there on the work had to be subdivided. Each student was assigned one major unit which he had to design in harmony with all the rest. Individual findings and design suggestions were submitted to the group and after agreement upon general principles and co-ordination of measurements and all-over sizes, the final designs were planned. Every single unit was designed in regard to the whole. Every part was fittted tightly to any other part in a number of various plans and arrangements. Neither the refrigerator nor the stove was treated as an isolated unit. Heights, depths, surfaces, appearance of handles, fixtures, and so forth were coordinated and unified. A number of innovations or technical improvements were suggested in the design of every unit.

Studying the problem of food storage, Callaway came to the conclusion that refrigerators at present on the market take fairly good care of cold storage, but neglect the problem of *cool* storage. He found that the space for refrigeration could be smaller than was usually provided if a possibility for cool storage was at hand. He suggested utilizing cold leakage from the refrigerator for the cooler (Illustration 11). His *cooler-refrigerator unit* provides, in addition to the usual refrigerator storage, an adjacent compartment and a number of bins for cool storage. The appearance of the whole unit ties in with Bell's cabinet and drawer units. This second storage problem, providing adequate and convenient facilities for dishes and cooking utensils, had to be solved in relationship with the planning of working space. The design for the *cabinet unit,* which includes a number of differently equipped drawers, tries to limit the use of space below and above a certain height. Experiments and observations, as well as interviews with housewives, led to the conviction that cupboards going down to the floor or up to the ceiling are not desirable. In general, the upper and lower limit was kept so as to allow comfortable reach, as well as easy cleaning of space under or above the cabinets.

An interesting feature in the upper cupboards is the use of blinds instead of doors. The experience that opens doors at head-height are always a nuisance, and that, on the other hand, completely open shelves are not in every case desirable, suggested the use of blinds. They can be made in a smooth plastic material and are similar to those used in buses and trains. They are easy to clean and can be made in colors. (Illustration 12).

The cue for solving the problem of drawer handles came from watching housewives at work. Towels appear in many unexpected places, hanging on door knobs, over edges, or on open doors. Bell's drawer handles are plastic rods of sufficient length to hang towels on, so that during the working process the housewife may have them at the various places where they are needed.

In connection with the cupboard and working process problem, Bell also designed a service table on wheels which may be used for the setting and cleaning of the dining table, and also serve as a tea table.

Winterbottom specialized on the *stove unit.* He solved this problem in terms of standardized parts which may be assembled in various ways. The burners are arranged so as to allow ample free space on top of the stove in any of the possible variations. The oven is constructed as a separate part, which may be directly connected with the stove unit, either above or below top level, or installed independent of the stove. The stove unit, with the same foot clearance as the cabinet drawer units, has one drawer for the utensils which are most needed in cooking. The principle of standardized parts allowing various combinations of assembly would be adaptable to both electric and gas stove units. The submitted design suggests the use of electricity. (Illustrations Nos. 13 and 14).

The *sink unit* was the most discussed part of the whole kitchen problem. Each student developed his own solution after the preliminary specified studies had been in the hands of Christy, who, in the course of his studies, developed various types of sink units, one of which was incorporated in the collective kitchen design. Considerable time was spent with the minute control of processes involving the use of water during food preparation, dishwashing, and general cleaning. The question of adequate facility for waste disposal was thoroughly discussed. Christy believed that nothing less than a three-section sink unit could be really satisfactory. The first section should contain a mechanical garbage disposal unit, the second should be reserved for dishwashing, and the third for rinsing. After careful consideration of economic and space restrictions, it was, however, decided to use a two-section sink unit for the standardized kitchen equipment of the projected minimum-size kitchen.

Several interesting ideas were developed in the redesigning of faucet, rinsing valve, and spray arrangement. Christy's design suggests a combination of faucet and spray in the form of a metal-plastic unit attached to an elastic hose which may be pulled out. Either a spray or a steady stream of water is obtained by varying pressure on the lever. (See cross-sectional drawing 15). Winterbottom and Bell developed new types of mixing valves. They were interested in planning a device which would allow for simultaneous manipulation of volume control and hot and cold mixing with one hand. Bell achieved this result in a volume-lever, mixing-wheel combination, and Winterbottom in a fixture with a push and pull device for volume control and a turning button for mixing. (Illustrations 16 and 17).

After the completion of the main design task, the possibilities of an advertising campaign which would popularize the design were discussed and sketched suggestions for graphical layout were made.

The final results of the collective and individual studies on this comprehensive subject were submitted in a presentation to which guests were invited. A large number of experts, designers, engineers, housewives, and interested laymen attended the session and took part in a lively and instructive open discussion.

The general research, preliminary planning, and specified research for this kitchen design problem were completed in approximately four hours of daily class and home work during a period of six weeks, and the final designs were worked out

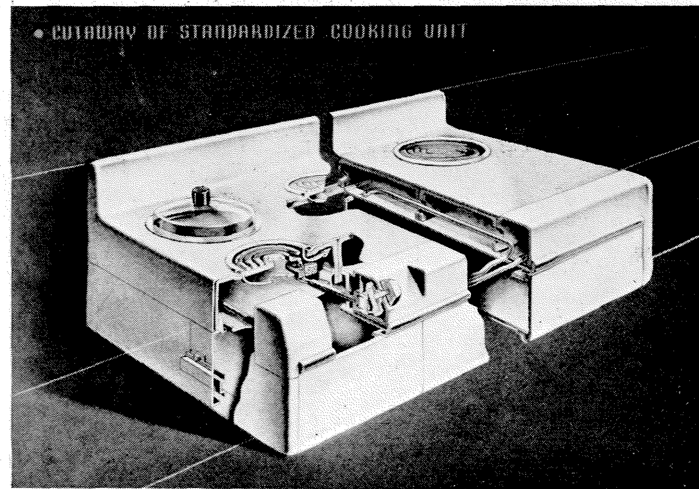


Fig. 14. Cutaway drawing of standardized cooking unit for a collective project of kitchen equipment. (Second year work)
Photograph by W. A. Martin

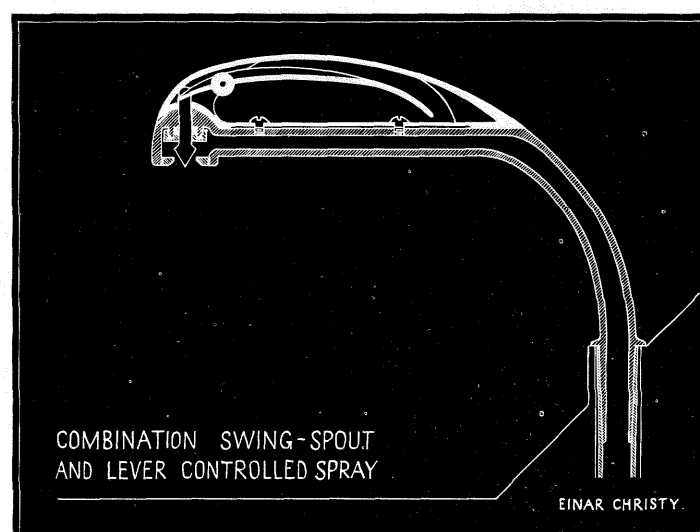


Fig. 15. Cross-sectional drawing of swing spout for a sink, designed for collective project of kitchen equipment. (Second year work)
Photograph by O. K. Harter

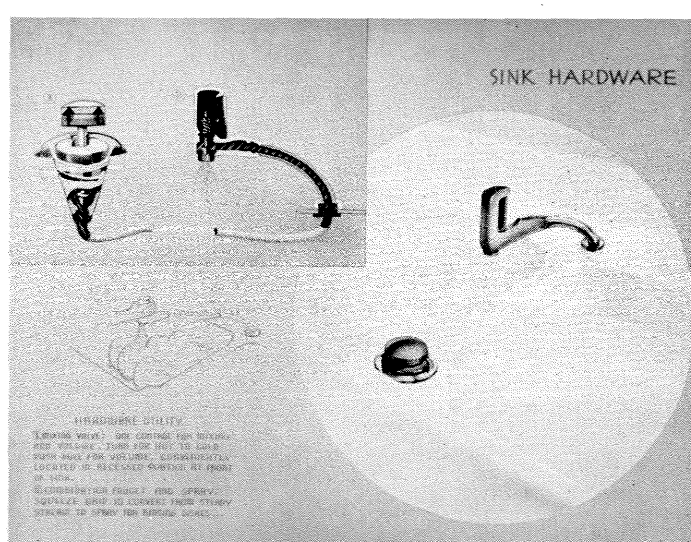


Fig. 16. Sink hardware with cutaway drawing for mixing valve and combination faucet and spray. From collective project of kitchen equipment. (Second year work) Photograph by W. A. Martin

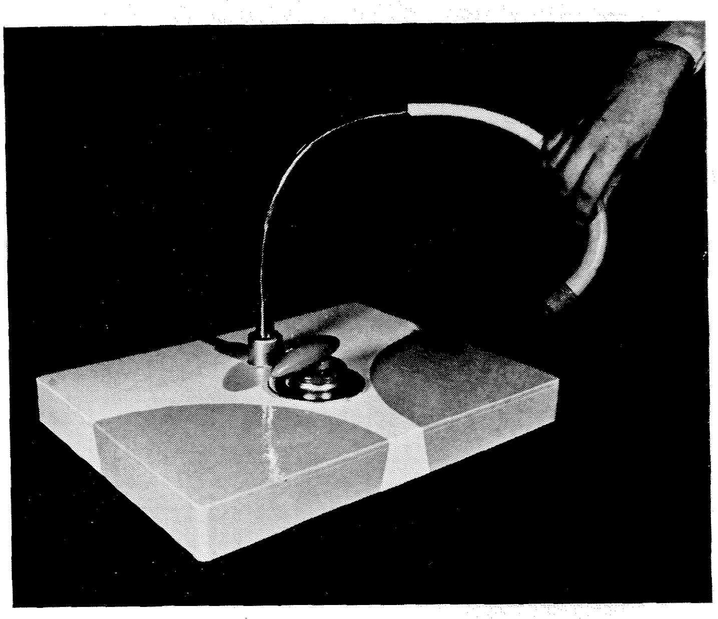


Fig. 17. Sink hardware model. Swing spout with spray attached to an elastic hose. From a collective project of kitchen equipment. (Second year work) Photograph by O. K. Harter

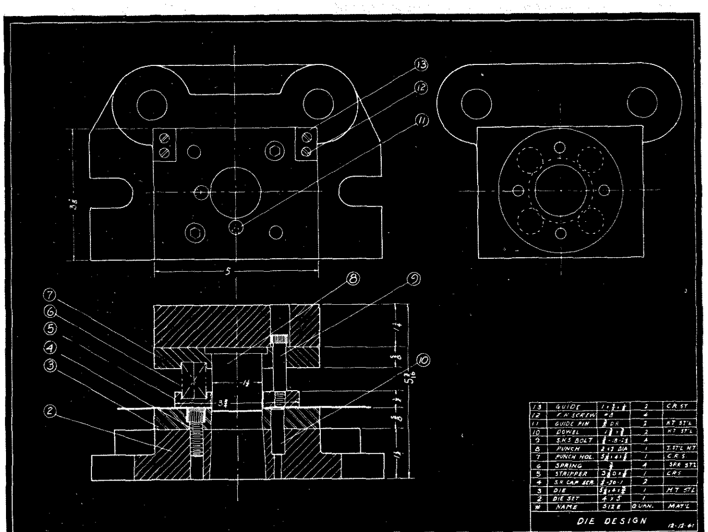


Fig. 18. Die design made during shop practice instruction. (First year work) Photograph by O. K. Harter

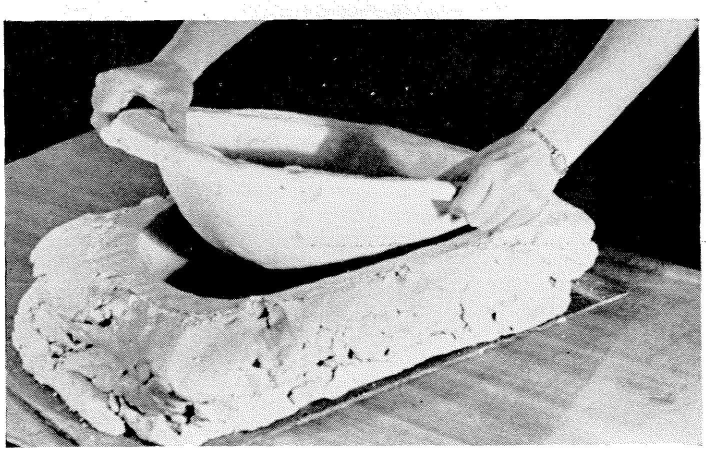


Fig. 19. Making of plaster mold in workshop of Industrial Design Section. (Second year work) Photograph by B. Morant

in two weeks, with an average of six to eight working hours daily.

This problem concluded the regular study period for the second year students who concentrated for the rest of the school year on their individual thesis work. *The thesis,* leading to a master's degree, consists of scientific research on a problem chosen by the student, and is to be submitted in the form of a written report, with the design solution illustrated by drawings and models.

COORDINATED CLASSWORK

The detailed description of the design problem program may lead to the erroneous conclusion that there might be almost no time left for other activities indicated and prescribed in the general instruction program. However, the classes in technological subjects, in art history, psychology, economics, shop practice, the field trips, including visits to factories, department stores, museums, designer's studios, etc., fill actually about the same number of hours as do the assigned design problems.

Most of the classes are closely coördinated and all instructors are contributing, in the form of expert advice, to the solution of given design problems.

Models are made under the guidance of Mr. Morant in workshop classes, during which time the students learn to handle tools, and machines and to make patterns and dies. The technical details involving materials, production methods, and costs are discussed in Mr. Youtz's classes.

