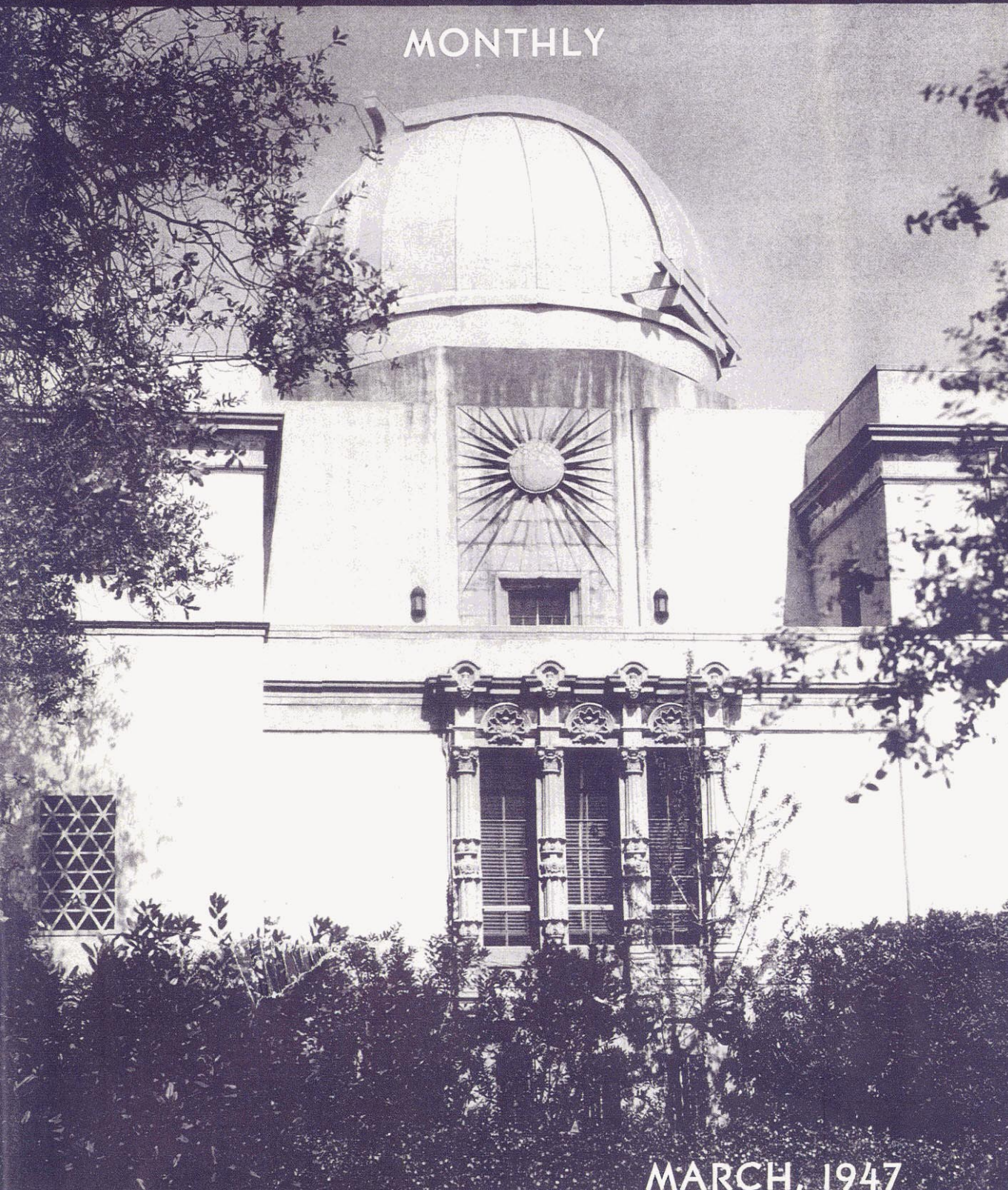


ENGINEERING AND SCIENCE

MONTHLY



MARCH, 1947

Hollywood Wholesale Electric Co.

Distributors of Electrical Supplies and Appliances

"The Mark of Dependability"

Phone HOLLYWOOD 7221

6820 Romaine Street

Hollywood 38

TECHNICAL DESIGN COORDINATOR CO.

Complete Mechanical Electrical Hydraulic Automotive
and Aircraft Engineering Service

Consulting—Research—Design and Development

16218 Ventura Boulevard

STate 4-4905

Encino, Calif.

ANgelus 0580

HOLLYWOOD TOOL AND DIE

"One of the Best Equipped Job Shops in the West"

Tools — Dies — Jigs — Fixtures — Gages
Special Machinery — Metal Stamping

Experimental Work

Also Tooling Development of New Products

6765 Romaine St., Hollywood 38

Phone HOLLYWOOD 3588

Life Insurance

Annuities

LYLE H. CHENEY

New York Life Insurance Company

RYan 1-6191

SYcamore 2-7141

Security Building
Pasadena 1, Calif.

VROMAN'S

Sy: 3-1171 Ry: 1-6669

Books & Stationery

Office Equipment

469 E. Colorado St.

1271 E. Colorado St.

Radio *Specialties* Company
DISTRIBUTORS
RADIOS - APPLIANCES - ELECTRONIC PARTS - EQUIPMENT

Phone PROspect 7271

1956 So. Figueroa

::

Los Angeles 7

SMITH-EMERY COMPANY

Since 1910

Chemical and Physical

Testing Laboratories

920 Santee Street

Los Angeles 15, California

Research Welding Company

Magnesium Aluminum Stainless-steel Hastaloy

SPECIALISTS

Jet Assemblies Components

101 West Spring Street, Long Beach
Nevada 62205

Laboratory

BALANCES

We have in stock a
large assortment of
laboratory balances.

- AINSWORTH Analytical Balances
- BECKER Analytical Balances
- TORSION Balances
- ASSAY Balances
- BALANCES — General Utility and for special applications

*Let us help you select
the right balance for the
work you are doing.*

BRAUN CORPORATION

2260 EAST 15TH ST., LOS ANGELES, CALIF., U. S. A.

San Francisco, California
BRAUN-KNECHT-HEIMANN-CO.



Seattle, Washington
SCIENTIFIC SUPPLIES CO.



A Quarter Century
of Leadership

1st In the manufacture of:

Plaster Mixers
All Steel Concrete Mixers
Two-Man Suction Dredges
Steel-Frame Contractors Hoists

Leaders In the manufacture of:

Evaporative Air Coolers
Road Rollers
Air-Power Weed Spraying
Equipment
Portable Paint Spraying
Equipment
Self-Priming Pumps

ESSICK MANUFACTURING CO.

TUcker 5144

1950 Santa Fe Ave.

Los Angeles 21

BY-LINES

DAVID F. WELCH

Mr. Welch received his A.B. degree in mechanical engineering from Stanford University in 1941 after combining several years of production and design experience with his college work. In 1939 he was in the production control department of the Sperry Gyroscope Company, and in 1940 he was design assistant for the Singer Sewing Machine Company. After graduation he was engaged in general manufacturing with the General Electric Corporation.



Coming to the California Institute, he received the I.D. or professional degree in industrial design in 1943. He is at present instructor in industrial design and engineering drafting at C.I.T., and a partner in the Industrial Design Associates, a Pasadena consulting firm.

COVER CAPTION

The south end of the Henry M. Robinson Laboratory of Astrophysics, erected in 1932 with funds provided by the International Education Board and the General Education Board. This building houses the Astrophysical Observatory offices, the Astrophysics Library, Graduate School administrative offices, Industrial Design offices, classrooms and laboratories, the graphic arts department and the photographic laboratory.

This building holds the record on campus for the greatest depth, having a pit extending 75 feet below the level of the first three basements. This shaft was constructed as a part of the late Dr. George E. Hale's work with solar telescopes. Designed to accommodate a spectograph, work was halted when the Palomar lens arrived in 1936. Dr. Hale died shortly afterward and work on the solar telescope has never been resumed.

Mr. Robinson, for whom the Laboratory is named, was for many years a trustee of the California Institute of Technology, vice-president of its Board, and a member of the Executive Council. He was also chairman of the board of directors of the Huntington Library and Art Gallery and of the Huntington Memorial Hospital. His interests were varied. At the time of his death in 1937, he was the only layman serving on the observatory council of the Institute. Mr. and Mrs. Robinson presented the Charles Arms Laboratory of the Geological Sciences to Caltech 10 years ago. In his will, Mr. Robinson left a \$50,000 endowment to the Department of Physics, and after certain other bequests, the balance of his estate to the operation and maintenance of the 200 inch telescope on Mount Palomar.

MARCH, 1947

ENGINEERING AND SCIENCE

Monthly



The Truth Shall

Make You Free

CONTENTS FOR MARCH, 1947

Industrial Design at the California Institute	3
<i>By David F. Welch</i>	

C. I. T. News	11
---------------	----

Alumni News	16
-------------	----

ENGINEERING AND SCIENCE MONTHLY

Published at the California Institute of Technology

PUBLICATIONS COMMITTEE: Hugh F. Colvin '36, Chairman; Raymond D. Andrews '15; Harry K. Farrar '27; Robert G. Smith '31.

EDITORIAL ADVISORY COMMITTEE: Hugh F. Colvin, Chairman; Professor George W. Beadle, biology; Professor Robert D. Gray, industrial relations; George H. Hall, administrative assistant to the President; Langdon Hedrick, President, ASCIT; Professor Richard H. Jahns '35, geology and geophysics; Professor William H. Pickering '32, electrical engineering; Professor J. E. Wallace Sterling, humanities; Professor Ernest C. Watson, physics and mathematics.

EDITORIAL CONSULTANT: Professor of English George R. MacMinn.

STAFF:

Editor-in-Chief—Hugh F. Colvin, '36 Business Manager—Wesley P. Bunnelle
Managing Editor—Wesley P. Bunnelle Circulation Manager—W. D. Sellers, '25
Associate and News Editor—Jean Barker

ENGINEERING AND SCIENCE MONTHLY is published monthly on the 25th of each month by the Alumni Association, California Institute of Technology, Inc., 1201 East California Street, Pasadena, California. Annual subscription \$3.50, single copies 35 cents. Entered as second class matter at the Post Office at Pasadena, California, on September 6, 1939, under the Act of March 3, 1879. All Publishers' Rights Reserved. Reproduction of material contained herein forbidden without written authorization.

INDUSTRIAL DESIGN AT CALTECH

ENGINEERING AND SCIENCE

Monthly

Vol. X, No. 3

March, 1947



Industrial Design at the California Institute

By DAVID F. WELCH

THE question has often been asked as to how the Industrial Designer fits into a product development program, particularly in a large manufacturing organization with a competent staff of research engineers and machine designers within its own engineering department. To answer this question it is first necessary to define in a broad sense the generally accepted meaning of Industrial Design. Then we may illustrate specifically how the Industrial Designer's services are integrated into a well thought out development program for any product from a machine tool to a household vacuum cleaner. The term Industrial Design, relative to consumer products, has come to mean design for mass production with particular emphasis on appearance and consumer needs. These needs or functional requirements and trends in aesthetic tastes are established by careful selective research, not by whim or fancy on the part of the designer. Today, the manufacturer cannot afford to gamble on the marketability of a particular model or

product which may have cost thousands or even millions of dollars to "tool up" for production.