Questions of oral presentation, or of advertising campaigns, prescribed in connection with some design problems, are discussed in Professor Brighouse's classes on buying phychology. Mr. Wilcox's classes in design techniques include work on

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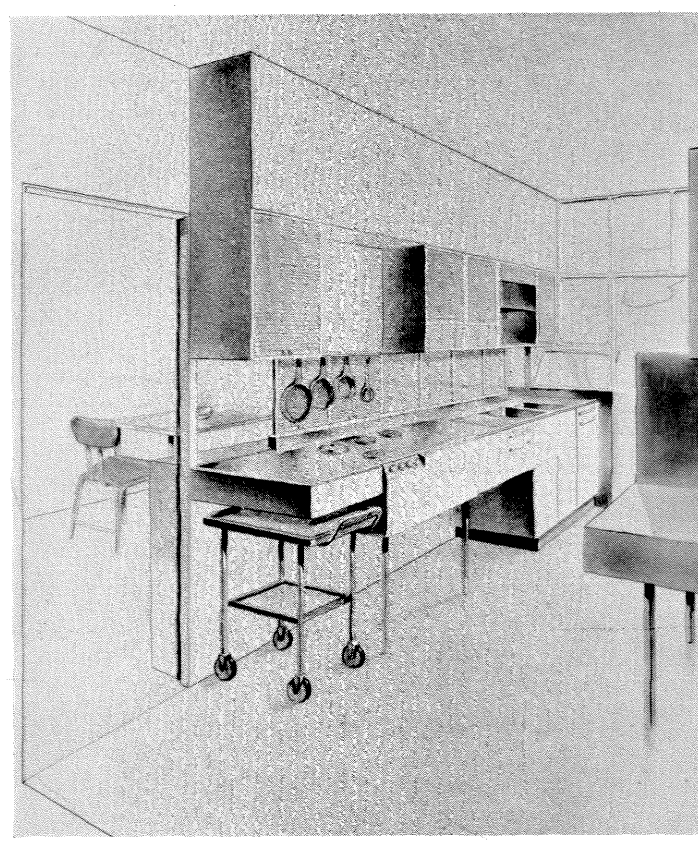


Fig. 20. Perspective drawing of the collective project of kitchen equipment. (Second year work) Photograph by O. K. Harter

COSMIC RAY RESEARCH

By PROF. WILLIAM H. PICKERING

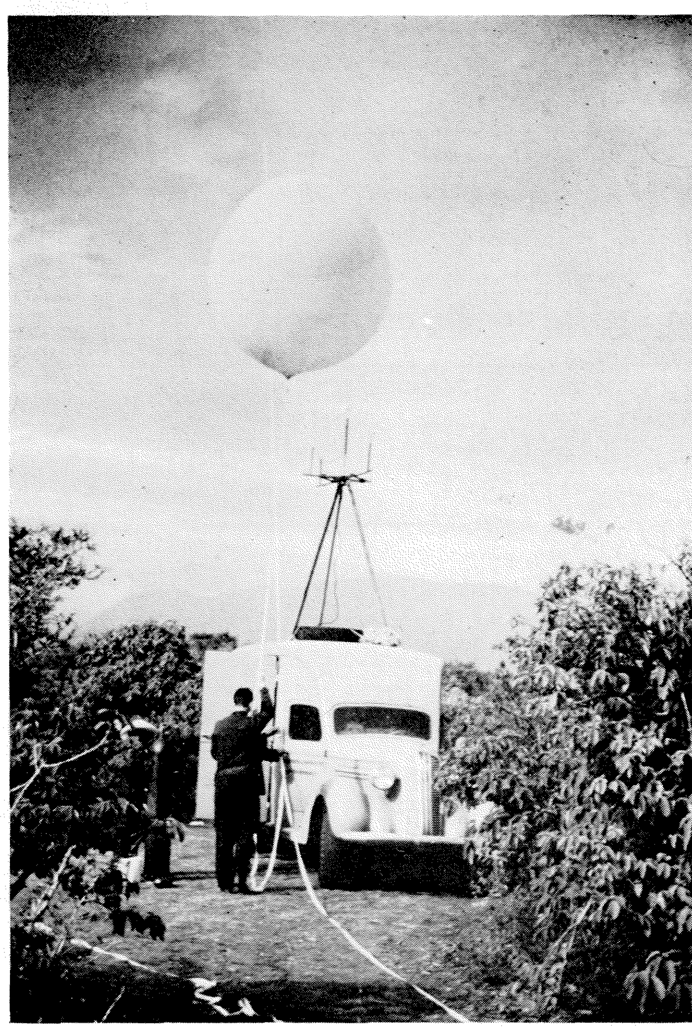
Many of us have wondered about the nature of cosmic rays and the equipment used in studying them. Dr. Pickering presents a qualitative answer in the following article.

For the past ten or fifteen years physicists in all parts of the world have shown a great interest in research and study of the cosmic ray. Here at the Institute, under the leadership of Dr. R. A. Millikan, a large and active group have contributed many important discoveries in this field. One phase of the work is described in the following article:

First, a few lines on the question, "What are cosmic rays and why have physicists devoted so much effort to these investigations?" Briefly we can say that cosmic rays are rays of somewhat the same nature as x-rays or the radiations from radium, which are continually bombarding the earth from outer space. They differ from these mundane radiations in that they have enormously greater energies. Thus the radiations from radium have energies of about a million electron volts; that is, they correspond to the radiation produced by a million-volt x-ray tube. Other artificially produced radiations might have energies reaching up to a few tens of millions of volts. The cosmic ray energies, on the other hand, are measured in the billions of volts. Because of this enormous energy, much of the radiation can penetrate through the earth's atmosphere down to sea level and even beyond. The atmosphere, of course, is equivalent to 76 centimeters of mercury, or about 30 feet of water, and so no ordinary x-ray can penetrate very far through it.

Cosmic ray investigations might conveniently be divided into two categories. First, the rays provide the physicist with a natural source of radiation possessing an energy much greater than any other source, either natural or artificial. Hence, by a study of the passage of this radiation through matter, the physicist can extend the realm of his nuclear studies into a region far beyond the limits that can be reached by any other means. Secondly, the physicist and the astrophysicist together have an interest in the nature and origin of the rays. How can such tremendous energies be generated? Why are the rays so constant in intensity between day and night, winter and summer? What is the actual nature of this radiation? Is it a high energy, very short wavelength electromagnetic radiation, or does it consist of charged particles? In both of these categories much has been learned, many questions have been answered, but much remains to be solved. The particular investigations that we are discussing deal with the problem of the energy spectrum of the primary rays incident upon the earth's atmosphere. They also permit the testing of an hypothesis as to the origin of the radiation, for clearly a knowledge of the energy spectrum of the radiation will give considerable information about this important point.

One might well ask how the energy of these rays can be measured when this energy is so tremendous. The principle is very simple. We all know that a magnetic field exerts a force on an electric current. Here the electric current is the incoming



Above — A view of the traveling laboratory, showing a balloon about to be released.

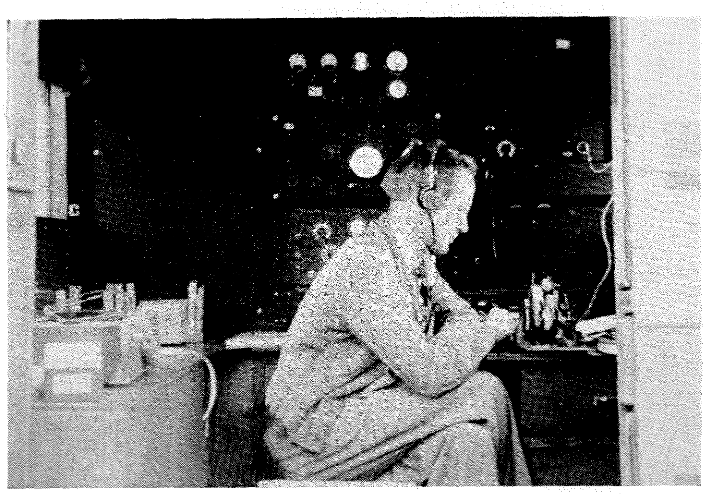
Right—The compact detector and radio transmitter unit ready to be sent aloft.

Another view of the truck laboratory.

stream of cosmic ray particles, the magnetic field is the field of the earth itself, and the force exerted on the particles bends their straight path into a gigantic spiral. Calculations show that there is a definite relationship between the energy of a cosmic ray particle and the latitude at which it strikes the earth. Only the most energetic particles are able to reach the equator, while all particles can reach the magnetic poles. Hence, if we can find out how many particles are reaching the earth at different latitudes, we can deduce the energy spectrum of the incoming radiation, or at least the spectrum of the charged particle component of the radiation. The problem then reduces to measuring the amount of incoming radiation at different latitudes. This requires that we measure the radiation present at the top of the atmosphere or, since that is unattainable, at the very highest altitudes possible.

Two methods have been developed for doing this. Both involve sending an instrument aloft by means of balloons. In the first method the instrument is an electroscope and an arrangement to make a photographic record of its rate of discharge. In order to get a sensitive record at all altitudes it is recharged every four minutes, this being done by a contact mechanism which connects it momentarily to a charged condenser. The discharge rate gives a measure of the ionisation present, and thus of the cosmic ray intensity. In addition to this record, a barometer and temperature record are also placed on the film so that a correlation between cosmic ray intensity and barometric pressure is obtained. Flights with these instruments require the recovery of the instrument in order to obtain the record. Since an average flight will travel about 100 miles from its starting point, there are not many places where 100 per cent recovery can be expected. The second method avoids this trouble by using radio to send the information back to the starting point while the flight is actually in process. This method involves using a different type of detector for the radiation than an electroscope, because of the obvious difficulties of connecting an electroscope to a radio transmitter. The detector used is a Geiger counter. This useful little device is essentially a copper cylinder with an axial wire. It is placed in a partial vacuum and a high voltage connected between wire and cylinder. When an ionizing particle passes through the counter a momentary breakdown takes place and a relatively large voltage pulse is obtained. This can then be amplified and made to run a loudspeaker, or a relay, or ring a bell, or do anything else that an electric current is able to do. In our apparatus we make it operate a radio transmitter. Then, on the ground, we receive a pulse and have this recorded on a moving paper tape. Barometer and temperature signals are also radioed to the ground station by a method similar to one used in a radiometerograph. Another advantage of the Geiger counter is that it can be connected into an electric circuit, which will respond only to simultaneous pulses between two or more counters. Thus, we can connect up two Geiger counters in a vertical line and only record those particles which operate both counters simultaneously. Such particles, of course, must be shooting in a vertical direction. This selectivity enables us to make a much more accurate study of the energy spectrum of the radiation than can be done with the electroscope, which responds to rays coming from all directions. The reason is that the energy which a particle arriving at the earth will require, is dependent not only on the latitude but also on the direction of arrival. By recording only the vertical particles, we then know exactly what minimum energy is possessed by the rays we are counting.

This radio and Geiger counter instrument, the cosmic ray radio-sonde, as we call it, has been used for observations at several different latitudes during the past three years. At the



Dr. Pickering receiving signals from one of the balloon units.

end of 1939, flights were made in India, in order to obtain information near the magnetic equator. Last year the equipment was mounted in a truck to form a completely self-contained traveling laboratory, and in December observations were taken in Mexico. In April of this year some additional data were taken in Utah and Idaho. The series of flights made so far give a fairly good picture of the variations in the radiation at latitudes extending from about 50° to the equator.

Now that the traveling laboratory is being used, the procedure in making a flight is somewhat as follows. First, a good location is chosen. This requires a spot completely out of sight of any automobile traffic or power lines, because of the danger of electrical interference on the receiver. It also requires a reasonably good horizon, so that when the balloon is near the end of its flight it will not be hidden behind some mountains. At the very short wavelength used for the radio, the signals only travel in straight lines. If the balloon was below the horizon it could not be heard on the radio. In Los Angeles county, at least in prewar days, good locations were very scarce, as we have found to our sorrow. We finally found a good spot about fifty miles from Pasadena. The next step is to prepare the instrument for the flight. It is placed in a bamboo cage for protection, and then wrapped up in cellophane for thermal insulation. The cellophane is partly clear and partly black. We have found that it is possible to keep the temperature inside the basket to within about 10 degrees of the ground temperature during the whole flight. To lift the instrument two balloons are generally used. They are inflated equally with hydrogen to a diameter of about five feet. This gives a total net lift of about 4800 grams. The instrument weighs about 3500 grams so that 1300 grams upward pull is available. This will give a rate of rise of about 1000 feet per minute. A good flight will go up for about 80 or 90 minutes, then one balloon will burst, and the remaining balloon will lower the instrument to the ground at about the same rate as the ascent. Since we use about 100 feet of tape between balloons and instrument, the remaining balloon makes a pretty good marker after the landing and we hope that some of the local inhabitants will have their curiosity aroused and retrieve the instrument for us. We offer a suitable reward to help the process along.

In India we were rather surprised to get about three-quarters of our instruments back. It took a long time, but eventually they arrived in Pasadena. The Indian Meteorological Service provided us with a suitable reward notice with instructions in three different languages. Even in the remote villages of the tribesmen on the northwest frontier it seemed that someone could read at least one of the languages. One instrument that was released at Peshawar was recovered and returned very promptly. It seems that the tribesmen saw the balloon drifting down to earth in the late afternoon sunshine. They approached the instrument, only to hear an ominous buzzing sound. This confirmed their worst suspicions, and they gathered at a respectful distance to watch the inevitable exposion. Soon the whole village was waiting hopefully, and so, far into the night . . . The next morning some of the bolder ones decided it was a dud; after a few exploratory stones had been hurled at it, they investigated in detail. The reward notice instructed them to turn the instrument over to the nearest government official, in this case a British Army office a mere thirty miles away, and what is a thirty-mile walk when a silver rupee is at the other end! Early the following morning we had our instrument again, as the Army officer, with a commendable scientific curiosity, drove the sixty miles to Peshawar to find out what it was all about.

Our Mexican experiments were performed at Victoria and at Acapulco. To date we have not received any of our instruments back from Mexico, although we have had a report that two of them have been located. Probably they will be back "mañana."