As an analogy we might compare the relationship of the Industrial Designer to the Product Engineer or Machine Designer with that of the modern Architect to the Structural Engineer. The good architect designs his building about its functional requirements and above all about the human activities which it is going to enclose. He is deeply conscious of proportional relationships in the structure itself and is an expert in fully utilizing the inherent beauty of his building materials. He is definitely not trying to apply period ornament to achieve a beautiful building. His work is done in conjunction with that of the structural engineer, not before or after the basic structure has been designed. It is not the architect's job to beautify a reinforced concrete building designed only from a structural standpoint by an engineer, nor is it the engineer's lot to devise some elaborate structural scheme to make an architect's dream possible to construct.

Design lecture in the drafting room. The instructor and students discuss design features involved in comfortable seating as part of the development of the problem in wooden furniture.



MARCH, 1947

Working together they have achieved a dynamic beauty which we find in many of our skyscrapers, bridges, and super-highways.

The Industrial Designer brings a thorough consideration of the human elements and consumer preferences into product design. It is his part to incorporate in the design all factors which will make the product safer, more convenient, easier to use, and more attractive to the potential consumer. These factors he determines from a careful study of the product in use as well as from other research data he may gather. Again, his specialized training in aesthetics, in addition to a fundamental knowledge of materials and processes, enables him to achieve a beauty of form and texture in the finished product which is not mere coincidence. Working with the engineer from the earliest design conception is essential in order to approach an ultimate in good design. The Industrial Designer today does far more than merely styling or dressing up an engineer's working model. An engineering department consisting of research men, machine designers, and draftsmen is no more qualified to completely design a household appliance for competitive marketing than an Industrial Designer would be able to design a centrifugal pump or some highly specialized electronic device. Together, they can attain the same degree of perfection in product design that the architect and the structural engineer have accomplished in many of their works. To work effectively together, each must have a clear understanding and a sincere appreciation of the other's problems.

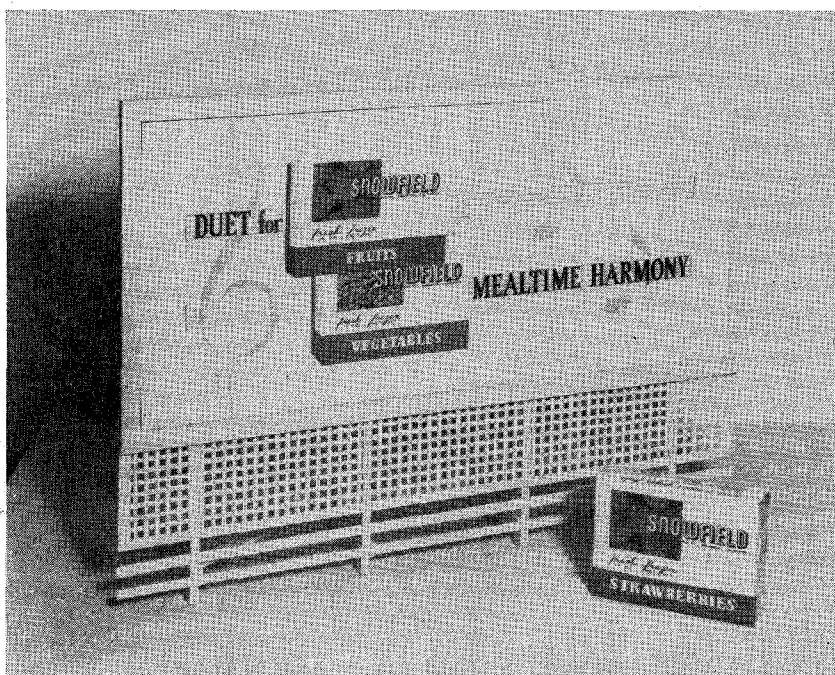
Industrial Design is a relatively new profession. In fact it has been legally established as a profession only since 1944. Instead of its arising during the early years of the Industrial Revolution, as one might think, it was not until the year 1919 that the beginnings of Industrial Design could be perceived. At the Bauhaus in Weimar, Germany, a progressive group of artists, architects, and craftsmen made the first organized effort toward utilizing some of the aesthetic possibilities in new materials and mass production methods. The first tubular furniture and so-called "modern" lighting fixtures were designed and fabricated in quantities by the Bauhaus group. Chrome tubing and spun

sheet metal were used for the first time as materials beautiful in themselves without any effort to imitate traditional wood furniture or ornate candelabra. America did not feel the influence of this group to any extent until the middle twenties, when a few manufacturers began to call in artists, sculptors and stage designers to help them improve the appearance of their products. From this phase the profession developed rapidly, until today we find a number from this original group, particularly those who were quick to learn manufacturing techniques in evaluating new materials, and who were sympathetic to manufacturing problems, as leaders in the profession.

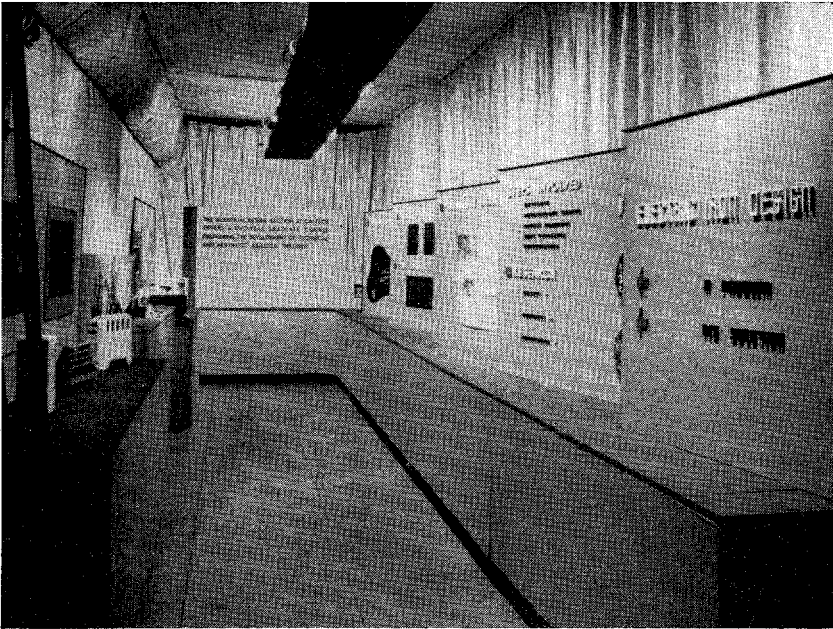
In 1944, the ground work was laid for a professional organization, the Society of Industrial Designers, whose purpose was to raise the general quality of design work done in this country, and to protect manufacturers as well as the profession itself by limiting membership to qualified designers. There are approximately fifty members of the Society at the present time, with the large majority in the New York and Detroit areas. The Society is definitely encouraging education in the field of Industrial Design and is strongly advocating technical training in engineering or architecture as a background for further study rather than in commercial or fine arts.

The scope of services offered by the Industrial Designer varies widely. Many of the larger offices now handle product development from the research stage through to production, package design, advertising, and even designing the merchandising outlets. Many specialize in the design of transportation equipment and interiors, including aircraft, ships, trains, buses, and automobiles.

Most of our very large corporations have found it necessary to establish their own Industrial Design departments. Many other organizations, large and small, will call in an Industrial Designer on individual products and in some cases even send out several key engineers to work in the Designer's office as the project is carried on. Today, the small manufacturer is finding it more necessary than ever to call on the services of an Industrial Designer. His need is almost



Package and billboard, representing the solution of a problem involving co-relationships between the product, the package, and its advertising medium. This problem marks the transition point between two and three dimensional design discussion in the classroom.



Problem solution of the presentation of a series of exhibits designed to show the idea of the steps in developing all of the phases of a product design. This exhibit was a group project.

imperative because of his difficulty in competing with the large manufacturer on purely a price basis. Even now, our consumers and particularly the buyers for large organizations are becoming much more critical and demanding more quality and consumer appeal in their goods. Soon price will again play its important part in a highly competitive market, and the small manufacturer's only hope is to have an entirely unique, a better, or a more attractive product to justify his higher manufacturing costs. A good many small manufacturers, particularly those who have grown up during the war, are planning ahead wisely and are now anticipating this inevitable highly competitive market and calling in the Industrial Designer.

To illustrate specifically how the Industrial Designer fits into a product development program let us break down a typical program into its various stages, showing his relationship to each. Assuming that a large organization manufacturing commercial refrigerators is interested in producing a small household deep freeze unit, a development program might be set up as follows:

1. **Market Research:** Carried on by Sales Department.
Purpose: To evaluate competition, anticipate prospective volume of sales and locate best markets.
2. **Consumer Survey:** Carried on by Sales Department under guidance of Industrial Design.
Purpose: To determine popular sizes, price ranges, details of usage such as which foods are most frequently stored, which most frequently sought, location of unit kitchen, porch, garage, color preferences, etc.
3. **Engineering Research:** Engineering and Research Departments.
Purpose: To study physical principles, materials, processes, etc.
4. **Report and Conference Integrating all Facts Found:** Sales, Engineering, and Industrial Design.
Purpose: To provide a sound basic foundation for preliminary design.

Discussion of new materials and merchandising methods around the conference table as a preliminary to their selection for a newly designed product.



Redesign from a functional point of view of the conventional electric food mixer.

5. Preliminary Design: Engineering and Industrial Design.

Purpose: Formulation of basic ideas into a working design to incorporate all practical sales features advocated in research.

6. Conference: Executive, Sales, Engineering, and Industrial Design.

Purpose: Modification and suggestions on preliminary design.

7. Layout Drawings: Engineering and Industrial Design.

Purpose: Completion of mechanical design, development of basic form, specification of hardware trim, and finishes.

8. Detail Drawings: Engineering.

Purpose: Preparation of production drawings.

9. Cost Estimates: Engineering.

10. Working Model: Engineering.

11. Presentation Drawings: Industrial Design.

12. Full Scale Appearance Model: Industrial Design.

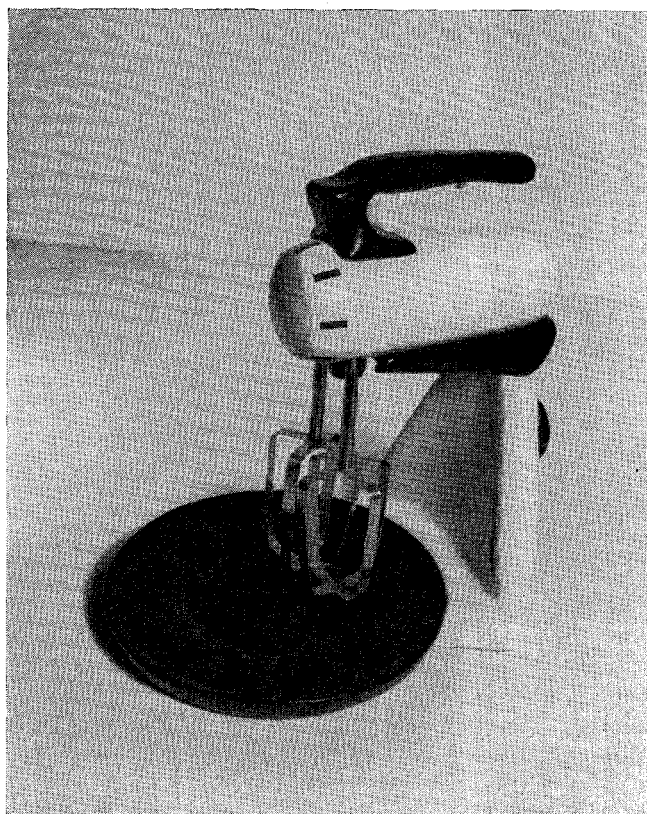
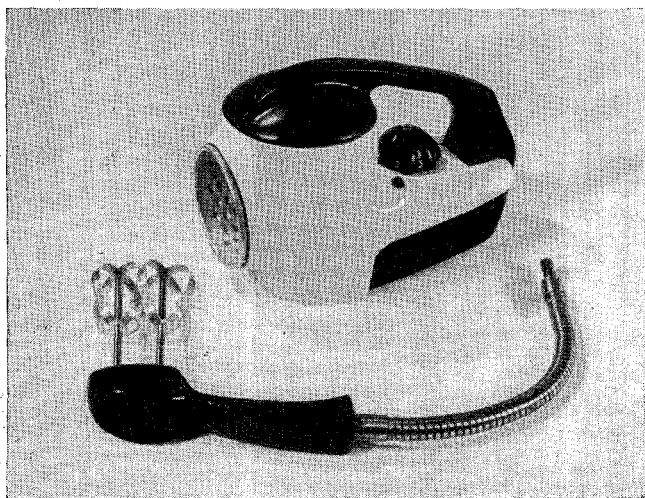
13. Conference: Executive, Sales, Engineering and Industrial Design.