Because of the press of other work, the observations taken in Mexico and in this country have not yet been calculated in detail. However, they do seem to give support for the hypothesis of the origin of the cosmic rays which has been put forward by Millikan, Neher and Pickering. This hypothesis starts with the experimental fact that the cosmic rays seem to be uniformly distributed in space. The implication is that they do not have their origin in either the sun or the stars, but that they are formed in interstellar space. We know that there is a very small density of atoms in interstellar space so the hypothesis is made that these atoms can, by a process of self-annihilation, convert their mass energy into kinetic energy of two cosmic ray particles. Two particles are needed to give conservation of momentum in the process. Although no direct evidence for such a process has been observed, nevertheless we do know from experiments in nuclear physics such as those of Lauritsen and Fowler at the Kellogg Radiation Laboratory, that a part at least of the mass energy of an atom can be changed to kinetic energy of a pair of electrons. The extension of this process to the conversion of all of the atomic mass into kinetic energy is not unreasonable. If this process is the cause of the cosmic radiation, then it follows that the cosmic rays should have only certain definite energies corresponding to the annihilation of certain definite atoms. Each kind of atom would give rise to particles of a definite calculable energy. Now observations of the stars, and particularly Bowen's observations on the ring nebulae trillions of miles away from the nearest star, and therefore presumably giving a fair picture of the conditions in interstellar space, show that there are only six kinds of atoms that are very abundant in space. All the rest are relatively rare. Hence, on the above hypothesis, most of the cosmic ray particles should have energies corresponding to the annihilation of one of these kinds of atoms. The lowest energy particles would correspond to hydrogen and would be so low in energy that they could not get past the magnetic field of the sun to reach the earth. The next atom is helium which would give rise to two billion volt rays, then come carbon, nitrogen and oxygen to give a band of energies between 6 and 8 billion volts. The last is silicon with an energy of about 13 billion volts. This is the theoretical energy spectrum according to the hypothesis. Experimentally the evidence for the 13 billion volt energy is excellent. The 6 to 8 billion volt band has been known for some time and the most recent data appears to give added strength to the hypothesis by confirming that there is essentially no energy in the spectrum in the regions between these bands. However, until the data is completely evaluated, we cannot put a definite figure on the actual energies in the various parts of the spectrum.

WORLD WAR: THEN AND NOW

AN EXERCISE IN HISTORY

By J. E. WALLACE STERLING

In the introductory article to a series beginning with this issue, Prof. Sterling asks and indicates some answers to the question, "Does history repeat itself?" referring of course to the current war.

Does history repeat itself?

In the early nineteen-twenties, an outstanding German general, Max von Hoffman, wrote a book, *The War of Lost Opportunities*. It was about the war in which he had just brilliantly served and in it he offered explanations for repeated German failures to reach a final decision on the field of battle. Failure in the West in 1914 against Belgium, France and Britain was followed by failure in the East in 1915 against Russia. Recourse was then had to a second attempt to win in the West, chiefly at Verdun, but in vain. After these three failures, Germany, in General Hoffman's opinion, should have bent every effort to secure a peace. But this was not done. Instead a campaign of unrestricted submarine warfare was begun, and, after the collapse of Russia late in 1917, preparations were accelerated for a final Herculean land effort in the West. This also failed, but it exhausted the German army and "left Germany defenceless to the cold hate of England, the fanatical desire for revenge of France, and a crack-brained Wilson."

The Treaty of Versailles stripped Germany of her military might. But after Hitler's accession to power in January, 1933, Germany began openly to rearm. The period of this rearmament was contemporaneous with the Italian war against Abyssinia and the civil war in Spain, and in the latter arena Germany and other nations had an opportunity to test new equipment and tactics. There was much talk of *Blitzkrieg:* lightning war. The phrase implied not only that blows would fall from the sky but also that these, in conjunction with blows struck from the ground, would achieve quick victory. But neither Abyssinia nor Spain afforded a convincing preview of the *Blitz* in action, although numerous extenuating circumstances were cited. It took the German "Campaign of Eighteen Days" against Poland, September, 1939, adequately to demonstrate the effectiveness of the new warfare. Even so, this masterful performance was discredited in some western quarters on grounds of Polish weakness. Such judgment was revised, however, after the quick and comparatively cheap German successes against France and Britain, two great powers, in May and June, 1940.

The newspaper headlines of these anxious months recalled the headlines of August, 1914. On both occasions the German juggernaut seemed irresistible. But in 1914, there was the miracle of the Marne; and in 1940, there was the epic of Dunkirk. Even with the great advantage over 1914 of being able to concentrate her force in the West—thanks to the agreements with Russia, the defeat of Poland, and the alliance with Italy—Germany failed to achieve a final decision in the spring of 1940. The French army was put out of action, it is true, but Britain, supported by the European governments in exile and with cash-and-carry access to American supplies, was left to continue the fight. When, late in August and in September, the Germans attacked Britain, they were repulsed with heavy losses.

Why did Hitler allow Britain to get her second wind in the period from June to August, 1940? The whole answer to this question is not yet known. Some say Hitler believed the Churchill government would accept his "peace offer" of July 19; others think Germany was surprised by her own successes and therefore militarily unprepared to exploit the victories she had just won; others hold that her General Staff made an error of strategical judgment in proceeding first to finish off France. Whatever the reasons, the failure to press the attack against Britain immediately after Dunkirk is already being pointed to as one of Germany's "lost opportunities" in this war.

Meanwhile the war at sea had been getting under way. General Hoffmann has something to say also about the sea campaigns of the first world war. In his opinion, Germany began submarine warfare then before she had U-boats in sufficient numbers to achieve her purpose, and so succeeded only in exposing her hand. Further, although action by the German High Seas Fleet was not seriously in prospect after the Battle of Jutland, May 31, 1916, building of large surface naval vessels continued. The energy and material which this building consumed might better have been applied, Hoffmann thinks, on the construction of submarines, on which reliance was placed after 1916 in an effort to reach a decision at sea, an effort which came very close to success.

In 1939, Germany began her campaigns at sea under the direction of Admiral Erich Raeder. This man had fought at Dogger Bank and at Jutland in the first world war and harbored bitter memories of having his ship sunk under him at the latter engagement. He is reported to have looked forward to the day when he might avenge not only the loss of his ship but also the humiliation attached to the surrender of the German High Seas Fleet in 1918-19. Raeder became head of the German Admiralty in 1935. By then he had reflected much on Germany's naval position and policy. He recognized that the limitations imposed by the Versailles Treaty made it impracticable for Germany to challenge successfully the British navy's battleline. He recognized also that Germany's chief successes at sea in the first world war had been accomplished by surface and undersea raiders. His thinking on these matters is set down in his two-volume work on cruiser warfare and is reflected in German sea campaigns since 1939.

In the prosecution of these campaigns Germany has enjoyed many advantages over 1914-1918. Diplomatic achievement and the march of events have won her the support of Italy and Japan, both considerable naval powers and stronger now than a quarter-century ago when they were Germany's enemies. Military successes from Narvik to the Pyrenees have placed in

German hands coastal bases close to the British Isles and the North Atlantic supply lines, on both of which German armed forces can prey by water and by air. Furthermore, Britain's defensive strength was less in 1940 than in 1914. Not only did she stand practically alone in the later year, but also she enjoyed only about one-half her former destroyer strength and lacked strategically valuable bases in Eire. Building, American aid, and more recently American participation have done much to readjust the balance toward the more favorable situation of 1914-1918, but with fronts now in the Near, Middle and Far East, the necessary lengthening of the supply lines has placed dangerously heavy burdens on Allied shipping and its protection. But German concentration on raider warfare at sea, carried on with the comparative advantages just mentioned, did not bring Germany a decision in the North Atlantic in the first half of 1941. Indeed, such operational successes as is enjoyed had the result, reminiscent of 1917, of hastening the repeal of the restrictive provisions of the Neutrality Act, a repeal which amounted to reasserting a traditional American doctrine of freedom of the seas. To be sure, the end of the German raider campaign is not yet, and its current forcefulness is seriously hampering the war effort of the United Nations; but it is being answered in a manner which bids fair again to deny Germany the decision she seeks in this theater of war.

The *Blitzkrieg,* that had worked against Poland and France, failed over Britain. Nor was it well adapted to the sea. As a result, by midsummer of 1941, Mr. Churchill's "tight little isle" was in much better condition to carry on the struggle than it had been a year earlier; in fact, that condition was steadily improving as a result of increasing support from the Empire-Commonwealth and the United States. This combination of circumstances had the effect of taking some of the *Blitz* out of *Blitzkrieg* by bringing in prospect a long war. This prospect confronted Germany with many problems, among them supply and morale, which would be more seriously aggravated the longer the war lasted, unless they could be solved by new victories. The *Blitz* victories in Yugoslavia, Greece and Crete provided no such solution. Could Russia be laid low, however, a solution might be possible!

On June 22, 1941, when Germany attacked the U.S.S.R., the *Reich* had been at war a little more than twenty-two months. A comparable date in the first world war would be July, 1916, by which time Germany's third attempt to reach a decision on land was bogging down in the hills around Verdun, the pressure on that fortress was being relieved by a British offensive on the Somme, and the U-boat campaign, indecisive against Allied shipping, was arousing the United States to stiffer protests. The time was approaching, when, according to General Hoffmann, the Germany of William II should have launched an all-out peace offensive on the basis of the *status quo* 1916, conceding the restoration of Belgium if necessary. In December, 1916, Germany did offer to discuss peace terms at a general conference of the powers, but this move did not represent a determined effort to end hostilities, and the Allies, considering the offer a war maneuver rather than a serious peace proposal, rejected it.

In midsummer, 1941, the Germany of Adolf Hitler was bent not on an all-out peace move but on a new all-out war move. Germany's decision to attack Russia was certainly one of the most important of the war. At least two considerations appeared to have entered into it: a) that Russian resources were necessary for the continuance of the prolonged war in the West (b) that the *Blitzkrieg* would work against the Soviets. It was clear, of course, that success would bring within reach the additional strategic and economic resources of the Middle East.

These attractive possibilities were materially offset, however, by two inescapable facts. First, the attack on Russia placed Hitler's Germany in the toils of a two-front war which had fatefully divided Germany strength in 1914-1918 and which, therefore, Hitler had previously foresworn. Secondly, by bringing Russia into the ranks of Germany's enemies, Hitler closed the main opening in the continental blockade which Britain and her allies had been applying since the war began. This blockade was in the main a sea blockade, but it had already been reinforced by a land front in North Africa and was soon (July-August, 1941) to be further reinforced by a support line from Syria to India and a strengthened supply line, not only from the British Isles but also from the New World, into the Red Sea and the Persian Gulf. Since Russia has not succumbed to the German *Blitz,* Germany finds herself virtually landlocked in Europe and surrounded by foes whose strength gives promise of waxing as German strength wanes. Added strain has thus been placed on Germany's war machine, whose increased demands for men and equipment have made necessary an intensification of the already ruthless exploitation of Europe's resources. This in turn has evoked from the people of the occupied countries a progressively more violent opposition which is cheating Germany of the full realization of the great resources at her command.

Germany, then, as in the first world war, has tried to reach a decision in the East after failing to do so in the West. She has sacrificed the advantage of a one-front war with which she began the struggle and finds herself as in the days of William II caught between two fires. Any effective strengthening of forces for an offensive on one front will involve some weakening of forces for defense on the other, and vice versa. During this past winter there has been expectation of a renewed German offensive in some direction, and most observers thought it would be toward the East. The German advance in the Crimea may well have been intended as the initial move in such a drive, but the relatively minor gains there cannot be effectively developed or exploited until the tactical initiative has been wrested from the advancing Russian armies further north, especially in the Kharkov area. So long as the Russians retain the initiative they now enjoy and the potentialities of a land front in Western Europe continue to increase, it is difficult to foresee how Germany can successfully extricate herself from the meshes which entangled her when the *Blitz* failed in Russia.

The progress of the war in Europe recalls not only the war of 1914-1918 but also the Napoleonic wars. In so doing it is making good the assertions of those military and political strategists who have long maintained that no power can dominate that continent until it has decisively defeated the great naval

(Continued on page 23)

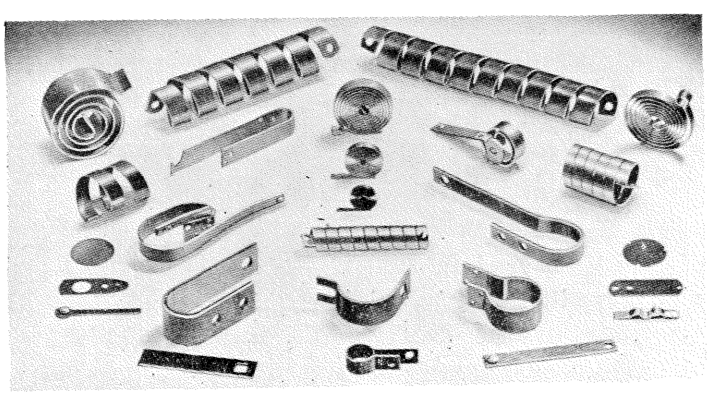
THERMOSTATIC BIMETAL

By ERNEST R. HOWARD, '34, *H. A. Wilson Co.*

Many important problems of control in industrial processes are being solved by the use of thermostatic bimetal. Mr. Howard discusses a number of these applications and outlines the basic principles of bimetal behavior.

One of the most unique bimetal applications in production today is a circuit breaker containing a bimetal helix of two turns shunted by a piece of copper braid welded to the ends of the helix and used as the complete and short circuited secondary of a current transformer. The two turns of this secondary produce a voltage which dissipates energy into the bimetal itself, heats the bimetal helix, causes it to rotate and if primary current exceeds a given value causes the helix to trip a disconnect switch. The domestic, industrial and war world of today is literally full of applications of bimetal and possibilities for its effective use. Bimetal is used in jeep and tank, in aircraft instruments and radiator control valves of many kinds.

Let us see what properties bimetal has that it finds such diverse uses. Bimetal in general contains two layers of metal of equal thickness, one a thermally high expanding component, the other a thermally low expanding component. The American Society for Testing Materials defines bimetal or thermostatic metal as "a composite material, usually in the form of sheet or strip, comprising two or more materials of any appropriate nature, metallic or otherwise, which, by virtue of the differing expansivities of the components, tends to alter its curvature when its temperature is changed." The components used for bimetals are chosen first for their temperature characteristics and then for strength, workability, stability, heat conductivity, and electrical properties. Brass and invar make the cheapest and most common bimetal, but it can readily be seen that the temperature this metal will stand is limited by brass to about 300° F. Most of the socalled high temperature bimetals have replaced brass as the high expanding member by an iron nickel chromium alloy of the stainless steel family, and can stand subjection to temperatures of 800° F., sometimes 900 and 1000° F., but then with practically no loading. Bimetals may be made to react to change in temperature over any given range of temperature by proper choice of components, particularly those used as the low expansion component. The addition of a third or intermediate layer to bimetal is made to change electrical resistivity for certain applications which will be discussed later. In practice, the components of bimetal are welded together into a large bar which is subsequently hot and cold rolled to sheet. Most bimetal depends on final cold rolling to finish size for its physical properties and is not heat treatable in the sense of improving physical properties. A low temperature heat treatment (350° F. for the brass invar metal and 650° F. for most of the others) is given for stress removal after final fabrication. The nature of bimetal then is sheet material which may be fabricated into any of a number of forms which will be responsive to temperature changes.



Assorted bimetal shapes.

The uses of bimetal fall into four general classifications as follows: (1) Temperature Indication, (2) Temperature Control, (3) Control of function with temperature change over a range of temperature, and (4) Control of function by auxiliary heating of the bimetal. Let us consider at least one example of each of these classes. First, temperature indication is well pictured in the spiral coil or helix actuated pointer thermometers which indicate temperatures on wings of airplanes, in domestic refrigerators, in offices and factories, in laboratory baths and furnaces, in candy making and even in roast meat. In this type of service the bimetal is .005 to .015″ thick, the coil is made to fit the pointer scale and the only load requirement that the bimetal must meet is the production of enough torque to move the pointer freely. The range of temperatures covered by bimetal in temperature indication includes minus 50° F. and plus 1000° F. Angular deflection rates up to 2½ to 3 degrees per degree F. can be obtained.

The second classification, that of temperature control, can be amply illustrated by the room temperature thermostat, a device in some cases consisting of a bimetal blade upon which is mounted a current carrying contact point aligned with a mating stationary contact point which can be an adjustment. The operation consists in the bimetal blade moving the pair of contacts into open or closed circuit and thus stopping or starting the supply of heat to the room. In many applications of this type the bimetal may remain within a few degrees of its controlling temperature over an indefinite period of time.

The automatic choke on a modern gasoline engine is a good example of the third classification mentioned above. Here no attempt is made to control temperature itself, but the supply of air to a fuel-air mixture is controlled by the temperature of that air. The usual automotive type of choke control consists of a bimetal coil which positions a butterfly valve in the intake airstream so that the desired fuel air mixture is obtained for any air temperature encountered. This classification may also be considered to include the large number of applications where a piece of bimetal compensates for temperature changes in devices which are complete in themselves except when they have to operate over a range of temperature, for example voltage regulators. In the Tirrel or vibrating contact type of regulator, voltage is controlled by regulating generator field current by controlling the amount of times a certain pair of contacts are closed. One of these contacts is mounted on an armature spring and is drawn away from the other as the voltage coil underneath the armature increases its pull. This arrangement works satisfactorily for a range of loads and voltages at a given temperature, but when temperature changes, regulation too changes in the same direction. By the insertion of a piece of bimetal into the armature this voltage regulation can either be made the same for any temperature or may be overcompensated if such is the wish of the designer. In other type of voltage reguators compensation by bimetal is obtained dependent on the method of voltage regulation used.

Time delay devices and circuit breaker applications are the two main groups which compose the fourth or final classification, that is, where control of a function is effected by the introduction of heat to a piece of bimetal. In this section functions such as time and current which in themselves have no connection with temperature whatever may be controlled by the auxiliary heating of bimetal. If for instance a certain time sequence of electrical operations is desired, a number of bimetal strips (or other shapes) can be so assembled that they will provide the required making and breaking of circuits when they are heated with outside resistors or by current passing through their own electrical resistance. One of the newest fields using bimetal is that of the circuit breaker. A piece of bimetal is made the active element in a circuit breaker by passing current through it and thus having it respond to the temperature generated in it. The circuit breaker operates when the temperature built up is enough to open circuit. While in some cases this circuit opening is slow make and break, in most cases the final opening of the circuit is done quickly by snap action either inherent in the shape of the bimetal or accomplished by the tripping of a latch in the body of the circuit breaker. The circuit breaker may have either manual or automatic reset as designed. It is for use in electrical circuit breakers that the trimetals or graduated resistance metals mentioned above have been introduced. With their use a single circuit breaker design may be used for several current capacities simply by using a trimetal of different electrical resistance for each capacity. Constant mechanical properties are exhibited by these different trimetals because they are made to the same physical dimensions and have the same modulus of elasticity. Constant thermal deflection characterists are obtained because all have practically the same temperature deflection rate and all have the same I^2R heating product when used at their rated capacities. For example if a circuit breaker is designed for 15 amperes using R-440 (440 ohms, sq. mil. ft.), the same construction will produce a 20 ampere breaker using R-245, a 25 ampere breaker using R-157, a 30 ampere breaker using R-118, a 35 ampere breaker using R-77, a 40 ampere breaker using R-56, and a 50 ampere breaker using R-39.

While it is not the purpose of this article to go into details in the mathematics of bimetal, it will be well to put forth the fundamental equations which can be applied to any piece of bimetal as minutely or as roughly as required for the desired result. As stated before the fundamental characteristic of bimetal is its ability to change curvature with change in temperature. This is simply expressed as

$$\frac{1}{R} = \frac{F\,T}{t}$$

where 1/R is curvature (R in inches)
T is temperature in deg. F.
t is thickness in inches
F is flexivity in inches per inch per deg. F.
(ASTM B106)

For most bimetals F is equal to 1½ times the difference in thermal coefficient of linear expansion of the high and low expanding components. Bimetal which is free to move will change its curvature according to this formula if its temperature changes. Then if we pick up the basic flexure equation from page six of the Strength of Materials Book

$$M = \frac{EIFT}{t}$$

where 1/R is curvature (R in inches)
M is bending moment in ounce inches
E is modulus of elasticity in ounces per sq. in.
I is moment of inertia in inches fourth,

we have the whole story. Combining these two equations we get a third showing what torque a piece of bimetal will develop with change in temperature in case it is restrained from actual motion.

$$M = EI\,\frac{FT}{t}$$

Practically all bimetal formulas are combinations of the above three equations. Thus the deflection of the free end of a cantilever blade of bimetal is

$$d = \frac{F\,L^2T}{2\,t}$$

where d is the deflection in inches
F is Flexivity as defined above
L is free or active length in inches
t is thickness in inches
T is temperature change in degrees F.

The deflection of the free end of a spiral or helix clamped at the other end is given by

$$R = \frac{FTL}{t}$$

where R is the angular rotation in radians
F is the Flexivity
L is the developed length of the coiled strip in inches
t is the thickness in inches.

(Continued on page 24)

BOLIVIA: SHANGRI-LA OF SOUTH AMERICA

By LUIS HERNÁN TEJADA-FLORES

Mr. Tejada has given us a delightful picture of his native Bolivia. Illustrations are taken from the author's collection.

"The Shangri-La of the new world"—this phrase aptly describes Bolivia, one of the least known countries of Spanish America. Hidden away in the remote Andes, at the very heart of the southern continent, Bolivia is practically unkown to tourists who rarely penetrate to its Tibet-like elevations. The natural setting is a fantastic one, with a rarefied atmosphere as stimulating as champagne, majestic mountains that dwarf the Alps and rival the Himalayas, a great inland sea of incredible beauty and vast stretches of weird and barren plateau alternating with the lush vegetation of hidden protected valleys.

The principal and most populous region of the country is its western half, called the "altiplano"—a tableland some 13,000 feet high, pierced with gigantic mountain-cones (Illimani, Illampu, Mururata, Huayna Potosi and many others) that seem to scrape the brilliant blue sky. Here the wind wails incessantly over the vast stretches of scrub vegetation, and huge Biblical-looking pillars of dust rise constantly from the ground in twirling spirals. Here men, donkeys, and railroad trains are reduced to tiny specks under the gigantic heavens. Here browse hundreds of the curious llamas—tiny camel-like creatures with long-necked dainty heads brightened by a red woollen tassel in the ear, diminutive packs on their backs, and high-stepping cloven hooves.

In the midst of the altiplano lies Lake Titicaca, a gigantic body of water that stretches between Bolivia and Peru and covers an extension larger than all of Switzerland. Its turqouise waves carry fragile reed canoes called "balsas" and modern lake-steamers, and its shores are made picturesque by fields of a purplish-grained cereal called "quinua," by waving eucalyptus trees, and grazing sheep and donkeys, and the adobe huts of the country people.

Here and there—as though they had been scattered carelessly over this gigantic countryside — one comes upon the estates of gentlefolk, the villages of the Indians, and then, unaccountably a large city like Oruro or Potosi or the capital, La Paz. La Paz—the ancient Ciudad de Nuestra Señora de la Paz (City of Our Lady of Peace)—is the highest capital in the world, perched about two and a half miles in the air. It is a metropolis of several hundred thousand souls, set like a jewel in a perfect bowl of encircling mountains, its proud buildings shimmering in the rarefied air. There are broad new avenues lined with modernistic terraced houses of blue and green and white and ochre plaster; and side by side with them, steep centuries-old narrow streets, winding uphill over tortuous

These Indian women wear a derby hat like the "cholas," but a distinctive jacket of their own: rich velveteen heavily beaded and embroidered.

cobbles, lined with ancient Spanish houses touching wall to wall and giving the passerby a glimpse through their massive arches into paved inner courts with trees and wells.

To complete a sketch of this picturesque country, we must not forget the unexpected subtropical valleys tucked away amidst the austere mountains and quite invisible until one stumbles accidentally upon them like the original Shangri-La of James Hilton's novel. Such is Yungas, two hours' drive from La Paz: a veritable paradise of wooded canyons, exuberant fruit trees, wild orchids, and screaming green parrots.

Like Tibet, Bolivia is a land of ancient and mysterious traditions. Centuries before European men discovered a new world, what we call Bolivia today was the cradle of the oldest civilization in this hemisphere—one that was already obscure in the night of time when the later empires of the Incas, Aztecs, and Mayas flourished in North and South America. Little is left of this prehistoric culture, save what archaeologists have been able to piece together from the wonderful monoliths and ruins at Tiahuanacu on the altiplano. Here a race of gigantic men, more than eight feet tall, had built a city of temples and palaces and public buildings, of which the most interesting remnant is the Portal of the Sun, believed to be religious in its significance and astronomical in its construction. Tiahuanacu was already in ruins when—as legend tells it—two demigods were born on an island in nearby Lake Titicaca. These were Manco-Capac and Mama-Ocllo, who went to Cuzco and founded the Inca Empire; and modern Bolivia's Titicaca remained, until the time of the Spanish conquest, the sacred lake of the Incas.

During the colorful days of the Spanish colony, Bolivia—or Upper Peru as it was then called—was a great center of wealth and culture. The city of Potosi—the Villa Imperial, or Imperial Town of the Spaniards—was the silver mint of the Spanish crown. And the city of Sucre boasted the third university to be founded in the entire new world: the Universidad de San Francisco de Charcas, established in the sixteenth century and still flourishing today.

The colorful inhabitants of Bolivia are perhaps the most picturesque feature of this picturesque country. Like the Tibetans, and natives of other cold and mountainous countries, the native men wear ear-muffs. And also like the Tibetans, they have a rich fund of folklore.

In Bolivia there are great differences between the three groups of the population: the white people of Spanish or other European origin, the Indians, and the "cholos" of mixed Spanish and Indian blood. White persons form a sophisticated and cosmopolitan (if relatively small) group with the same general customs to be found in Europe or the United States. Business and the professions occupy them; motorcars, the cinema, bridge, tennis, club-life, and even roulette are their diversions.

But the Indians of the Bolivian altiplano are quite unique. Silent, stern, melancholy, coppery-faced and aquiline-featured, they are of pure Aymará and Quechua racial stock, and in the main speak their own automonous language rather than Spanish. Every one of them is a subject for the camera or the artist's brush, not only for his costume of hand-woven and home-dyed cloth, but for his odd grace of bearing—whether it be a venerable white-haired grandmother who walks barefooted down a country road, spinning as she goes with a quaint distaff held in her hand; or a solemn little Indian boy in his "poncho" with a slit for the head and his ever-present knitted "llucho" cap with ear-flaps; or a buxom matron wearing a dozen full-gathered skirts at a time and twirling in the monotonous rhythm of the dance. These Indians live as their forefathers did in thatched-roofed houses with the family's burro, chickens, and two or three small black pigs running around freely in the enclosure that corresponds to a garden. Despite his comparative poverty, the Indian has moments of colorful social life—like, for instance, his wedding when he may decorate his houstop and wall with colored flags, and mount himself and his bride on milk-white mules with silver saddles.

But even richer in color is his psychological world, peopled with all sorts of supernatural beings that have been left over from an earlier religion and curiously blended with Christianity. He always sets little crosses along the gable of his house to keep away evil spirits. He avoids places which he is convinced are haunted by the "duendes"; ghosts of babies who died unbaptized, and who come back to pelt the intruder with stones. He places a sharp knife under his bed when he is ill, in order that it may cut his pain in two. He goes to sorcerers and sorceresses to have spells put upon people, and will himself practice witchcraft at home—using a waxen image of his enemy that he binds with string, just as he wishes to bind the enemy himself in real life.