14. Pilot Production Model: Engineering and Industrial Design.

15. Design Modifications or Changes: Engineering.

16. Final Product.

It can be readily seen from the rather typical program outlined above how the Industrial Designer works along with the Sales and Engineering Departments from the very earliest stages through supervision of any final changes necessary on the production model which may affect the appearance of the product. Experience has proven this type of relationship between the Industrial Designer and manufacturing organizations to be by far the most satisfactory, whether the Industrial Designer is a part of the organization's staff or is called in as a consultant.



In a bulletin on the subject of Design Education sent out by the Society of Industrial Designers, Mr. Philip McConnell, Executive Secretary, has indicated a growing demand for designers who have a sound technical background along with their more specialized training in design. This bulletin was based on information obtained from questionnaires sent out to a number of Industrial Design firms throughout the country in an effort to estimate the recent growth of the field and probable future expansions. Mr. McConnell states in his bulletin, "The mere fact that in 22 firms which answered our questionnaire there were positions (available) for 66 trained designers is an indication that sufficient training is not available." Elaborating on that training he further states, "An Industrial Designer's training must make him a specialist in forms and shapes and their historical development, an imaginative specialist in the psychological problems of the consumer and consumer's relationship to the things he uses, and an expert on materials and processes of manufacturing. Any course of training which purports to prepare a student for a career as an Industrial Designer is seriously deficient if it does not equip (him) to work in each of the three branches of the field, and to synthesize them in his own practice."

Redesign of the electric food mixer as the result of a study of the operations required in the preparation of a meal. This appliance incorporates a food grater.

Emphatic criticism of many schools offering Industrial Design has been made by heads of some of the large design organizations on the grounds that so many recent graduates are no more than accomplished renderers. Some have stated preferences for architectural or engineering graduates as being better material for their staff, despite their lack of training in Industrial Design. In his book *Design This Day*, published in 1940, Walter Dorwin Teague gives the following advice to prospective students in Industrial Design: "Take your technical training as architect or engineer, and franchise that is necessary, still, to practice in these fields. But keep your mind on general principles rather than on minute details, and keep your eyes on everything that is going on around you in the world of beautiful—significant—form. So into factories, work in modern industrial plants, study machines and learn how things are made today, and for God's sake remember that slide rules and handbooks are tools and not vocations."

The two-year graduate course given in Industrial Design at the California Institute of Technology is the most advanced in this country. It has been very carefully planned to meet the high requirements demanded by the profession today and offers a working solution for the many legitimate objections to the numerous art school courses being given in Industrial Design. To qualify for admission the student must not only have a natural aptitude for art and design, but must also be a graduate of high standing in engineering or architecture, which provides a good background in fundamental engineering. As a rule the student with this undergraduate background has had little or no formal training in art, presentation of techniques, design, or aesthetics, so rather intensive study in these fields is emphasized in conjunction with each design problem.

The two-year course itself is planned around a series of design problems beginning with a two-dimensional problem on paper, such as an advertising poster, and progressing on to design problems in wood, ceramics, glass, plastic, die casting, and sheet metal. Second-year work consists of more complex problems involving many combinations of materials in the fields of heating, ventilating, lighting, interior and exhibition layouts, and is climaxed by a thesis problem of the student's own selection, to be very thoroughly developed from the first market survey through a final working model.

A sound basic approach applicable to any design problem is introduced at the very beginning and stressed over and over again in each problem as outlined below:

1. Careful study and analysis of the problem at hand
2. Fundamental Research
3. Market and Consumer Research
4. Preliminary Design
5. Engineering Layouts
6. Final Presentation of Color Rendering
7. Full Scale Model
8. Cost Estimates
9. Seminar Presentation to a jury of Experts.

Coordinated with the work in each design, the student simultaneously receives instruction in other phases of the problem, such as the physical characteristics, the production aspects, aesthetic possibilities and relative costs of the materials being utilized. The merchandising problems, business aspects and current design trends are also studied in conjunction with the problems. For example, during the development of a wood frame dinette chair, first the basic problem of comfortably supporting the averaged-sized body is thoroughly analyzed: then the physical properties of various woods, structural joints, lamination techniques, relative costs and surface finishes, as well as various cushioning and covering materials are taken up in the non-metallic materials course. Mass production methods in furniture manufacture are studied and an actual full scale model is fabricated. This model is finally rated by a group of experts for comfort, aesthetic appeal, strength, and relative cost. Visits are also made to one or more local furniture manufacturing plants and furniture retailing establishments in order to gain additional background for the problem.

The following typical problem recently completed by students in the Industrial Design Section will serve to illustrate graphically how the student is brought into close touch with actual problems he will be encountering later as a professional man. This particular problem was carried out in conjunction with the Plumbing Division of the General Tire & Rubber Company in Pasadena, over a period of five weeks. Several representative solutions in the form of full scale models, each worked out by an individual student, are shown in the accompanying illustrations. It is to be noted that definite requirements have

Model development in the Industrial Design Laboratory as a test of the preliminary research and drafting room studies.



been set up for the completion of every problem and a complete solution is required in each case. Upon completion of each problem the student presents the results of his work to a jury composed of experts in each phase of the problem from the technical end through merchandising. A major difficulty in problem planning has been to encourage initiative and ingenuity on one hand and yet to end up with a sound and thorough solution, perhaps a little in

advance of what production economics might allow today, but definitely more than a dream of things to come. In each problem, the limitations which industry would place on the particular design are pointed out, not in a restrictive sense but as more essential factors to consider in the design process. During his training the student can afford to, and definitely must, design a step or two ahead of what he might be allowed in actual practice.

PROBLEM IN CHAIR DESIGN

INDUSTRIAL DESIGN SECTION		
CALIFORNIA INSTITUTE OF TECHNOLOGY		
I.D. 101 A	DESIGN PROBLEM II	FIRST YEAR
WOOD FRAME DINETTE SET		
PRESENTED:	NOVEMBER 8, 1946	
DUE:	DECEMBER 11, 1946	
SEMINAR:	DECEMBER 20, 1946	
<p>STATEMENT OF THE PROBLEM: A furniture manufacturer is planning a low priced wood dinette set consisting of a table and four chairs. The set is to be designed particularly to meet the needs of the returning veterans who are furnishing their own small homes or dwelling units. Comfort, sturdy construction, low cost, and attractive appearance are primary requisites of the design. The chair should be designed first and will be used as a basis for the style or feeling to be carried out in the construction of the table. The seat of the chair and possibly the back support may be cushioned for additional comfort.</p>		
<p>REQUIREMENTS:</p> <ol style="list-style-type: none"> 1. RESEARCH <ol style="list-style-type: none"> A. STUDY OF GENERAL REQUIREMENTS FOR COMFORTABLE SEATING. B. STUDY OF BASIC DIMENSIONS TO BE CONSIDERED IN DESIGNING FOR THE AVERAGE SIZED HUMAN BODY. C. STUDY OF HISTORICAL AND CONTEMPORARY CHAIR DESIGN. D. STUDY OF LOW PRICED WOODS, JOINT CONSTRUCTION, LAMINATION TECHNIQUES, SURFACE FINISHES, PADDING OR CUSHION MATERIAL, UPHOLSTERY FABRICS AND MASS PRODUCTION METHODS IN FURNITURE MANUFACTURE. 2. PRELIMINARY SKETCHES ON 8 1/2 X 11 SHEETS. 3. QUARTER SIZE DIMENSIONED LAYOUT DRAWINGS OF CHAIR AND TABLE ON TRACING VELLUM. 4. FULL SCALE MODEL OF CHAIR. 5. COLOR RENDERING OF TABLE. 6. PRESENTATION AT THE SEMINAR FRIDAY EVENING, DECEMBER 20, 1946. 		

STUDY FOLLOWED IN DEVELOPING THE DINETTE SET

Research came first. The general requirements for comfortable seating, the basic dimensions to be considered in designing for the average-sized human body, historical and contemporary chair design had to be learned. This was followed by a study of low-priced woods, joint construction, lamination techniques, surface finishes, padding or cushion materials, upholstery fabrics and mass production methods in furniture manufacture.

Lectures were given before the class. "Moulded Plywood Furniture" by

Charles Eames, considered the foremost designer in this relatively new field, was one.

The class took field trips to furniture manufacturers and dealers. Brown-Saltman Furniture, S. Karpen & Brothers, and the Gillespie Furniture Company were visited.

After much research by individual class members and teams, conferences, model making, and more conferences, students constructed full-sized chairs in the laboratory.

At the December seminar, a presentation of final designs was made to a jury consisting of Mr. Percy Solotoy of Brown-Saltman, Mr. Charles Eames, Mr. H. W. Anderson of Gillespie Furniture, and faculty members. Class members showed their chairs and the pictorial renderings of matching tables, and defended their designs. Presentation techniques as well as development were criticized. The industrial designer often has to sell his product.

* * * *

STEPS IN THE DESIGN OF A KNOCKDOWN CHAIR

Local interviews and market research revealed that in the small home the dinette chair often doubles for living room use. This indicated that the design should be more formal and dressier than the usual kitchen chair. This con-



An example of the problem approach given the student is the following study of sink hardware design. The student was asked to consider a local division of a large corporation which is equipped to mass produce sink hardware, utilizing only metal stampings and screw-machine parts in a furnace-brazed assembly. This is a radical departure from the conventional sand or die-cast fixture and the organization wants a distinctive line of fixtures designed around its basic

idea for manufacture. The first items to be brought out will be a "swing spout" for the kitchen sink, a lavatory faucet, and tub fixtures. The designs must incorporate the following features:

1. Functional Improvements over competitive lines
2. Low Cost
3. Distinctive appearance based on functional requirements and the logical use of materials and the manufacturing process.