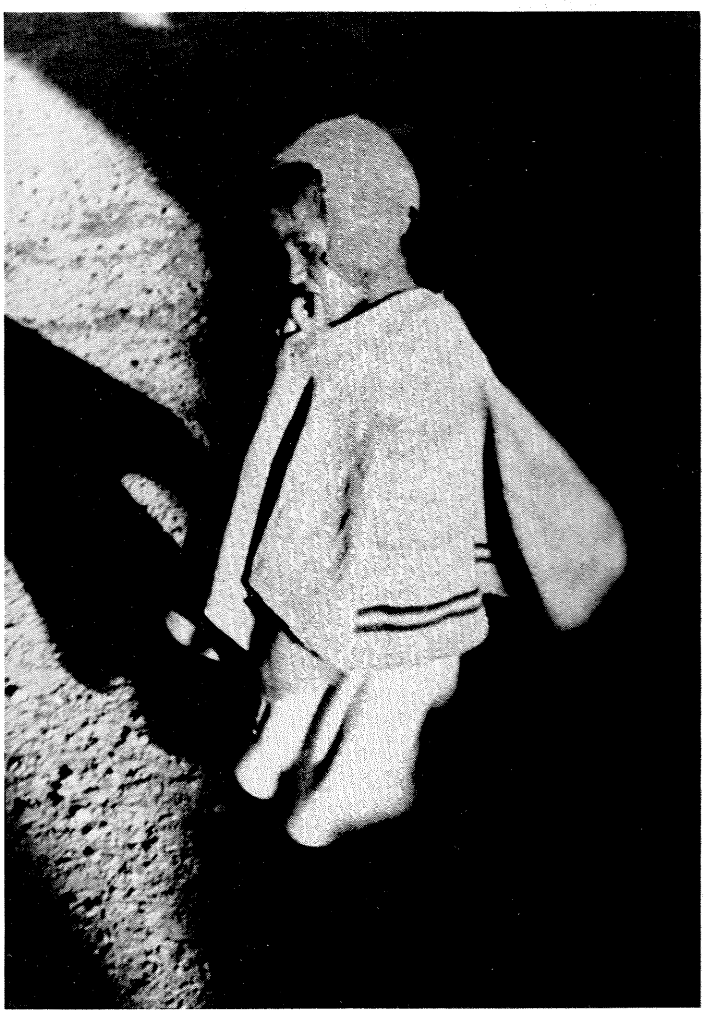
Still more picturesque than the Indian is the "cholo"—not particularly the men of this class, but the women, the delightful "cholitas" of La Paz who are famous for their exquisite costumes, their laughing ways, their half-Spanish charm. The chola is very different from the Indian woman, and makes no effort to imitate the white one, but is proud of her own customs and way of life and above all of her magnificent clothing and jewelry on which she spends a considerable amount of money. All of her clothes are costly—from her French-heeled high-laced boots of green or wine-colored suede, or bronzed kid; to her "pollera" or full gathered skirt of heavy satin in magenta, blue, red, rose, golden yellow, or black; to her embroidered and deeply-fringed silk shawl in light pink or green or some rich dark color; to her black or gray or tan felt hat shaped exactly like a man's derby and worn above her lively face witht two glossy black braids hanging down. Every "chola" owns one or more pairs of handsome large earrings in silver or gold—often set with real pearls, and sometimes even with rubies or diamonds. These are worked by hand in a curious and distinctively Bolivian style, as are the beautiful pins used to fasten the chola's shawl over the left shoulder—generally in the shape of a small dagger to which is attached (by a chain) a silver or gold fish with articulated scales and tail. Nothing more lively can be imagined than a group of "cholas" in holiday attire walking down the street, talking among themselves in merry and high-pitched voices, displaying their heirlooms of silver jewelry, wearing two or three silk shawls of different colors apiece, and stepping smartly on the pavement in their extremely high-heeled boots or a more modern type of little black patent-leather shoe shaped exactly like a ballet slipper.

The picturesque side of Bolivia is of course the most appealing one to an American unfamiliar with the country. But there is another practical, down-to-earth side that is of vital interest to Americans: Astonishing as it may seem, Bolivia, a veritable Shangri-La of mystery and color and strangely-remote geographical situation, is "right in the thick" of the world-wide fight for democracy.

Back in 1809, Pedro Dominga Murillo, a private individual of La Paz, made the first attempt in all of Spanish America to revolt against the dominion of Spain. It was he who "lighted the torch" of freedom that was to be taken up by Bolivar and San Martin, and was to bring emancipation and democratic government to all of the republics to the south of the United States. Murillo's revolution was unsuccessful; he was hung by the Spaniards, and after death his head was cut off and exhibited in a cage as a terrible lesson to would-be lovers of liberty. But, as Bolivian and universal history show, his "torch" of freedom could never be extinguished—and on the anniversary of his gallant uprising, a great torch-light procession is held in La Paz and goes under the name of "las tea (torches) de Murillo." Don Pedro Domingo's spirit lives on in Bolivia today, and is expressed in this stirring line of the national anthem: "morir antes que esclavos vivir"—"better to die than to live as slaves."

So it is not surprising that the dominant public sentiment in Bolivia is strongly sympathetic to the United States and Britain. To be sure, there has been much Nazi propaganda, but fortunately it has been self-defeating. The former German Minister, Ernest Wendle, was expelled from La Paz many months before the Río conference, because he had attempted to make a coup d'état and seize the government for Hitler. Since then, Bolivia has broken relations with the nations of the Axis, and has frozen the credits of Japanese, German, and Italian residents. Right now, Bolivia is the United Nations' principal source of tin; her production of this precious metal, which is immense, is being turned out exclusively for the United States.

This little girl in her father's arms holds tightly to a strand of "serpentina"—the gaily-colored paper used at all festivals.



A "llokalla" or Aymara boy, wearing the characteristic cap with ear-muffs used on the cold and windy plateau.

Bolivia's democracy is not merely one of political sympathies, but—to an ever-increasing degree—is becoming one of everyday life and of public education as well. The Universidad Mayor de San Andrés, ably headed by Dr. Hector Ormachea, has made great progress along extremely modern lines in recent years. Nearing completion is a vast new structure which will make it the first "skyscraper university" in Latin America. Scientific and technical studies are gaining in prominence: an astronomical observatory is about to be inaugurated, and physics and mathematics will receive new emphasis in the projected Department of Exact Sciences. For there is a new generation in Bolivia which believes that the material betterment that springs from science cannot mar ancient beauties, and will but enhance the charm of the Shangri-La of South America.

GAS UTILITIES IN THE PRESENT EMERGENCY

By FRED HOUGH, '24

Executive Engineer, Southern Counties Gas Co.

Utilities play an important and unique part in war as well as in peace. Mr. Hough has outlined the role of gas utilities in this first of a series of articles on utilities in the war.

The gas industry is displaying again in this emergency the stability that characterized it during the depression. Compared to the tremendous changes wrought by the war in the steel, rubber, and aluminum production industries, in the aircraft and automobile manufacturing industries, and in the home construction and home appliance industries, the gas utilities are doing business as usual. However, it is only when viewed in the light of changes that have occurred in other industries that those occurring in the gas industry seem small. Actually the impact of the war on the industry has been great. Some of the problems encountered in this emergency are peculiar to the gas industry itself, others are common to all business.

NATURAL GAS SUPPLY PROBLEMS

Those natural gas utilities that depend entirely upon dry-gas fields for their gas supply, have had relatively few gas supply problems attributable to the war. However, those utilities that use casing-head gas find that they are affected indirectly by many of the changes occurring in the petroleum industry, because their commodity is a by-product of petroleum production and is therefore available in quantities proportional to the amount of crude produced.

Continuous vigilance must be employed so that government agencies which control petroleum production are fully informed as to the effect of their plans on the utilities' gas supply. The production of abnormally large quantities of gas in a field not adequately equipped with gas transmission facilities would simply result in gas wastage, and the curtailment of production in fields in which such facilities are located results in an inadequate supply for the utilities.

The Petroleum Coordinator (OPC), now has a Production committee in each of the five petroleum producing regions of the country. One of the functions of these committees is to set up production quotas each month for each of the fields in their jurisdiction. These quotas are based on estimates of requirements for each product produced, including natural gas. If the demand for fuel oil increases, production is shifted to those fields that produce relatively heavy oil. If the demand for natural gas or butan increases, production is shifted to those light oil fields that produce relatively large quantities of these products. The relative amount of different products can also be varied by producing high or low ratio wells within a field.

This plan results in the gas utilities' requirements getting full consideration in the production planning, and makes possible the most efficient use of petroleum production facilities. However, there are many variables involved in the problems that these committees must solve and some of them, such as the weather, are not predictable with accuracy. Consequently, the committee's problems are difficult and their solutions are subject to error. All of which tends to jeopardize the gas supply to utilities that depend largely on casing-head gas.

NEW LOADS

The war has added many large loads to gas utility systems and has in many cases created demands for gas that the utilities have been unable to supply. Airplane plants, shipyards, and many other defense industries use natural gas in large quantities. In normal times loads of this character have been supplied in part at least on surplus gas schedules that permit the curtailment of service during periods of peak demand.

In California and in other regions where gas is used extensively for space heating, the gas transmission and distribution systems have a large excess capacity available to supply industrial loads during seasons when the space heating load is small or non-existent. However, during cold weather the gas systems are loaded to the limit to supply the firm load only. In the Los Angeles Basin, for example, the estimated firm load for July and August, 1942, is 153,000 Mcf of 1100 B.t.u. gas/day, while the estimated firm load for a peak winter day next winter is 518,000 Mcf of 1100 B.t.u. gas/day. The difference between the extreme peak day firm load, for which the gas system must be designed and built, and an average summer day firm load represents the surplus capacity normally available for industrial users who can either shut down or use a substitute fuel during periods of peak domestic demand.

The large shifts of population to defense industrial areas has created new loads more difficult for some utilities to handle than the loads of the defense industries themselves. During 1942, 50,000 new gas consumers were connected to the utilities lines in Southern California (excluding San Diego). This represents an increase in peak day demand for firm gas of approximately 25,000 Mcf/day and an increase in population of 165,000.

In New Orleans a shipyard is now under construction that will, when completed and operating, employ 50,000 men. To house these workers, a single housing project is underway, designed to house 100,000 people. The gas load created by this project will easily equal that of a city of 100,000 inhabitants. There are many problems involved in providing such loads in these times.

The firm peak day gas load in the City of San Diego has increased, largely as a result of war activities in that city, from 14,700 Mcf/day in 1937 to 32,400 Mcf per day in 1942.

The War Production Board has generally found it inexpedient to allocate to the gas industry the large quantities of steel and other critical materials that would be required to increase the capacity of existing gas systems to meet all of the demands that are made on them during this emergency. Instead, WPB has issued a Limitation Order (L-31), which limits the use of natural gas in those areas where the supply is inadequate to meet war needs. This order provides that after the effective date of the order (March 1, 1942):

(1) Natural gas cannot be used for major space heating in new houses, and

(2) No new non-residental consumer can use natural gas unless adequate standby fuel facilities have been provided, or special approval is obtained from WPB.

The order was one of the "Sunday punches" that brought most of the home construction in Southern California to a grinding stop. Permits for new single dwellings issued in Southern California during February 1942, totaled 2860, while in the same area in March, the month immediately following the effective date of the order, the total was 970. However, considerable home construction having Defense Housing status is still being done in Southern California. In most cases, kerosene or oil heat is being provided. Several large housing projects in the vicinity of defense industries are under construction, and they will use oil for space heating.

PRECAUTION AGAINST SABOTAGE AND AIR RAIDS

In common with other owners of large industrial plants, the gas utilities have given much thought and taken many steps to protect their property from sabotage. In addition to protecting themselves from losses due to damage to their property, the utilities have the added responsibility of protecting the continuity of their service. In the case of gas utilities this latter problem is of paramount importance. If electric or water service is interrupted, it can be resumed again as soon as the cause of the trouble has been eliminated and the necessary repairs have been made. However, if service is interrupted to a gas distribution system, it cannot be safely resumed after the necessary repairs have been made, until every gas burning appliance on the system has been shut off. In normal times the usual practice in such cases involves sending a gas utility employee to each consumer's premises to turn off the gas service cock. After this operation has been completed, and the cause of the interruption has been eliminated, gas is turned back into the distribution system and then an employee again visits each consumer's premises and checks all appliances and turns on the gas. Such an operation in a city of even moderate size would take a large force of men several days under the most favorable conditions.

It is evident that such an occurrence would cause much inconvenience and even suffering, especially in those natural gas territories where gas is used extensively for all domestic fuel requirements and is also used in hospitals, restaurants, etc. Under these circumstances it is also easy to understand why the major anti-sabotage and air raid protection activities of the gas utilities have been devoted to insuring, insofar as it is possible, the continuity of their service.

Those gas utilities that operate in areas where there are many defense industries and where air raids are most likely to occur are taking extensive precautions.

Important plants and compressor stations have been placed under armed guard.

Improved fences and yard lighting have been provided and a pass system set up to limit admittance to stations to those who can identify themselvs and who are there on legitimate business.

Precautions against sabotage from within have been taken.

By-passes are being installed around major supply stations, and supplementary sources of supply are being provided, so that the knocking-out of one station will not necessarily result in an interruption to service.

Spare parts and emergency repair facilities have been provided to minimize the seriousness of any given damage.

Increased fire-fighting facilities have been provided, and special fire-fighting training is being given to employees.

Valves have been installed in distribution systems that will make it possible to localize the effect of damage resulting from air raids.

Emergency crews have been organized to function during air raids. They will isolate damaged portions of distribution systems, and make emergency repairs to mains and holders. They are being trained to meet the emergencies to be encountered during a raid.

Key supervisors and dispatchers have been provided with special records and maps necessary for the efficient handling of emergencies. They have been drilled in the proper handling of situations that might occur during a raid.

Emergency rations for repair crews have ben provided at strategic points.

Air raid shelters are being built to protect emergency crews waiting to be called to active duty.

Emergency communication facilities have been provided.

Blackout facilities have been provided for those plants that must operate during a raid.

In all of this work the experience of the gas companies in England has served as a guide. The gas utilities are endeavoring in every way possible to cooperate with the Office of Civilian Defense and have received much valuable assistance from that organization. They are closely tied in with the Civilian Defense Control Centers, so that their work will be properly coordinated with the efforts of other agencies operating during an air raid.

So much for problems that are more or less peculiar to the gas industry. We also, of course, have the problems common to all business operating during wartimes.

The rubber shortage has made it necessary to curtail service in some cases and to radically change some of our operating procedures.

Many knotty personnel problems have arisen. The complete stoppage of appliance merchandising has left our sales organizations with nothing to do. We stand to lose these carefully trained and experienced organizations. Our engineers and trained technicians, most of whom have families, are getting commissions in the armed forces, or, to insure an adequate income for their families, are taking jobs in defense industries where they feel less likely to be drafted.

We have so far been able to obtain deferment by the draft boards for men in key positions and hope to be able to continue to do this.

All of our purchases of materials and supplies are controlled by the War Production Board Order P-46. This Order assigns us an A-5 rating for operating supplies and for materials required for maintenance and repair and for minor capital betterments. These latter are limited to a material cost for any one job of $1500 for underground construction and $500 for above ground construction. Extensions to supply new consumers are limited to a total length of pipe (including that on the consumer's premises) of 250 feet.

Special approval must be obtained from the Power Branch of WPB for all jobs that do not fall within these limits set by P-46. Many such jobs arise because of requests to supply new defense industries, increase in number of domestic consumers, etc. Consequently, a tremendous amount of detail must be referred to Washington.

Enough has been said, I believe, to make clear the meaning of the statement made at the beginning of this article. When compared with some other industries, the gas industry is doing business as usual, but nevertheless the impact of the war on the industry has been great.