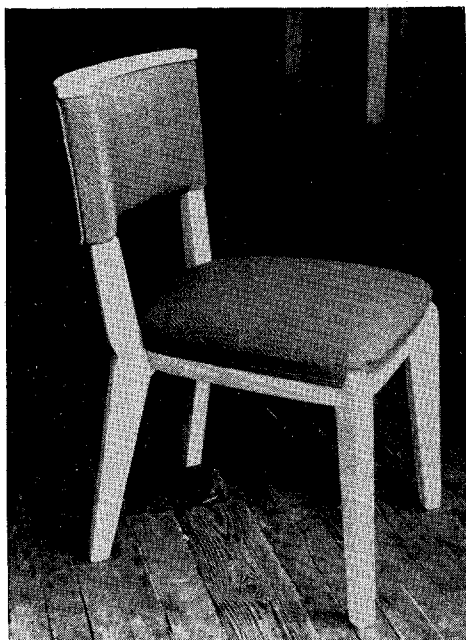
clusion, along with data gathered on the sitting habits and dimensions of the average person served as a basis for the design. The height, size, and tilt of the seat and back were established, and the application of slight padding upholstered with a washable fabric was decided upon.

Materials and methods of manufacture were next considered, from which three premises were evolved. First, it was found that the modern large-scale furniture manufacturer prefers to buy his lumber in trimmed short lengths under three feet, for economies in handling, shipping, and scrap disposal. Therefore each part of the chair was designed to be cut in pairs from a piece 24"x 4"x 1". Secondly, new superior glues and high-frequency curing methods favored an all-glued chair, devoid of screws or dowels. Therefore all joints were designed for mortise or side gluing. Thirdly, the high cost of crating and shipping, combined with the problem of storage space in the small home, indicated that a knock-down chair was desirable. The chair was therefore designed to disassemble into four major sections which could fit into a small carton 4"x 27"x 30". In this way mass production at low cost was made possible.

Based on these premises, the form of the finished model rapidly took shape. The need for a diagonal brace between the legs suggested the formation of the cross-frame made by the two leg sections, achieving maximum rigidity. Each joint was designed to give the most direct support and the greatest gluing surface. Finally,

the radii of the curves and the degree of taper were adjusted to produce the most harmonious effect, and the chair took on the appearance of comfort and stability.

The model proved successful, and a local manufacturer undertook to develop it as a commercial project. Subsequent models were built in his plant with progressive refinements in design and the chair is now being considered for large-scale production.



Chair with wood back and leatherette seat.



Molded plywood chair.

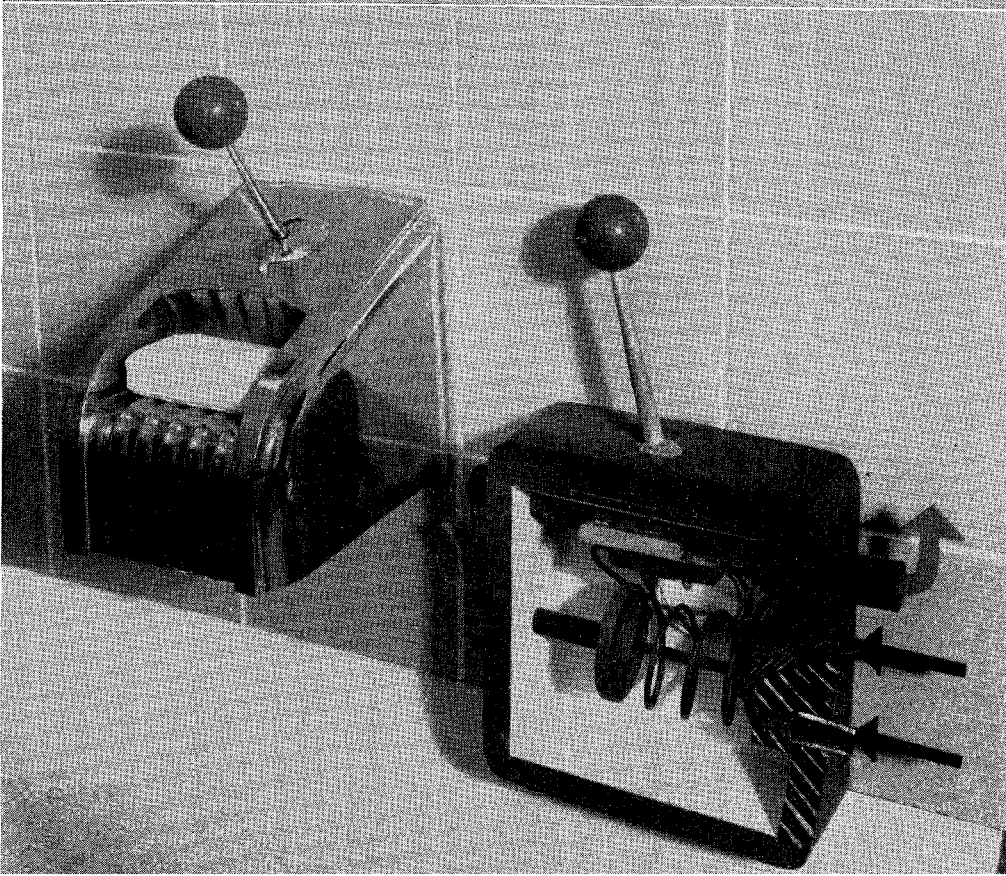
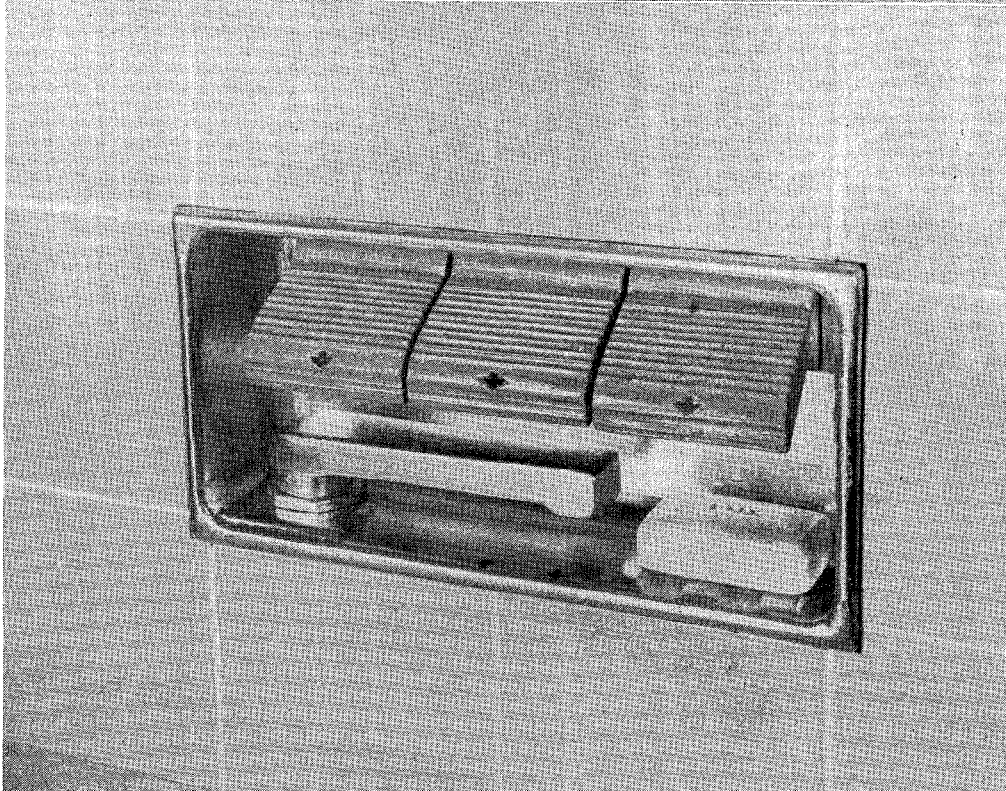
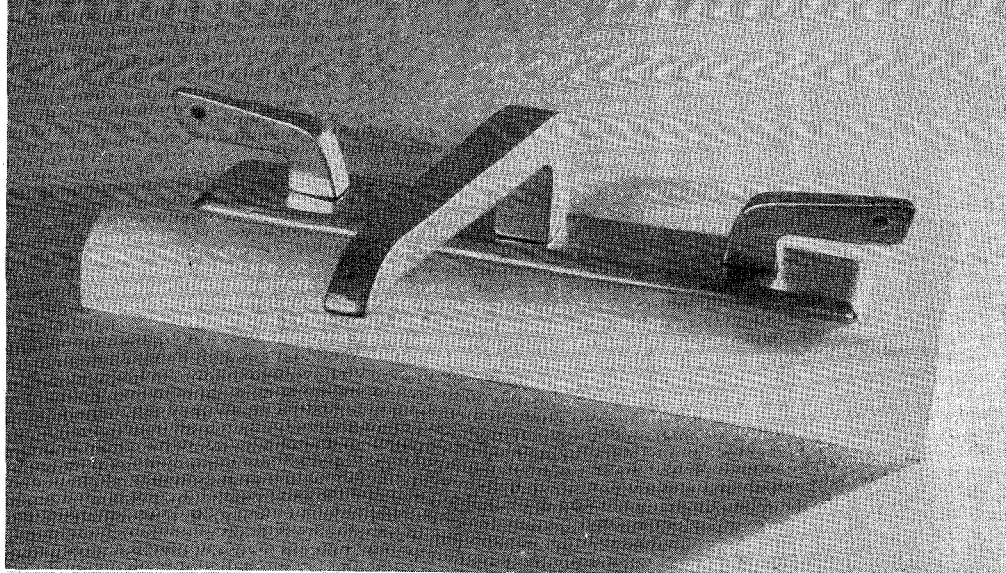
Preliminary sketches must be ready to show the client on May 24, 1946. The student is to consider himself a staff designer in a large office and is to be personally responsible for the complete development of one of the three units listed above. The staff will be divided into three groups. The first group, consisting of two men, will be working on the swing spout, while the remaining two groups, consisting of three men each, will work on individual solutions for the faucet and tub fixtures.

Requirements:

1. Preliminary Research
2. Preliminary Sketches
3. Conference with Client
4. Full size Layout Drawing
5. Presentation Rendering
6. Full Size Mock-up
7. Cost Estimate
8. Presentation Seminar.

There are few aspects of the complex procedure of designing for mass production which the Institute program is not examining. This two-year graduate course in Industrial Design gives the student the opportunity to devote full time to intensive study, and to gather a matured perspective view of the profession's many sides which it might take years to amass in industry itself, or in the employ of other designers. Collaboration with industry itself is constantly maintained in current problems, not only through field trips into factories of the area which are actually producing products similar to those on the Section's drawing boards, but also by participation of experts from those factories in seminars, where the students' solutions are analyzed critically. In addition, consultants are being drawn in frequently from the fields of advertising, merchandising, photography and other subjects as needed for a rounded picture. Another unique aspect of the Institute's program is that all work is being carried on under the guidance and close supervision of practicing Industrial Designers. Student reception has been more than gratifying during the past year, and with the opening of the current year, and with the opening of the current year, applications for admission far exceeded the number of openings available.

UPPER: Model of kitchen swing spout. CENTER: Model of built-in bathtub fixture with swing spout. LOWER: Models of bathtub fixtures and enlarged schematic layout of proposed thermostatically-controlled mixing valve.