(Continued from page 10)

renderings for current problems; and even the guest lectures are, if possible, more or less directly concerned with some theme that is of interest in connection with the particular problem which the students are solving at the time. The subject of Professor Macarthur's classes is history of art is the evolution of formal expression in relation to cultural and social development.

CONCLUSION

Summarizing the experiences of the first year of the activities of the Industrial Design Section at the California Institute of Technology, it may be said that the soundness of the chosen directives has been proved by the results of students' work and by the approval of critical experts from outside. Much of the desirable development, particularly in regard to closer contacts with industry, can be expected only after a longer period of time. The fact alone that the California Institute has opened its doors to students of industrial design is of principal and promising importance for the development of this young profession.

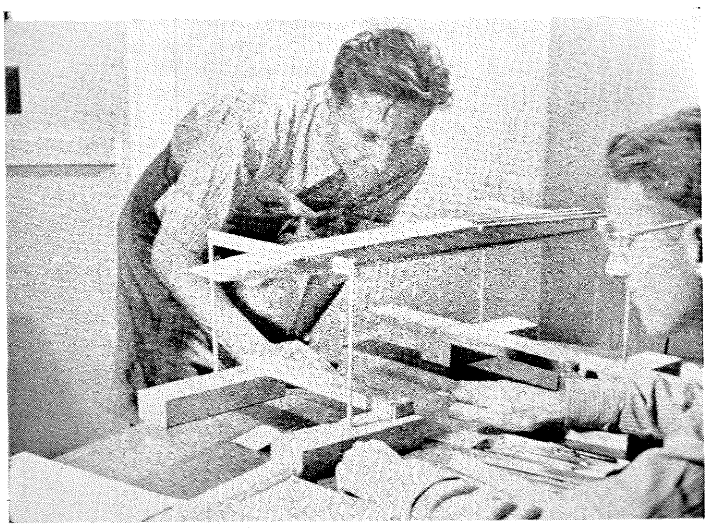


Fig. 21. Work on model of prefabricated house. (Second year thesis work) Photograph by B. Morant

(Continued from page 15)

power of the West and the great land power of the East. This Germany has not yet done and the difficulty of doing it increases with the passage of time.

The opening of the shooting war in the Far East has not fundamentally altered Germany's position. Some troops and supplies had already been diverted by the Allies from European fronts in anticipation of Japan's belligerency; more would have had to be sent in any event once hostilities commenced; but the unexpected rapidity of Japan's advances introduced into the Allied need for stronger opposition to Japan an urgency which had the indirect result of easing somewhat Allied pressure on Germany. But the basic Allied strategy still holds: it is to keep Germany locked up in Europe until her military strength can be ground to pieces between the jaws of a two-front offensive. To this end there is an increasing flow to Russia and Britain of supplies which will one day make possible this grinding-up process.

It should not be overlooked that Japan's belligerency has had its counterpart in the belligerency of the United States and in the enhanced anti-axis co-operation of Latin America. The resulting intensification of the war effort in America is even now going far to offset any advantage accruing to Germany from Japan's entry into active warfare. Furthermore, Russia has not yet been obliged to meet a Japanese attack on her Far Eastern provinces, and so has escaped the difficulties of an active war on two fronts. This happy circumstance has been one of the factors enabling Russia to sustain an undiminished

(Continued on page 24)

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(Continued from page 23)

counter-offensive against Germany. Action on the Japanese-Russian front is, it would seem, inevitable. Any serious interruption of Japanese campaigns on any other front—Australia, India, China—might well have the effect of turning Japanese energies once more against the Russian Far East and other bases in the North Pacific. The longer such a development is postponed, the better prepared will be both Russian defenses and the bases and supply lines essential to the delivery of assistance to this part of Russia from North America. In short, spectacularly successful though Japan has been in five and one-half months of warfare, she has done little more than give Germany some superficial and probably short-lived respite. Successes comparable to those in Malaya and Burma are not likely to be repeated, because not only has Japan's problem of supply become more difficult but also the opposition which bars her way has grown in wisdom and stature. And the more widely Japan spreadeagles her strength over Eastern Asia and the Southwestern Pacific, the more precarious becomes her position from sheer unbalance and the more exposed to effective counter-attack. Germany has already enjoyed the first and choices fruits of Japan's entry into the war. These have not brought victory for the Reich; they have only deferred defeat.

All this is by no means meant to suggest that the overpowering of Germany will be easy, or that her capacity and will to resist will crumble before the specter of defeat; or that, with Germany's collapse, Japan will give up. These two powers and their satellites will take a deal of beating and the United Nations cannot afford to indulge in easy optimism. For certain as is their final victory, it will be difficult and costly to achieve.

What provision the eventual peace settlement will make for the defeated Axis powers is, of course, not known. But, in all justice, severity is more to be expected than leniency. One may be permitted to wonder whether under the settlement Germany will be in a position and mood, as in 1919-20, to set up investigating committees to inquire into "the causes of the German collapse." The investigations of two decades ago were searchingly self-critical: weaknesses of the army and the home front were laid bare and mistakes of campaign were exposed. Military lessons learned from these investigations have contributed materially to the successes of German arms since 1939. These successes may be, indeed, the most important end-product of the inquiry. But there appears also to have been a not unimportant by-product. From the inquiry the German military mind seems to have emerged, as did General Hoffmann, reflecting on the first world war as one of "lost opportunities," and with the conviction that given a second chance in which weaknesses would be eliminated and mistakes corrected, new opportunities would not be lost but seized upon and victory made certain.

It would be most regrettable if, after this war, some surviving German general, titillated by the "ifs" and "might-have-beens" of history, should stamp the German war effort of 1939-194? as one of "lost opportunities," and dwell upon those moments in the war's progress where victory had barely eluded German arms. How could the German military mind be made to resist toying with the fire which such speculations would strike into flame? Surely this is one problem which will have to occupy the attention of the peace-makers, if they are to inherit the earth. Perhaps it should be made obligatory on all German army officers to take an orientation course in The Physical Principles of World History, the main lesson of which would be that he who plays with fire will surely get burned, and that, in this particular at least, history does repeat itself!

(Continued from page 17)

These are basic formulas. In actual practice it is found that other factors such as width, width-thickness ratio, Cross curvature, and method of mounting may sometimes have an appreciable effect on bimetal action.

Thin bimetal responds more quickly to temperature change of the surrounding medium than does thick bimetal. Thus, if heavy bimetal must be used for power considerations and quick temperature response is a factor, rapid flow of the medium in which the bimetal is placed must be provided. There is no lag in the response of bimetal to temperature change provided that the bimetal itself has changed temperatures. Since bimetal is used in thicknesses of .002 inches to .125 inches, in widths of 1/32 inch to 2 inches, and in lengths of ¼ inch to 100 inches, it can be seen that its applications are varied and that each application may have its own peculiarities The illustration shows an assortment of various shapes and sizes covering a large number of uses.

Bimetals of course have limitations as to the temperatures they can stand and the loads they can carry. However, as engineering materials, bimetals have their place, for in many applications they are either the only solution to the problem or else offer the cheapest satisfactory solution.

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FIFTH ANNUAL ALUMNI SEMINAR

Speakers at the Fifth Annual Alumni Seminar emphasized the fact that we in democratic countries, particularly in the United States of America, have much to fight for, discussed methods of defending ourselves against attacks, told of how best to reach our production goals, set forth the historical aspect of our position in the war, and, for good measure, included talks on the diverse subjects of fishing and distribution of electricity.

Dr. Eugene C. Blake of the Pasadena Presbyterian Church, speaking at the chapel service which opened the seminar, reminded his listeners that the founders of our country thought of it as a new land whence liberty for all men of every race and nation would spring. He declared that "In these latter days, America's once accepted universal mission has too often been forgotten or rejected. The fearful isolationist, and the selfishness that so easily overcomes us all, have nearly betrayed us into an anti-Christian nationalism that as God lives is doomed and is therefore not *worth* dying for."

At one of the two ten o'clock meetings, Professor G. R. MacMinn discussed the meaning, dangers, and the faults of democracy at set forth by Walt Whitman whose greatness, in Prof. MacMinn's words, "lies in his poetic optimism, in his prophetic faith in a developing democracy." Whitman was a staunch supporter of democracy although he recognized and detested its political corruption, its "bats and night dogs" in the capitol at Washington. He regarded political democracy as a gymnasium, "a training-school for making first-class men." Whitman was an internationalist too, for as he believed "in the sacredness of the Union, so he believed in a 'fraternity over the whole globe'—a democratic comradeship uniting 'all nations, and all humanity' ".

While Professor MacMinn was telling one group about Walt Whitman, Professor Sorensen was relating to another group some of his recent experiences in a recent discussion of power distribution. The discussion centered on the problem of tracing the flow of electricity from a number of sources to a number of loads when all are connected through one network. One of Professor Sorensen's tasks had been to aid in convincing a number of politically-trained men that there is no unique way for tracing the physical flow of energy through a network from sources to loads and that the flow must, for accounting and other practical purposes, be considered to be according to contact.

In one of the eleven o'clock sessions, Professor Michael discussed and illustrated the science and techniques of trout fishing. He told how knowledge of mechanics, entomology, optics, hydraulics, chemistry, and Meteorology contributes to filling the creel. This talk aroused a great deal of curiosity and enthusiasm and probably caused several alumni to set forth in search of streams in which to apply their newly acquired or rejuvenated hobby. One Los Angeles newspaper carried in its sports pages a complete story of the talk.

Offsetting the light nature of the talk on fishing, and occurring at the same time, was the talk on poison gasses by Doctors Carl Niemann and Joseph Koepfli. The speakers pointed out that an almost impossibly large load of poison gas would be required to cause any considerable loss of life on the Pacific coast. It was also stated that the Japanese, if they attempt gas attacks, probably will use mustard gas and Lewisite which they have already employed. In connection with combating poison gases, the listeners were told that civilians can obtain some protection, even without masks, by going indoors, sealing doors and windows, and staying indoors until decontamination squads have completed their work.

The lunch period permitted many alumni to renew acquaintances while enjoying lunch in the pleasant surroundings of the student houses. That this feature of the Seminar was popular is attested by the fact that three hundred alumni and friends were served.

Following lunch were presentations of "The Engineer's Place in the Present Emergency" and "Protection from Aerial Bombardment". In the former, Professor Robert D. Gray urged directors of industries to take upon themselves the responsibility for adapting their plants to war production. The importance of this step was emphasized by the statement that "If too many managers wait too long for orders from Washington, they may find that the orders are coming from Berlin or Tokyo instead". In addition, Professor Gray stated that every engineer owed it

to himself and to his country to find a job which challenges him and uses every bit of his abliity and urged engineers holding jobs not to their liking to find jobs which they liked.

In introducing Mr. Harald Omsted who subsequently spoke on "Protection from Aerial Bombardment," Professor Martel reminded his audience that civilian defense was really an ancient activity, Aeneas the Peloponesian, having written about fifth columnists and blackouts in 360 B.C. Professor Martel said that this interesting information was found in "Through Engineering Eyes" by Helen Cullimore. Mr. Omsted, now working with the structural engineering group at the Institute, held his listeners in rapt attention as he related his experiences before, during, and after the German invasion of Norway. During his stay in Norway, Mr. Omsted designed a number of air-raid shelters and saw some of the communities containing them bombed. His experiences convinced him that we should build shelters in the areas containing harbor facilities and plants producing oil and war implements. Mr. Omsted estimated that shelters could be made of timber, concrete, and masonry, then still on the non-critical materials list, for as little as $22 per person to be sheltered. He added, however, that if the building were delayed, both materials and labor might become too scarce to permit their construction.

The 2:30 p.m. meetings were devoted to an industrial relations seminar and to a talk by Dr. J. E. Wallace Sterling on "The War in Review and in Prospect". At the industrial relations seminar, those attending held a question and answer discussion regarding the engineer's place in industry, carrying into greater detail the subjects opened earlier by Professor Gray.

Dr. Sterling stated that Japan had not yet been entirely successful. She had substantially achieved her first two objectives; that is, she had disrupted communications by knocking out Hawaii, Wake, and the Philippines and had gained many of the things she needs. Now Japan will require time to rehabilitate the conquered territory, consolidate her positions, and knock out any potential bases for counterattacks. The strain of Germany's effort was beginning to tell on her, declared Dr. Sterling. Goebbel's preaching of fear of defeat rather than hope of victory was a favorable sign, as was the loss by Germany of many of her reserves intended for a spring offensive. "If the proposed second front can be opened in time", said Dr. Sterling, "it might prevent Hitler's threatened offensive in the Near East. The British have over 750,000 men in Egypt and vicinity who are doing nothing but waiting a possible German offensive. If the latter is made impossible by the opening of a new western front they could be used to work against the Japanese in India."

At the single closing meeting, Dr. Millikan declared "The greatest world issue today is whether war, the destroyer, or science, the creator, will survive. The issue is between life for the race guided by science or eternal war caused by self-styled supermen." Dr. Millikan related that over a year ago a Japanese general had asked him to state the attitude of United States toward Japan. Dr. Millikan said that he told the general that civilized nations would band against Japan and that "You Japanese have cut your own jugular vein and your doom is sealed."

Following the last speaker, alumni thanked the Institute staff, and the 1942 Seminar Board and Committees for their work in making the seminar possible. In addition, Clarence Kiech, who conceived the Seminar idea and brought the first seminar into being in 1938 was honored with a vote of thanks.

Registration records show that 204 alumni and 189 guests attended the Seminar.

That the Seminar resulted in considerable publicity for the Institute is shown by the fact that the aggregate circulation of newspapers containing advance notices and subsequent articles about the Seminar was well over a million.

CALTECH SUMMER PROGRAM

FULL-TIME SUMMER COURSES to be given as part of the Engineering, Science, and Management Defense Training Program authorized by the U. S. Office of Education.

Professor Franklin Thomas, in general charge of all Institute courses given as part of the ESMDT program, recently announced that arrangements were being completed for giving the following full-time tuition-free courses during the Summer of 1942.

AERONAUTICAL ENGINEERING and ULTRA-HIGH FREQUENCY TECHNIQUES have been organized primarily for Army and Navy officers, but enrollment is open to a limited number of civilians.

BASIC ELECTRIC CIRCUITS AND MACHINERY.