C. I. T. NEWS

AMOUNT OF C.I.T. WAR WORK TOLD

ALMOST 25 per cent of the 335 million dollars of war contracts placed with colleges during the war by the Office of Scientific Research and Development was given to the California Institute. The only school to top this figure was the Massachusetts Institute of Technology which grossed approximately 117 million to Caltech's 83. These contracts were given on a straight cost basis, no school making a profit on the research and development undertaken.

TAU BETA PI ELECTION WAS IMPORTANT MARCH EVENT

HOWARD Vesper '22, spoke at the initiation of 28 into Tau Beta Pi this month. One of the highest honors a Caltech student can attain, only those in top eighth of the junior class and top fifth of the senior class are eligible. Membership is not based solely on grades, however, but takes into consideration the character, personality and general campus activities of the candidates. President Lee A. DuBridge and associate Professor of Electrical Engineering Gilbert D. McCann '34 were initiated into the fraternity. It is the policy of Tau Beta Pi to elect not only students but also men who have demonstrated great service and ability in the field of engineering.

Speaker Howard Vesper was a charter member of the Institute's Tau Beta Pi chapter, having been inducted in 1922, the year he graduated. He is now president of the California Research Corporation, research affiliate of Standard Oil Company of California. Mr. Vesper's record as an undergraduate is impressive. He was on the staff of the *California Tech*, student newspaper, for four years, and assistant editor for two. He was on the *Big T* staff for four years, editing this yearbook as a senior. He won his basketball letter three years in a row, was in the Glee Club and Orchestra for four years, publicity manager and on the Board of Control in his junior year. Mr. Vesper also served as football manager and as an officer of the Varsity Club. He was also highest ranking man in his junior class.

Graduating in chemical engineering, Mr. Vesper started working for Standard of California immediately and has progressed to the research corporation's presidency.

Students elected to membership who were inducted after going through a probationary pledge period which included obtaining the autographs of all Tau Betes on campus and writing a technical essay and polishing replicas of the "Bent," fraternity insignia, are Earl Beder, Los Angeles; William Dixon, Milwaukee; Byrne Eggenberger, Temple City; Richard Ferrell, San Francisco; Taylor Fletcher, Temple City; Bruce Gavril, Sand Springs, Georgia; Joseph Green, Los Angeles; William Hammerle, Hamilton, Ohio; Delbert Hausmann; Harvey Holm, Sacramento; Wil-

bur Jarmie, Los Angeles; Warren Marshall, Atlanta, Georgia; Albert McEuen, Los Angeles; Walter Ogier, South Pasadena; John Rasmussen, Pasadena; Carl Rasmussen, Los Angeles; Harvey Roberson, Rocky, Oklahoma; George Scott, Sacramento; Lyle Six, Pasadena; John Swain, Pasadena; Robert Urschig, La Jolla; Robert Walker, San Pedro; John Whittlesey, Los Angeles; Don Wilkinson, Los Angeles; Bill Woodson, Berkeley; and Byron Youtz, Santa Maria.

CHEMISTRY STAFF DEVELOPS OXYGEN MEASURING DEVICE

DEVELOPMENT by the California Institute before Pearl Harbor of a small and relatively simple meter used extensively throughout the war by the Army and Navy for determining the amount of oxygen in gas, was announced recently by Caltech.

The meter was invented by Dr. Linus Pauling, head of the Caltech Division of Chemistry and Chemical Engineering. Collaborating with him were Dr. Reuben D. Wood, now in the chemistry department of George Washington University, Washington, D. C. and Dr. James H. Sturdivant, associate professor of chemistry at Caltech.

Used during the war in planes and submarines, industrial plants, and in the relatively new field of aviation medicine for determining the ability of pilots to stand high altitudes, the meter is now being used for peacetime purposes and is responsible for development of a small, highly technical industry in Pasadena.

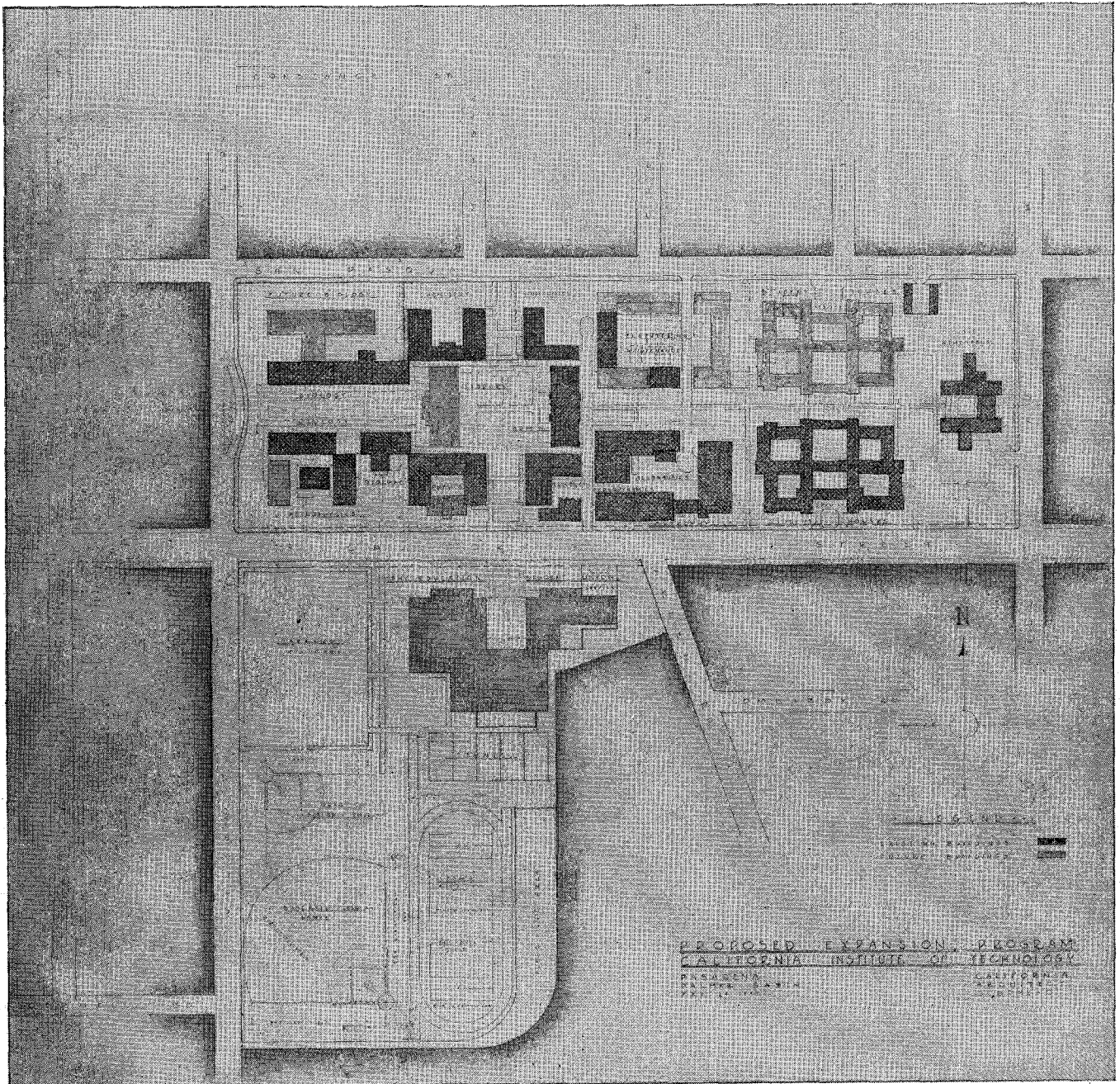
The meter depends on the known fact that oxygen is slightly attracted to a magnet, while most common gases are repelled. The device consists of a pair of very small spheres connected by a slender rod, suspended between the poles of a strong magnet by a filament attached to the middle of the rod. Responses of the spheres to the magnetic pull is conditioned by the oxygen concentration, with the amount and rate of their swing registered by means of a light beam reflected from a small mirror attached to the filament. So small and sensitive is this piece of mechanism that its assembly must be accomplished with the aid of a microscope.

Developed for war-time needs at Caltech under an Office of Scientific Research and Development contract at the request of the National Defense Research Committee, the meter was kept under wraps until the end of the war and has since been further developed. The first few dozen of the instruments were manufactured at Caltech after which the contract for their production was turned over to the A. O. Beckman Company which established a plant in Pasadena for their production.

Meters of this type are now being used throughout the country by hospitals in administering anaesthetics in which oxygen is given with the anaesthetic to the patient. By use of the Pauling Oxygen Analyser, its trade name, those administering the anaesthetic can determine at all times the amount of oxygen the patient is getting and thus be assured that it is sufficient.

Industrial plants are using the meter in manufacturing processes where oxygen and other gases are used.

CITY OF PASADENA VOTES TO SELL TOURNAMENT PARK TO CALTECH



THE first step in an expansion program that has been projected in order to meet Caltech's anticipated needs for the next 25 years was taken in March when, by a majority of better than three and one-half to one, the voters of Pasadena approved abandonment of Tournament Park and its sale to the Institute.

Plans for the use of the park call for making it the center of all student activities. Buildings to be placed on the property will be a gymnasium and swimming pool and student union building. Present athletic facilities will be retained but tentative plans call for their relocation so as to best use all the space available and also to provide parking facilities for at least 400 automobiles.

At the present time the park, which has been used by Caltech Student since 1910 as an athletic field, has a baseball diamond, tennis courts, dirt volleyball and basketball courts, and a football field and track, the latter known as Paddock Field. Named in honor of Charlie Paddock, Pasadena's greatest athlete, that facility will continue to carry his name. The baseball field, once used by the Chicago Cubs for spring training, is now located in the northwest corner of the park.

Tentative plans for relocation of athletic facilities envision two baseball diamonds in the southwest section of the park, with Paddock Field moved to the southeast section and running north and south instead of east and west as it now does. Just north of Paddock Field will be the tennis courts and north of them,

facing California Street and the present campus, will be the new buildings.

A student committee to assist the Institute in determining desirable facilities for the Student Union building is to be appointed. Members of this committee will be asked to visit similar buildings on other campuses during the summer months and bring back recommendations for the Caltech facility.

Parking space for automobiles is now planned for the northwest section of the park with entrances and exits off Wilson avenue.

Plans will remain tentative until such a time as the City government advises the Institute as to what portion of the park it wishes to retain for development of a small neighborhood park. Tentative plans were drawn upon the assumption that the small picnic grounds in the southeast section of the property would most likely be retained for this park.

Institute plans also call for use of property which it has owned for several years adjoining the park property on the north along California Street and running from the park boundary line to Arden Road. This property would be used for the Student Union building.

In addition to the Tournament Park development, plans have also been made for utilizing all space now available on the campus. These call for additional student housing on the San Pasqual side of the campus and directly across from the present dormitories, additional mechanical engineering facilities, another wing to the biology building, an auditorium capable of accomodating the entire student body, a central library and a small addition to the Bridge physics laboratory.

The proposed library building will be parallel to Throop Hall on the west portion of the campus and between physics and chemistry laboratories.

The auditorium, as now projected, will be located on the northwest corner of the campus just west of Culbertson Hall.

This building program will necessitate razing of several old buildings, including the old dormitory, campus cafeteria, soil conservation laboratory, internal combustion laboratory, Throop club and a number of other existing temporary structures.

It is anticipated that completion of the Tournament Park and campus building program will require several years, depending of course, on funds available for construction. Priority will be given the facilities planned for Tournament Park and the addition to Engineering.