The courses listed below are open to both men and women, but they offer a particular opportunity for women to prepare themselves for essential work in war industry and defense:

AIRCRAFT DRAFTING
TOPOGRAPHICAL MAP DRAFTING

Detailed information and application blanks can be secured by addressing the Committee on Engineering Defense Training Courses at the Institute.

SCIENCE MUST RULE TO BAN WAR

"The life of the human race must be governed by science or we shall have eternal war," Dr. Robert A. Millikan told a meeting of the University Club in Los Angeles. For the management of the post-war period, Dr. Millikan offered the formula of "international, collectivist, enlightened co-operation."

"Science is the creator, war the destroyer. The two are in a death struggle today as never before in history," he declared.

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ROCKEFELLER FOUNDATION GAVE CALTECH $77,000 DURING 1941

Rockefeller Foundation grants to Caltech in 1941 totaled $77,000, according to the annual review released by Raymond B. Fosdick, Foundation president. One grant of $40,000 was for the support, as previously authorized, of the development of organic chemistry in its relationship to biological problems.

The other $33,000 was for research on the structure of anti-bodies and the nature of immunology reactions, under the direction of Professor Linus Pauling, payable over three years.

One grant, out on the far borderline between chemistry and biology, was designed to assist Professor Pauling and his associates in their attempts to gain an understanding of the structure and formation of these chemical substances called "anti-bodies," whose presence in the blood of certain people is responsible for the fact that they possess a "natural" immunity to infectious diseases, and whose absence from the blood of other people makes them susceptible.

ENGEL CAPTURED

Dr. Rene Engel, former instructor in geology at Caltech, is interned in the Santo Tomas University at Manila, according to word received by Mrs. Engel from Francis B. Sayre, United States High Commissioner to the Philippine Islands. Mrs. Engel is the author of the book, "I Remember the Emersons," which was recently published.

THOMAS TELLS NEED

Professor Franklin Thomas, head of the civil engineering department at the California Institute of Technology, recently spoke at the Kiwanis Club luncheon in Pasadena on how the Institute has made adjustments in order to assist the war effort.

He explained a course to be stressed next fall for the study of a new science by which targets are located by radio. There are now seventy-five courses at Caltech applied to the war program, he said. Demand for students is so great that the entire junior class in civil engineering has been offered summer work by the Aeronautical Authority. He told of naval and army officers scheduled for assignment to Caltech by the score in the months ahead.

DR. MILLIKAN STRESSES RESEARCH

Dr. Robert A. Millikan took a prominent part in the first annual meeting of the board of directors of the National Science Fund held at the University Club recently. Dr. Millikan, who has been active during the past year in making the National Science Fund known to scientists throughout the country, stressed the necessity for maintaining basic scientific research, even during these war years.

The National Science Fund is a new type of foundation created last spring by the National Academy of Sciences to receive and administer gifts for the advancement of science and to act as a national clearing house in advising donors how to give wisely to science.

COLOR BLINDNESS INHERITED, SAYS DR. MORGAN

Color blindness is transmitted from generation to generation in exactly the same way as the white eye of the drosophila, or fruit fly, in the laboratory, Dr. Thomas Hunt Morgan, distinguished Caltech biologist and Nobel laureate, declared in an NBC broadcast.

During the broadcast of the story, "Are Acquired Characteristics Hereditary?" Dr. Morgan said, "We have a human longing to pass on to our offspring the fruits of our bodily gains and mental accumulations. And, while every scientific investigator has sympathy for this human desire, he cannot permit it to influence him in his examinations of the facts as they actually exist.

"In our own hope for the best, we forget that we are invoking a principle that also calls for the inheritance of the worst. If we cannot inherit the effects of the training of our parents, we escape, at least, the inheritance of their misfortunes. A receptive mind may be a better asset to a child than a mind weighted down from birth with the successes and failures of its ancestors."

Through the imagination and enterprise of Dr. Morgan, new light has been shed upon the vital problems of heredity. Through his tireless years of painstaking scientific research, man's knowledge has been advanced.

SOIL EXPERT AT CALTECH

Dr. Walter C. Lowdermilk, assistant chief of the United States Soil Conservation Service, was engaged, during May, in work at the laboratory which the service maintains at the California Institute of Technology.

Coincident with Dr. Lowdermilk's arrival, it became known that the Chinese government has requested that he act as adviser on forestry, soil conservation, and up-stream flood control in Free China, and that he is making preparations to visit the Orient, probably in the fall.

The invitation to Dr. Lowdermilk to advise the Chinese government on conservation problems, with a view of increasing the food supply for the vast population of that land, bears the signature of Generalissimo Chiang Kai-Shek, and was presented to him in Washington by the Chinese ambassador to the United States.

ICEPLANT

In answer to alumni inquiries, iceplant is still growing on the campus.

Alumni Business and Professional Guide

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"Electroshock" Treatment For Insanity Developed At Caltech

The most recent creation of Caltech's famed laboratories is an apparatus to restore normalcy to violently insane persons by a humane, safe "electroshock." The use of this treatment has returned eighteen of twenty patients suffering from the manic-depressive variety of insanity at the Patton State Hospital to society, and has saved them from long periods of suffering.

The new device, which looks like a tea table with instruments and controls on top, embodies the priciple of Ohms law of electricity, and employs large radio transmitter tubes for applying a constant amount of electricity, regardless of resistance. The machine automatically adjusts the voltage to equal the resistance, thus permitting the same dosage every treatment. The result is that physicians can administer electroshock as accurately as they can prescribe aspirin tablets.

On the average, treatments consist of shocks of 600 milliamperes lasting 2/10 of a second, administered twice a week for five weeks. The shock produces immediate unconsciousness, followed by a convulsion lasting about 1¼ minutes. Five minutes after the shock, the patient is normal, and remembers nothing of the shock. A pair of electrodes held against the patient's temples by an elastic band delivers the current. There is no danger of electrocution or other serious effects, due to a transformer which insulates the current in such a manner that it cannot be grounded.

Many requests have been received for duplicates of the apparatus, but it is probable that the machine cannot be put into production until after the end of the war, due to priorities materials required.

The new method has given credence to the old superstition that insane persons are sometimes made sane by a bump on the head. The use of shock as a cure for insanity was first tried by the administration of powerful drugs. However, the effects were so terrifying to the patient that it was often impossible to complete the treatments. The introduction of "electro-therapy" in 1938 was given an enthusiastic reception. However, because the resistance of the skin, skull, and tissue varied from patient to patient and from day to day, physicians could not be certain of the exact dosage. This new apparatus has overcome that difficulty. Also, it will be the means of an immense saving to the state, since patients are often released from institutions within six weeks instead of after months or years.

COMMENCEMENT

The annual commencement of the California Institute of Technology was held on June 5, the principal address being delivered by the Agent General for the Government of India at Washington, the Honorable Sir Girja Shankar Bajpai. His subject was "India in Her Relation to the War and the Post-War World," a topic of great importance, for India is one of the key points in the present world conflict. After conferring degrees on behalf of the trustees and faculty, Dr. Millikan spoke on the subject, "The Institute in War Time."

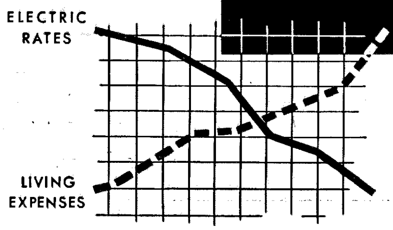
STRONG HONORED

The Franklin Institute for Science, Philadelphia, has awarded the Levy medal to Dr. John Donovan Strong, assistant in astrophysics at the California Institute of Technology. Dr. Strong's award was due to his paper on a new method of measuring the mean height of ozone in the atmosphere.

ENGINEER PASSES

Mr. John F. Hurley, stationary engineer for the past eighteen years at Cal Tech, passed away suddenly on May 8. He is survived by his wife, a son, and a daughter. Mr. Hurley was vice-president of National Association of Power Engineers, California No. 2.

One shining exception..



Nearly everything costs more these days. The three essentials—food, clothing and shelter—are higher. And the trend continues up! In the face of this increased cost of living, it is pleasant to note one shining exception. Your dollar spent for electricity today buys more current than ever before—more than twice as much as it did in 1925. And the rate trend has been steadily downward.

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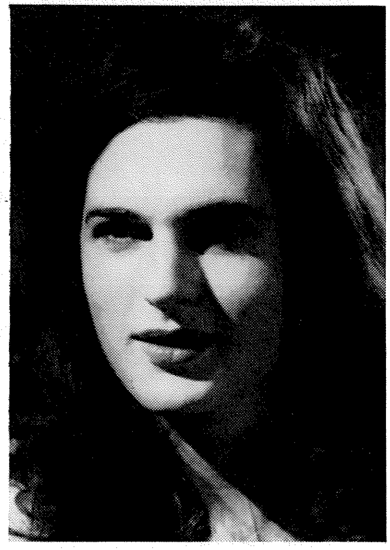
EARL CARROLL CHOOSES CALTECH BEAUTY QUEEN



QUEEN "MARY" WARREN

One might think that the millennium would come before the California Institution for Young Gentlemen would be blessed with a campus beauty queen, but that is just what it acquired in early May as a result of the combined efforts of the California Tech staff and Mr. Earl Carroll. Jack, Alias Mary, Warren, a sophomore of Ricketts House, reigns supreme in pulchritude among the undergraduates. He was selected over Pete "Patricia" Lambert of Dabney and George "Georgia" Osgood of Ricketts.

The Caltech beauty contest, which has received mention in several newspapers and magazines throughout the country, started last March when the unsuspecting Hollywood expert on feminine charm offered, in a form letter, to pick a queen from among submitted photographs. Little did Carroll suspect the overall maleness of the Institute, where a pair of pretty legs still causes whistles and collisions.

Always eager to cooperate with such a distinguished patron, several members of the California Tech staff got together and persuaded each of the houses and Throop Club to choose two of their fairest members. Then three makeup artists from the Pasadena Playhouse, Sonia Henius, Gwen Crawford, and Andrew Campbell, spent four hours applying wigs, rouge, and all the trimmings to the candidates. Glamour photographs were taken by expert Bob Gustavson, Ricketts junior, while Leon Green spent his time snapping innumerable informal shots of the proceedings.

Photographer Gustavson was far from satisfied with his pictures, but the three most successful were finally selected and carefully retouched before submitting them to Earl Carroll. All Caltech waited in suspense while the master scrutinized the entries. It was a day of rejoicing when his answer finally came, declaring, "I was very happy to select the queen of your campus. All of the girls were exceptionally beautiful and I found the selection most difficult. Either the girls are becoming lovelier or after all these years I am slowly succumbing to beauty blindness . . . . "

LAUE WRITES FROM MIDWAY

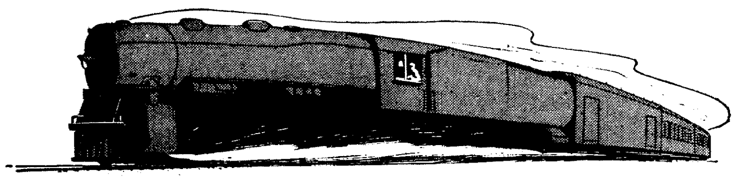
Professor Sorensen received a letter from Eric Laue, '40, who is stationed on Midway Island. Excerpts from the letter, dated March 15th, are as follows: . . . "My past year as an enlisted man in the service has indeed been very valuable. There has been an opportunity to actually see electrical equipment in strenuous service, and further, to work with it in a manner that would not have been possible under any other circumstances. There has been a growing appreciation of the importance of simplicity, ruggedness, and interchangeability in the design of military equipment. The high degree of dependability of the products of the electrical industry make it exceedingly useful and powerful in any setup.

" . . . Personally, I still hope to be able to finish off my training at Tech—a request to do so was blitzed in December, too. In any event, the best of wishes to you.

"Sincerely,

"Eric Laue."

Don't think *we* are happy about the tire shortage!



We've heard people say, "The railroads are pretty lucky. Pretty soon tires will begin to wear out and people will have to travel by train."

Well, we aren't very happy about it.

In the first place, we don't like the idea of people riding on our trains because they have to. We'd rather have them travel by train because they want to.

Second, we've always felt that there's a time and place for the automobile, and a time to take the train. Most of us in the Southern Pacific have automobiles, so we're affected by the tire situation, too.

And in the third place, we know that any business we get as a result of the war is only temporary. In the long run our success will depend upon the service we give.

At present it is difficult to serve you as well as we would like to because of the absolute necessity of giving priority to war traffic. War trains—the Victory trains—come first.

But if you do travel with us to save your tires, we'll do everything we can to give you a pleasant, comfortable trip.

SP

The Friendly Southern Pacific

NEWS OF CLASSES

1922

Harold R. Harris, vice-president of Panagra, visited the Tech campus early in April.

Olcott R. Bulkley is at present engaged in electrical design work for Basic Magnesium, Inc., at Las Vegas, Nevada.

Mr. and Mrs. Howard Vesper again invited all Tech Alumni in the San Francisco area to their home for an annual get-together on May 23rd, as they have so graciously and successfully done the past two years.

Lieutenant-Colonel Donald F. Shugart has been in command of the 62nd Transport Group of the U. S. Army Air Forces since June, 1941, and is now stationed at McClellan Field, Sacramento, California.

Ray W. Preston, after having spent the last twelve years with power companies in and about Portland, Oregon, left there on December 7th and is now in Seattle as an electrical designer for Navy and Army bases in Alaska. Any alumni visiting Seattle can contact him by calling Garfield 8141.

1924

The Fleet Operating Base for the Navy at Terminal Island, which, when completed, will be one of the finest in the country, was designed, with the exception of the drydock, by the Allied Engineers, headed by **Donald R. Warren,** a former San Francisco Bridge authority.

Frank R. Lovering has been promoted to major and is now intelligence officer at Camp Davis, North Carolina. Major Lovering had engineering R.O.T.C. training while attending school and was commissioned in the Coast Artillery Reserve in 1929, serving at Fort MacArthur and at Fort Funston. He was field superintendent for the Shell Oil Company at Iowa, Louisiana, when he was called into active service in March, 1940. Major Lovering is married and is the father of two children.

Grant Jenkins is now on duty at San Francisco as Captain with the Chemical Warfare Service.

1925

Lt. Harold Clough Sheffield of the U. S. Air Corps, has entire charge of the commissary at Williams Field, Arizona. Mr. and Mrs. Sheffield have a daughter, Susanne Elaine, born the latter part of March.

Robert Dillon is the father of a daughter, Patricia Anne, born April 21st.

Michael B. Karelitz has received a leave of absence from the Enterprise Engine and Foundry Company of San Francisco, and is now a research associate in the Radiation Lab of the Massachusetts Institute of Technology, cooperating with the N.D.R.C.

1926

Ted Coleman was in Washington on business recently. While there he had dinner with a group of Tech alumni including Ted Combs, Lt. Wayne Rogers, Capt. Harry Lind, Capt. Ed Joujon-Roche, and Fred Groat, all of whom are in the Engineers Corps.

Ernst Maag, of the Los Angeles County Department of Building and Safety, has been promoted to Structural Research Engineer.

1927

Major T. C. Combs is now at the Headquarters of the Engineer Organization Center, Camp Claiborne, Louisiana.

Thurman S. Peterson, Assistant Professor of Mathematics at the University of Oregon, has recently had published by the Harper and Brothers Publishers a textbook for college students entitled "Intermediate Algebra."

Douglas Wright Perry, born April 7, 1942, is the son of Mr. and Mrs. **Raymond C. Perry.**

Roland W. Reynolds is with the Machinery Sales Company doing development, research, and investigation of existing business.

1928

Al Lombard is in charge of aircraft scheduling in the War Production Board in Washington. He was formerly an engineer for Curtiss Wright.

George Harness, author of the book "Direct Current Machinery", has just finished his second book entitled "Alternating Current Machinery."

F. G. Gramatky, contractor, has just completed a quarter-million dollar grading contract at the Lemoore Airport. The contract was for the excavation and grading of company streets throughout the barracks area and on the various aprons, runways, and taxiways.

1929

Willard A. Findlay has just returned from Australia after three years of geologizing in Egypt, India, and Western Australia. He and Mrs. Findlay, who accompanied him on most of his travels, have many exciting incidents to report.

Capt. Wm. H. Mohr is now stationed at Fort Ord, Calif.

Bill Berry was promoted to Major in the Army Engineers and is on active duty with the Fourth Army Headquarters.

Tom Evans has been called to active duty as Captain in Corps of Engineers, U.S. Army. Having been a professor for several years, Tom was made executive officer of engineer school at Fort Belvoir, Virginia.

Larry Lynn was transferred to Fort Belvoir and was promoted to a Major in the Army Engineers the first of the year.

1930

J. W. McRae is engineer with the Bell Laboratory at Deal, New Jersey.

Raymond W. Hoeppel is now with the Baroid Sales Division of the National Lead Company as Research Chemist, and is living in Arcadia, California.

1932

R. Howard Griest, who has been working for the Bell Laboratory of New York since 1937, is now married and living in Summit, New Jersey.

J. D. Cobine has had a book published recently entitled "Conduction in Gasses."

1933

Paul Hawley is working for Standard Oil Company in Chicago and is teaching night classes at the Illinois Institute of Technology.

Robert G. Macdonald writes from the Hawaiian Islands that he is now stationed there and is working hard, but enjoying it. He may be addressed: 1st Lt. R. G. Macdonald, C.E., Company E, 47th Engineers, APO No. 957, c/o Postmaster, San Francisco, Calif.

Dick Plank, formerly of Bakersfield, is now working for National Supply in Torrance.

Richard Russell, of former baseball fame, is now with the Square-D Electric Company, Los Angeles.

Arthur Lamel is chief engineer at Trumbell Electric Company; **Ray Cripps** holds the same position at Lawyer Electric; and **Bernie Palm** holds down the fort at Sterling Motors. All three report a brisk business in the war effort, with most of their output going to the shipbuilding companies.

Wendell Morgan, who has been with the Metropolitan Water District for several years, has switched his allegiance to the Bureau of Reclamation in Denver.

Lee Morris is now Lieutenant of Navy in Charge of a Destroyer Repair Squadron.

Bill Moore, of Dames and Moore, is opening an office in the Bay area.

Tom Terrel is reported to be a prisoner in the Philippines.

1934

Edward B. Doll has received a year's leave of absence from the University of Kentucky, where he was teaching engineering, to take a position in Washington, D.C. Ed was married last year to a Kentucky girl.

Mr. and Mrs. Wm. C. Birdsey are the parents of a son, born May 2, in Pasadena.

Thomas P. Thayer has recently been in Cuba looking into chromite and manganese prospects.

Gilbert D. McCann is Central Station Engineer at Westinghouse in Pittsburgh where he has been conducting lightning research for the past four years. On a recent visit to New York he was interviewed on N.B.C. by Ben Grauer in regard to his experiment proving the safety of remaining in a closed automobile during a lightning storm. The McCanns are parents of a son born in December, 1941.

1935

Jesse E. Hobson, winner of the Eta Kappa Nu award for 1940, has left the Westinghouse E. & M. Company of Pittsburgh and is now head of the Engineering Department of the Illinois Institute of Technology. He now resides in Evanston, Ill.

Louis Rader is an engineer with General Electric Company of Schnectady.

Richard H. Jahns is surveying mica and beryllium deposits for the U. S. Geological Survey.

Nathan Karp was loaned by the Bureau of Wards and Docks to work as consulting engineer to the officer in charge of the construction of the Fleet Operating Base for the Navy at Terminal Island. He was instrumental in furthering several new designs for drydocks and piers. Upon completion of his duties there, he left for Porto Rico.

1936

T. E. Browne, Jr., engineer at Westinghouse Electric and Manufacturing Company, Trafford, Pa., is the beaming father of a second son.

Glenn R. Carley is now with the Instrument Development Section of the Naval Aircraft Factory of the Philadelphia Navy Yard.

1937

John R. Schultz returned from geologizing in Saudi, Arabia, and is now with the United States Engineers studying dam sites in the southern states.

Robert P. Bryson is in charge of bauxite investigations in Arkansas for the U.S. Geological Survey.

Mr. and Mrs. Joseph J. Peterson are parents of a son, Joseph Eric Peterson, born May 10, 1942.

1938

W. E. Milburn has been with the Seims Drake Company, Puget Sound, Contractors, who are building the Naval Air Base at Kodiak, Alaska. He has been doing structural design work.

William C. Brenner, after taking graduate work at Stanford, is now in the General Engineering Department of Westinghouse.

Paul Siechert is the father of a daughter, Carol Ann, who was born April 24 in Pasadena.

John C. Wells and **Robert Carr** have returned from foreign work, principally in Saudi, Arabia, with the Standard Oil Co., and they are now working on California geology for the same company.

Jack Knight returned recently from New Zealand where he had spent nearly three years in geological mapping and investigation for the Superior Oil Company.

Henry K. Evans has moved from Los Angeles to 1521 Sherwin Ave., Chicago.

1939

John Battle has been stationed at Brownsville, Texas, as meteorologist for Pan American Airways. He was married last November to Miss Patricia Culver, of Culver City, who is a graduate of U.S.C.

C. Russell Anderson is now with the hydraulics machinery laboratory at Cal Tech.

John S. Billheimer is with the Twin Cities Ordnance Plant of the Federal Cartridge Corp.

Delos Flint is working on chromite deposits in Montana for the U.S. Geological Survey.

Willard M. Snyder is now embarked on a career in the U.S. Navy starting as aviation cadet, and leading toward a commission. His temporary address is at the U.S. Naval Air Station, Corpus Christi, Texas.

David E. Hoyt will be married on June 20 to Miss Barbara Butz of Altadena.

Michael E. G. Hiehle was married April 25 to Miss Ruth Hays of Schnectady, N.Y. The bride is a graduate of Vassar College, and has just resigned her post as industrial secretary of the Y.W.C.A. in Schnectady. Mr. Hiehle is now employed by General Electric, and before going east was associated with the radio department of KHJ broadcasting station, Los Angeles. The bride and bridegroom spent their honeymoon in Quebec, Canada.

Richard H. Hopper, formerly instructor in Field Geology at the Institute, and more recently geologist for the Standard Oil Co. in the Dutch East Indies, returned from explorations in Timor to Batavia just in time to receive a commission as first lieutenant in the United States Army. He had an exciting trip in a small boat from Java, and is now stationed in Australia.

Harlowe J. Longfelder was married to Nancy Jane Nicholson of Seattle, Wash., on April 2, 1942. Harlow is an aerodynamicist for the Boeing Aircraft Company in Seattle.

William Green, since his graduation from Caltech, has been an engineer in the Switchgear Engineering Department of Westinghouse Electric and Manufacturing Company of East Pittsburgh, Pa. The war department has ordered him to active duty as second lieutenant in the Air Corps, Wright Field, Ohio. Last fall he married Miss Marjory Taylor of Wyoming, Ohio.

Phil Smith is working in Washington, D.C., in the film processing studio for Eastman Kodak Company.

Evert F. Cox is with the Bureau of Ordnance at Pearl Harbor.

1940

Mr. and Mrs. Robert Cox of 62 West 55th St., New York City, are the parents of a son, Thomas Riley, born April 19, 1942.

David Varnes has just returned from several months in Haiti and Santo Domingo where he was investigating reserves of manganese.

Keith Anderson is with the Water Resources Branch of the U.S. Geological Survey, and has been stationed in Iowa.

Mortimer Staatz is a graduate assistant in the Department of Geology and Geography at Northwestern University, Evanston, Ill.

1941

Paul Farrington is now a research assistant on the Caltech campus, having left his former position at the Kelco Company in San Diego.

Stanley J. Mitchell has been appointed junior engineer in the switchgear division of the Westinghouse Electric and Manufacturing Company at East Pittsbugh, Pa.

John Paulson is now with the Bureau of Reclamation in connection with the Boulder Dam project. His engagement to Betty Jane Gutwein of Pasadena was announced recently, and the wedding will probably take place in the late summer.

Ensign John H. Main is now in charge of aeronautical supplies at the U.S. Navy Yard, Philadelphia, Pa.

Ensign George Todd, U.S.N.R., is now stationed at Fort Schuyler, New York. An announcement of the engagement of Miss Laura Pettway Ellis, of Warrenton, North Carolina, to Ensign Todd was made the latter part of May.

Livingstone Porter, Jr., is resigning his position as geologist and engineer for the U.S. Gypsum Company at Midland, Calif., to take a position as Junior Hydraulic Engineer with the U.S. Geological Survey.

Robert Galeski is with a geophysical party engaged in petroleum exploration in Alberta, Canada.

Dale Turner recently resigned his graduate assistantship in the California Institute of Technology in order to accept a position with the geophysical division of the Superior Oil Company.

Carroll Maninger, who is with the New London Submarine Research Labs in New London, Conn., plans to be in Pasadena the last week of June, and will be married July 1.

Kirk Abbey was married to Miss Mary Helen Rice on April 19 in Phoenix, Arizona. In May he received a commission as Ensign in the U.S.N.R., and will be assigned to work in Radar.

Mr. Richard Pomeroy is the father of a baby girl, Sandra Lee Pomeroy. Sandra Lee arrived April 17.

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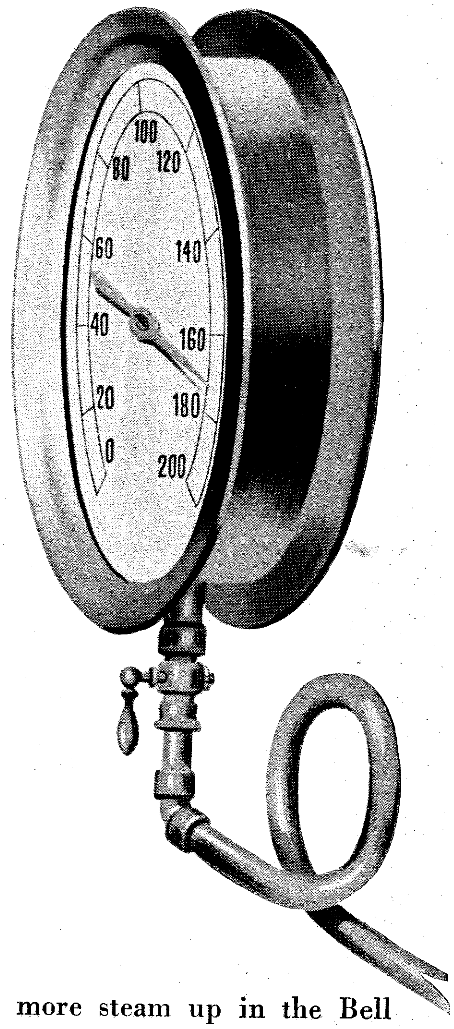

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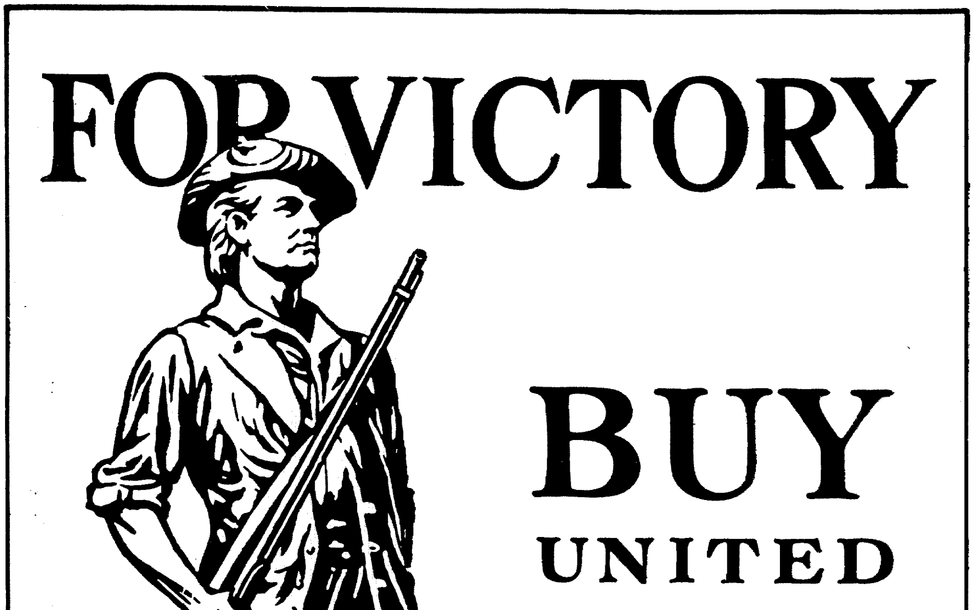
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