PROFESSOR VOTED CRYSTALLOGRAPHIC COUNCILLOR

DR. GEORGE Tunell, acting associate professor of minerology and metalliferous geology was elected to the office of Councillor of the Crystallographic Society at its March meeting in Annapolis, Maryland.

Crystallography is the science of the interatomic arrangement of matter, its causes, its nature and its consequences. The Society provides a meeting ground for the discussion of mutual problems and fosters development of the science.

Dr. Tunell, who is on a year's leave of absence from the Geophysical Laboratory of the Carnegie Institute of Technology, has been serving in his present post at C.I.T. since October, 1946.

DUBRIDGE ELECTED PHYSICAL SOCIETY PRESIDENT

PRESIDENT Lee A. DuBridge was elected president of the American Physical Society at the Council Meeting of that organization. Dr. Robert Oppenheimer, professor of theoretical physics at both the Institute and the University of California, was elected vice-president.

TECH JUNIOR WILL REPRESENT THIS AREA IN A.S.C.E. JR. MEETING

IRVING Sulmeyer, California Institute junior in civil engineering, will represent Southern California in the Southwestern Conference meeting of the Junior Forum of the American Society of Civil Engineering at Phoenix, Arizona, 25 April, as the winner of an elimination contest held recently in this area.

Sulmeyer earned the right to represent the Junior Forum at Phoenix when his paper on "Pride and Unity in the Engineering Profession" was adjudged best in a contest between Caltech and U.S.C. representatives.

As winner of the contest he was awarded \$25 in cash and will receive his transportation expenses to the Phoenix meeting.

LACEY WENT EAST TO RECEIVE LUCAS AWARD

DR. WILLIAM N. Lacey, professor of chemical engineering at Caltech, received the Anthony F. Lucas Gold Medal for 1947 at presentation ceremonies Wednesday, 19 March, in New York City where he attended the 75th anniversary banquet of the American Institute of Mining and Metallurgical Engineers.

Dr. Lacey was advised some time ago that he had been named for the Anthony F. Lucas medal. The citation stated that the award was made for "his distinguished achievement in directing research work in the fundamentals of hydrocarbon behavior and particularly his application of these fundamentals to oil and gas reservoirs which have led to greater efficiency in oil and gas production from our oil fields; his published data have been of immense value to the petroleum industry in determining improved producing procedures for the various types of oil and gas reservoirs."

Dr. Lacey presented a paper at the AIMME meeting on "Phase Behavior in the Methane-Ethane-n-Pentane System" prepared by him, Dr. Bruce H. Sage, professor of chemical engineering, and G. W. Billman, graduate student in chemical engineering.

The paper concerns a study of mixtures of interest to natural gas and gasoline industries and petroleum refining.

ENGINEERING RESEARCH LABORATORY BOUGHT

SALE of the Cutter Research Laboratory to the California Institute of Technology for a nominal consideration was approved by the Los Angeles office of the War Assets Administration in February. Constructed on land on South Raymond Avenue in Pasadena, owned by the Institute, the laboratory is a stucco building 60 by 60 feet, containing various scientific items and testing devices. The installation was used during the war for research connected with designing and operative techniques of milling machines and was reported to have cost the government \$100,158 to construct.

DEAN JONES WILL CONTACT ALUMNI AND PROSPECTIVE STUDENTS ON APRIL TRIP



ASSOCIATE Dean for Upperclassmen and Registrar, L. Winchester Jones, will extend a pre-war function by traveling East in April to interview applicants for admission to the freshman class, and to speak to Alumni groups in several cities. Before the war, members of the admissions committee interviewed prospective freshmen outside California, but this practice was discontinued when wartime travel difficulties interfered. In

addition to the resumption of eastern interviews this spring, Alumni contacts are planned as a part of the Registrar's extended trip.

The problem of admissions liaison for students outside the Southern California region has long been a difficult one, and as more and more students from all over the United States apply for admission to the California Institute, the problems of giving information to prospective students, administering entrance examinations, and subsequently interviewing prospective candidates have increased. Alumni can help solve these difficulties in two ways:

Administration of examinations in eastern cities is always a problem. There are usually 10 or 12 candidates, and obtaining a central point for administration as well as an administrator who will give two three-hour examinations on each of two Saturdays is a task. What the Institute proposes to do is to secure help from Alumni groups in several cities who can find a room in which to give the test, and who will arrange for the actual administration of the examination. All expense would be borne by the California Institute, while the Alumni will be asked to take the responsibility of giving the examinations.

Besides helping give Institute entrance examinations to high school seniors, Alumni outside the Southern California area will be requested to arrange contacts with high school instructors in mathematics, physics and chemistry, and to be ready to aid with any contacts student or school would like to make with the Institute.

It is emphasized that these prospective relationships are not being developed as a drive for more students at the Institute. The size of the entering classes is fixed, and usually of applying high school students, only those with excellent academic records are permitted to take the entrance examinations. This year there were 800. Of this group 180 will be chosen for the freshman class. Normally the class size is limited to 160. The Institute is striving for students of still higher all-around quality and general personality. Scientists and engineers, it has been found, must be able to do more than operate slide rules after graduation.

Dean Jones plans to meet with five Alumni groups on his trip. Starting on 15 April, his plans for meetings are as follows:

Chicago, Illinois: 17 April
Schenectady, New York: 19 April
Boston, Massachusetts: 21 April

New York City, New York: 24 April
Pittsburgh, Pennsylvania: 1 May

An attempt will be made to interview all students in the vicinity of his scheduled stops. The Dean will go as far south as Washington, D. C., and hopes to talk to a few applicants in Virginia.

By the time he has returned on 4 May, other members of the admissions committee will have covered Northern California, the San Joaquin Valley, San Diego and the Imperial Valley, and the local Southern California area. On the basis of examinations and interviews, 180 students will be informed early in June that they are to be admitted to the Institute with the class of 1951. Students who have shown by their examination records that they would meet with more success in a different type of school will be so informed at the time of the interview by a member of the admissions committee.

PAULING TO RECEIVE DEGREE FROM CAMBRIDGE

DR. LINUS Carl Pauling, professor of chemistry for 25 years has been selected with eight other candidates for degrees by the senate of Cambridge University, Cambridge, England. The degrees to be conferred upon Dr. Pauling by the University is the Doctorate of Science. Dr. and Mrs. Pauling will leave late in May for Cambridge.

DEAN THOMAS APPOINTED TO RIVER BOARD

PROFESSOR Franklin Thomas, recently resigned as vice-chairman of the Metropolitan Water District in which he had for many years played one of the key parts in bringing Colorado River water to Southern California, found himself early in November back on another river water commission.

Professor Thomas was appointed to the Colorado River Board of California, replacing W. P. Whitsett of Los Angeles. He will represent the Metropolitan Water District.

FACULTY MEMBERS HELP WITH ENCYCLOPEDIA

THREE members of the Institute faculty have made their first contributions to the Encyclopedia Britannica, writing for the 1947 revised printing of the reference work.

New contributors from Caltech and their topics are: Eric Temple Bell, professor of mathematics, who wrote and revised 23 articles in his field of interest; Jesse William Monroe DuMond, associate professor of physics, "Nature of X-Rays," and Aristotle Demetrius Michal, professor of mathematics, "Differential Forms" and "Tensor Analysis".

A revised printing of the reference work has been published each year since 1932 when the policy of continuous revision replaced the old "edition" system.

JAHNS OF GEOLOGY ELECTED TO SOCIETY POST

DR. RICHARD H. Jahns '35, associate professor of geology at Caltech, was elected vice-president of the Branner Geological Society of Southern California at its annual meeting held recently on the Caltech campus.

BASKETBALL REVIEW

THE end of the basketball season saw Coach Carl Shy's Engineers in the middle of the scoreboard with seven wins and seven losses. In the five-school Conference, Caltech tied for third with Redlands.

Guard Harry Moore was picked for the all-conference second team, and Center Paul Saltman holds an alternate berth on that group.

TRACK SEASON HAS UPS AND DOWNS

THE track season started well with the Beavers winning the conference relays at Occidental College. The meet was close the entire way, and with only the mile relay to be run, Tech led Oxy by a scant 2/5 point. The meet hinged on which of the two schools placed higher, as the next team in the running trailed by six points, too great a margin to make up by winning the race. Occidental built up a 20 yard lead on the first lap, which was cut to seven by Stan Barnes with a 51.8 second round of the track. On the last lap Ken Shauer caught his Oxy opponent on the back stretch, passed him on the turn, and finished five yards ahead. The fact that Pomona won the race was incidental.

Three of the five first places gained by Coach Doc Hanes' Beavers were taken by the Junior Varsity relay teams, which won every event for their class; the four man 880, the sprint medley and the mile.

The Beavers have been doing less well in dual meets, however, with losses to Occidental, Redlands and Pomona. The Tigers strong, well-balanced team took all places in the high hurdles, high jump, and two mile events. Ken Shauer, running on a bad leg which kept him out of later events, won the 440 in 50.3 seconds. Don Tillman was high scorer with a win in the discus and second in the shot put. Stan Barnes and Herb Sims took the first two places in the 880.

Bad luck continued the next weekend as Redlands nosed Tech out 66½ to 64½. The Engineers won eight first places to the Bulldog's five, with ties in two events. Shauer won the 440 again in 50.3 seconds. Stan Barnes took the 880 in 2:03.6. Distance events continued to give the Beavers trouble as Redlands swept the mile and two mile events. Don Tillman took a double win in the discus and shot put.

Pomona College also bested the men from the Institute 86-45. Highlight of the afternoon was Shauer's 48.8 440 which set new school and Conference records. Tillman came through in the shot put with a heave of 46 feet, 7 inches.

The same afternoon Pomona engaged in a second dual meet with Redlands, the Sagehens being victors to the tune of 69½ to 62½.

Doc Hanes' team will take a rest until the first Saturday of the Spring Term, when they meet Santa Barbara and U.C.L.A. in a three-way non-league contest at Westwood.

TRACK SCHEDULE

Saturday	5 April	Caltech & Santa Barbara	at U.C.L.A.
Saturday	12 April	Whittier	at Caltech
Saturday	19 April	Conference Meet	at Redlands

BASEBALL TEAM IS NOW PLAYING PRACTICE GAMES

WITH seven practice games scheduled before conference play starts, the baseball team is getting regular practices. Losing the first practice game to Pasadena Junior College, the Beavers, under the tutelage of Coach Harold Z. Musselman beat Muir Junior College 10-3, and then were downed by Compton.

Three more practice games will be played during the week-long vacation with the seventh game on Spring Term registration day, Monday, 31 March.

BASEBALL SCHEDULE

Monday	31 March	3:00 p.m.	Cal Poly	at Caltech
Saturday	5 April	2:15 p.m.	*Caltech	at Whittier
Saturday	12 April	2:15 p.m.	*Occidental	at Caltech
Tuesday	15 April	4:15 p.m.	Chapman	at Caltech
Saturday	19 April	2:15 p.m.	*Redlands	at Caltech
Tuesday	22 April	4:15 p.m.	La Verne	at Caltech
Saturday	26 April	2:15 p.m.	*Caltech	at Pomona
Saturday	3 May	2:15 p.m.	*Caltech	at Redlands
Tuesday	6 May	4:15 p.m.	Pepperdine	at Caltech
Saturday	10 May	2:15 p.m.	*Pomona	at Caltech
Tuesday	13 May	4:15 p.m.	Cal Poly	at Caltech
Saturday	17 May	2:15 p.m.	*Whittier	at Caltech
Saturday	24 May	2:15 p.m.	*Caltech	at Occidental

* Conference Games

OTHER SPRING SPORTS WARMING UP

THE first week of April will see most spring sports under way in conference competition. Johnny Lamb's tennis team, which went down 8-1 before powerful U.C.L.A.'s second string, has its first league contest on Saturday 5 April against Redlands.

VARSITY TENNIS MATCHES

Saturday	5 April	Redlands	at Caltech
Wednesday	9 April	Caltech	at Occidental
Saturday	12 April	Caltech	at Whittier
Saturday	19 April	Pepperdine	at Caltech
Saturday	3 May	Pomona	at Caltech
Wednesday	7 May	Occidental	at Caltech
Saturday	10 May	Caltech	at Redlands
Tuesday	13 May	Whittier	at Caltech
Saturday	17 May	Caltech	at Pomona
Friday	23 May	Conference Meet	at Caltech
&	&		
Saturday	24 May		

Bob Merrick's swimmers will open their League season on Friday, 4 April as hosts to Redlands in the Pasadena Junior College pool. The swimming team has also seen action this season in a practice tilt with Los Angeles City College, which it lost, 45-21.

VARSITY SWIMMING SCHEDULE

Friday	4 April	4:30 p.m.	Redlands	at Caltech
Friday	11 April	4:30 p.m.	Occidental	at Caltech
Wednesday	16 April	4:30 p.m.	Pomona	at Caltech
Thursday	24 April	4:30 p.m.	Compton JC	at Caltech
Friday	2 May	4:00 p.m.	Caltech	at Pomona
Wednesday	7 May	4:00 p.m.	Caltech	at Occidental
Friday	10 May	4:00 p.m.	Caltech	at Redlands
Saturday	17 May	1:30 p.m.	Conference Meet	at Occidental

Golf is also due to start at the end of the first week of the Spring Term, when the Beaver team will be guests of the Whittier College Poets in the Season's opener.

VARSITY GOLF SCHEDULE

Friday	4 April	1:30 p.m.	Caltech	at Whittier
Friday	11 April	1:30 p.m.	Redlands	at Caltech
Friday	18 April	1:30 p.m.	Pomona	at Caltech
Friday	25 April	1:30 p.m.	Whittier	at Caltech
Friday	2 May	1:30 p.m.	Caltech	at Redlands
Friday	9 May	1:30 p.m.	Caltech	at Pomona
Saturday	17 May	9:00 a.m.	Caltech	at U.C.L.A.
Saturday	24 May	9:00 a.m.	Conference Tournament	at Pomona

ALUMNI NEWS

ALUMNI ASSOCIATION OFFICERS

PRESIDENT A. L. Laws '26	SECRETARY D. S. Clark '29
VICE-PRESIDENT W. M. Jacobs '28	TREASURER W. R. Freeman '25
BOARD OF DIRECTORS	
F. T. Schell '27	J. R. Bradburn '32
C. F. Friend '38	R. D. Andrews '15
H. B. Lewis '23	H. M. Huston '29
C. W. Varney Jr. '22	

ALUMNI CHAPTER OFFICERS

New York Chapter:

PRESIDENT 969 Madison Ave., New York 21, N. Y., Tel. BUtterfield 8-4116	Evan Johnson '38
VICE-PRESIDENT 3 Oakridge Avenue, Summit, N. J.	H. E. Mendenhall '23
SECRETARY-TREASURER 174 North 19th Street, East Orange, N. J.	Tel. SU 6-2822 Richard Pond '39 Tel. OR 4-2164

San Francisco Chapter:

PRESIDENT 908 Curtis Street, Berkeley 6, California, Tel. THorneswall 2893	Maurice Jones '26
Bechtel McCone Brothers	Tel. DOuglas 4032
VICE-PRESIDENT 2226 McGee Avenue, Berkeley 3, California	Ted Vermeulen '36
Shell Development Company	Tel. EXbrook 5400
SECRETARY-TREASURER 1431 Park Blvd., San Mateo, California, Tel. San Mateo 3-7634	Robert P. Jones '35
Standard of California	Tel. SUtter 7700

The San Francisco Chapter meets weekly for lunch at the Fraternity Club, 345 Bush Street, on Mondays.

WILLIAM G. YOUNG '29 CHOSEN UCLA RESEARCH LECTURER

DR. WILLIAM G. Young '29, professor of chemistry and dean of the Division of Physical Sciences at U.C.L.A. has been chosen faculty research lecturer at that school for 1946-47. His selection was based largely upon his research on unsaturated organic chemical compounds and their reactions, a field in which he has received national recognition.

Two of the best-known chemical problems to which Dr. Young has devoted his attention are: First, the allylic rearrangement and second, cis-trans isomerism. Fundamental contributions have been made in correlating the nature of the products from reactions of allylic compounds with the mechanisms operating. Although Dr. Young's work has been principally in the fields of pure science, practical applications of his discoveries are thought to be possible in the fields of synthetic polymers and this relation to natural rubber and in many phases of the petroleum industry.

Dr. Young was graduated from Colorado College and took his Ph.D. from the Institute. He has been on the Los Angeles campus since 1930 and has been chairman of the chemistry department since 1940. Last December he was appointed dean of the division of physical sciences.

DUANE ROLLER '29 WINS OERSTED MEDAL

THE American Association of Physics Teachers has awarded the Oersted Medal to Duane Roller. Ph.D. '29, professor and head of the Department of Physics at Wabash College, Crawfordsville, Indiana. The award is made annually "for notable contributions to the teaching of physics."

Dr. Roller was co-author with Dr. Robert A. Millikan, another holder of the Oersted Medal, and Professor E. C. Watson of **Mechanics, Molecular Physics, Heat, and Sound**. This college physics text has been used at the Institute and other colleges for almost 10 years. While at C.I.T., Dr. Roller showed such great interest and ability in the teaching of freshman and sophomore physics courses that he was invited to work with Dr. Millikan and Professor Watson in the preparation of the new text. Besides his work with **Mechanics, Molecular Physics, Heat, and Sound**, Dr. Roller has also edited the *American Journal of Physics* since it was founded in 1933.

Dr. Roller did his undergraduate work at the University of Oklahoma. He also received the Master's degree at Oklahoma and taught there for 13 years, partly before and partly after his work for the Doctorate at the California Institute. Subsequently he was a research associate at Columbia and associate professor at Hunter College. During the First World War he was a pilot and during the recent war he was chief technical aide of the National Defense Research Committee.

The formal award was made at the January 31 session of the annual meeting of the American Association of Physics Teachers at Columbia University. In his address of acceptance Dr. Roller discussed one of his chief professional interests, physical terminology, another field in which he has made notable contributions both to the teaching of physics and to the science itself.

DUNNE AND HONEY SAILING HERE FROM EAST COAST

SAILING a 35-foot schooner from Nova Scotia to California is the means which Brian Dunne, Jr. and Dick Honey, both of the class of '45, have chosen to "get away from everything." Brian and Dick, together with two other former Navy men, have a tentative voyage mapped out which will carry them down the inland waterway to Florida, including a cruise through the West Indies, passage through the Panama Canal, and eventual arrival in California.

Brian served three years as navigator on Navy transports in the Pacific, and the men bought the converted fishing boat a month after discharge, christening her *Utopia*. Brian says the purpose of the trip is to "get away from everything until it settles down. Labor troubles, shortages and general unrest have things topsy-turvy. We believe conditions will be much improved in a year or so and meanwhile we're having the time of our lives."

FACULTY NOTES

Dr. Beno Gutenberg, professor of geophysics at the Institute since 1930, has been appointed director of the Seismological laboratory.

Dr. Ian Campbell has recently been promoted from associate professor to professor of petrology.

G. K. HARTMANN '33 JOINS NAVAL ORDNANCE LABORATORIES STAFF

DR. GREGORY K. Hartmann '33 has been appointed assistant chief of the Explosives Division of the Naval Ordnance Laboratories at White Oak, Maryland. He had previously been with the Applied Explosives Research Group of the Naval Bureau of Ordnance.

A consultant in experimental physics primarily concerned with explosive phenomena while with the Bureau of Ordnance, Dr. Hartmann was technical director of the Bureau's Instrumentation Group with the Bikini task force which was responsible for measuring the air blast and water shock for both bomb tests, and for measurements of radiation intensities at the time of the explosions. His group consisted of about 95 technicians and scientists.

During the war Dr. Hartmann made several trips abroad on Navy business. In 1943 he was assigned the task of surveying the state of British explosive research, and in 1944 returned to England to obtain information concerning certain aspects of problems connected with minesweeping. In 1945, following V-E Day, the Bureau of Ordnance sent Dr. Hartmann to Germany, where he traveled extensively interviewing German scientists to determine their knowledge in explosive research.

Receiving his B.S. degree in 1933 from the Institute, Dr. Hartmann went to Queens' College, Oxford University, England, as a Rhodes scholar. He was graduated from there with a B.A. degree in mathematics in 1936. He then returned to the United States and became an assistant in physics at Brown University while working on his Ph.D., which he received from

that institution in 1939. Next he went to the University of New Hampshire, where he remained as assistant professor of physics until joining the staff of the Bureau of Ordnance concerned with supersonic acoustics in 1941.

While at the Bureau of Ordnance, Dr. Hartmann worked on explosive experiments at the Underwater Explosives Laboratory, Woods Hole, Massachusetts. Besides his many other contributions to the explosives field, Dr. Hartmann has developed instruments and measurement techniques for determining explosive power.

EDWARD A. WHEELER EX '43 HEADS FM BROADCASTING COMPANY

EDWARD A. Wheeler, ex'43, is president of the North Shore Broadcasting Company, Inc., which opened station WEAW in Evanston, Illinois, the first of February. Wheeler has supervised the organization of the station and directed all of its activities since the original application for a license was filed with the FCC in 1945.

WEAW-FM serves an area more than 40 miles in radius around Evanston. As a local station, WEAW is sponsored by Evanston and Wilmette businesses and is giving free time to Northwestern University, local high schools and churches, the City of Evanston, and other civic groups. Northwestern University's schools of journalism and speech have each installed studios with their own control boards from which the program being broadcast is transmitted by telephone wire to WEAW.

PROGRAM

ALUMNI SEMINAR

Saturday 26 April 1947

- 9:00 a. m. THE DEVELOPMENT OF AN ELECTRICAL CALCULATOR
By Gilbert D. McCann, associate professor of electrical engineering
- 10:00 AN INSIGHT INTO THE MODERN NOVEL
By Harvey Eagleson, associate professor of English
- 11:00 PALEONTOLOGICAL EXPLORATIONS IN MEXICO
By Chester Stock, professor of paleontology
- 12:00 m. SOME DEVELOPMENTS IN PLANT BIOLOGY
By James F. Bonner, associate professor of plant physiology
- 1:00 p. m. LUNCH will be served in the student houses
The late luncheon is necessitated by the crowded conditions in the houses. We will be served after the students.
- 2:30 CASE HISTORIES IN AIR FIELD CONSTRUCTION
By Perry Banta, associate professor of sanitary engineering
- 3:30 HARBOR DEVELOPMENTS AT GUAM AND STUDIES ON CAVITATION
By Robert T. Knapp, associate professor of hydraulic engineering
- 4:30 to 6:30 FELLOWSHIP HOUR: Alumni are welcome to inspect the portions of the campus which are open. Arrangements have been made for a lounge at the Pasadena Athletic Club where groups may gather if they desire.
- 6:30 DINNER at the Shakespeare Club. Ladies Invited.
This will be an opportunity to meet in an informal manner. Music will be provided during the dinner.
After dinner we will hear from George H. Hall, director of public relations on Institute Public Relations, and
John A. Shutz, instructor in history on a timely subject of world-wide interest.

Guests are welcome to the seminar and ladies are welcome to the dinner. Please save the date 26 April from 9:00 in the morning until after the dinner meeting.

NEW DIRECTORS TO BE CHOSEN

IN ACCORDANCE with Section 1 of Article XII of the By-Laws of the Association, the Directors met as a nominating committee on 11, February, 1947. Five vacancies will occur on the Board at the end of the current fiscal year, one vacancy to be filled from the present board and four to be elected by the membership. The present members of the board are as follows:

R. D. Andrews '15—Term expires 1947
C. F. Friend '38—Term expires 1947
H. M. Huston, Jr. '29—Term expires 1947
A. L. Laws '26—Term expires 1947
C. W. Varney, Jr. '22—Term expires 1947
J. R. Bradburn '32—Term expires 1948
W. M. Jacobs '28—Term expires 1948
H. B. Lewis '23—Term expires 1948
F. T. Schell '27—Term expires 1948

The four members of the Association nominated by the Board are:

E. H. Hoge '18
W. D. Sellers '25
W. B. Miller '37
J. W. Lewis '41.

In accordance with the By-Laws: "Additional nominations may be made by petitions signed by at least 10 members in good standing, provided that the Petition must be received by the Secretary at least 30 days before the Annual Meeting.

Statements about the nominees of the Board are presented in this issue of **ENGINEERING AND SCIENCE**.

D. S. CLARK, Secretary

WENDELL B. MILLER



WENDELL B. Miller '37 received his B.S. in electrical engineering. As an undergraduate he distinguished himself by winning freshman numerals in football and track, and varsity letters in these sports in each of his next three years. This activity represents only a portion of the performance that brought him four honor keys. He remains the only alumnus to hold that number.

Besides his athletic achievements, Wendell spread his efforts through all other phases of extracurricular activities, holding posts with the ASB government, class office, forensic and publications groups. He served as second representative-at-large and on the Board of Control in his sophomore year. As a junior he was vice-president of the student body. In his senior year he was class president. He also found time to be Little T business manager.

After graduation Wendell started to work with the Southern California Telephone Company by whom he is now employed in the Alhambra Engineering District. He is an outside plant engineer, dealing with design and engineering plans for the outside plant, or cable serving from and beyond the exchange

offices. He was recently engaged in the outside-plant design for the special gas-filled, lightning-protected cable to Mount Wilson for use in connection with television transmission.

In 1944-45 Wendell served one year of an unexpired term of office on the Alumni Association Board of Directors. In the last two years he has been the Alumni Association's representative on the Institute Athletic Council.

EDISON R. HOGE



EDISON R. Hoge is a graduate of the Throop Institute of Technology, fore-runner of the present Institute, with the class of '18. In spite of working his way through four years, Ed had time to be assistant athletic manager and photographer for the school magazine under Editor Frank Capra, and held membership in the Gnome Club. As an undergraduate he lugged a Graflex camera along with his

books and made many early photographs of the campus. He has been combining science and engineering with technical photography ever since.

Mr. Hoge spent a year as control chemist for a Los Angeles firm. He then joined the Mount Wilson Observatory staff as the assistant solar observer and as assistant to Mr. Ferdinand Ellermann who was in charge of photographic work for the Observatory. When his son reached school age, Mr. Hoge moved down the mountain to Pasadena.

For three years he engaged in the rapidly developing radio field with Ben and Hugo Benioff, '22 and Ph.D. '35. Mr. Hoge then joined Leon T. Eliel, manager of the then newly formed Pacific Coast Branch of Fairchild Aerial Surveys. He became production manager, in charge of the photographic department and aerial mapping operations. In 1932 Mr. Hoge left Fairchild and started a successful small business of his own in "Technical Photography." Applications of photography to scientific and engineering projects included considerable work for the Mount Wilson Observatory and the preparation of exhibits for all the Planetariums in this country.

Upon the retirement of Mr. Ellermann from the Mount Wilson Observatory in 1937, Mr. Hoge was appointed to the Staff vacancy. His responsibilities include participation in the Solar Research Program at the Observatory and the many photographic problems in the Pasadena Laboratories.

During the war he participated as investigator and in charge of photography in a number of O.S.R.D. projects that were carried on at the Observatory. These included aerial photographic problems, B-29 formations and their defensive fire-power, the development of a method of obtaining radar reconnaissance motion pictures using standard equipment available in Army and Navy supply depots.

In addition Mr. Hoge acted as consultant in technical photographic problems to The Rapid Blue Print Company of Los Angeles, Lockheed Aircraft, the Photogrammetric Company, and the Navy. In 1944 he was asked by Dr. Robert T. Knapp, associate professor of hydraulic engineering, to participate in a

model wave and surge study that was then being developed on the Caltech campus for the Naval Operations Base at Terminal Island, California. Mr. Hoge was given the problems of photographic recording of data obtained on this important hydraulic study. A number of new photographic methods were developed and used successfully throughout the life of the project which terminated in 1945. Since then he has continued his association with Dr. Knapp as consultant on photographic matters in his new and larger Model Studies of the Harbor of Guam, now being conducted by the Institute for the Navy Bureau of Yards and Docks under the shelter of a large airplane hangar erected for the purpose at Azusa, California.

As a member of the staff of the Mount Wilson Observatory Mr. Hoge is looking forward to the merger with the Caltech Palomar 200 inch project into one large coordinated astronomical observatory which will include the finest in equipment and competent personnel anywhere in the world.

Mr. Hoge has been a member of the Association most of the time since its incorporation in 1935. He is also a member of the American Astronomical Society, Sigma Xi, and the Society of Motion Picture Engineers.

WILLIAM DOUGLAS SELLERS



WILLIAM Douglas Sellers, class of '25, returned to California in 1945 after having spent 20 years in the East.

As an undergraduate working toward his degree in electrical engineering, Doug played freshman and varsity football and tennis. He also sang in the glee club one year.

Following graduation in 1925 he was married and became a testman with the General Electric Company in Schenectady, subsequently entering the Engineering Department. Becoming interested in patent law, he took the Civil Service examination and entered the United States Patent Office in Washington as a patent examiner, which position he held for two years, employing his spare time in the study of law at George Washington University.

In 1928 he was employed as patent attorney by The Hoover Company, manufacturers of suction cleaners, and moved to Chicago. As senior practicing patent lawyer for The Hoover Company, he was in charge of litigation and under his releases products having a value of more than two hundred million dollars were sold in the American market. The best known case handled by Mr. Sellers was that of Hoover vs. Coe, which he argued before the United States Supreme Court in March of 1945 (securing a reversal of the decision in the Court of Appeals for the District of Columbia rendered by Justice Thurman Arnold of trust-busting fame. During the war Mr. Sellers had charge of The Hoover Company's administrative law activities.

Late in 1945 Mr. Sellers resigned as patent lawyer for The Hoover Company and returned to California to enter the general practice of law, specializing in

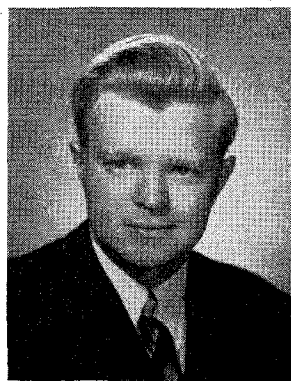
patent law and the related fields of trademarks and unfair competition. This practice he now carries on in his Pasadena office.

In addition to the degree of Bachelor of Science in Electrical Engineering received from the Institute, he also holds the degree of Master of Patent Law from John Marshall Law School and the degree of Doctor of Jurisprudence from De Paul University. He is a member of the Bars of the State of California, the State of Illinois, the District of Columbia, the District Court and the Court of Appeals for the Seventh Circuit, the Court of Customs and Patent Appeals, the United States Patent Office, and the United States Supreme Court.

During the last two years Mr. Sellers was a member of the Publicity Committee of the Chicago Patent Law Association and of the Publicity Committee of the American Bar Association, Patent Section. During the current year he is serving as a member of the Special Atomic Energy Committee of the American Bar Association, Patent Section, and as a member of the Legislative Committee of the Los Angeles Patent Law Association. In addition to this activity he also serves as chairman of the Membership Committee for the Alumni Association, and as Secretary and a Director of the West Hollywood Kiwanis Club. He is a thirty-second degree Mason and Shriner.

Mr. Sellers is the author of several articles in the field of law. He has written two articles for *Engineering and Science Monthly*, one entitled "The Flash of Genius Doctrine Approaches the Patent Office," in November, 1944, and the second, "An Engineer Before the United States Supreme Court," published in February, 1946. He is also circulation manager for the magazine.

JOSEPH W. LEWIS



JOSEPH W. Lewis graduated in mechanical engineering in 1941. His undergraduate career was marked by service as sophomore class president, Beavers president, senior class president and membership on the Board of Directors. He won letters as a member of the freshman football and varsity tennis teams. Joe was also a member of Ricketts House and the A.S.M.E.

In 1941 he began work with the Boyle Manufacturing Company, now the United States Steel Products Company, in their Los Angeles plant, as an Industrial Engineer. In 1942 he became plant supervisor of industrial relations and in 1943 manager of industrial relations. From June, 1944 to March, 1946 Joe was in the Naval Reserve as an aviation electronic technician. After his discharge he returned to United States Steel Products as assistant to the vice president and general manager of the West Coast Division of the Company, which position he still holds.

Joe's interests lie in the field of industrial relations. Before he entered service, he taught night school courses in industrial relations under the ESMWT program.

PERSONALS

1915

HERBERT B. HOLT was elected president of the National Furniture Warehousemen's Association at the 53rd annual convention of the Association held recently in Palm Beach. He is executive vice-president of Bekins Van and Storage Company and president of Bekins Van Lines.

1920

PAUL N. CROSBY is associated with the Stone and Webster Engineering Corporation of Vernon, California.

1924

GRANT V. JENKINS is now living in Beverly Hills, California.

1926

WILLIAM S. KINGSBURY has returned to Los Angeles after several years in the Army as a Lt. colonel in the Corps of Engineers. Steve was Executive Officer and Commanding Officer of the 398 Engineer General Service Regiment, and saw action in England, France and Germany. The first of last year Steve joined the Consolidated Rock Products Company as engineer and purchasing agent.

1927

JAMES BOYD, at present dean of the faculty at the Colorado School of Mines, has been nominated by President Truman to be director of the Federal Bureau of Mines.

1929

THOMAS H. EVANS, professor of civil engineering at Georgia School of Technology, Atlanta, Georgia, is the proud father of a son, Thomas Peterson Evans, born November 6, 1946. He writes that he plans to come out to visit Southern California next summer.

1931

WILLIAM FRED ARNDT recently moved to Silver Springs, Maryland, where he is associated with the Applied Physics Laboratory.

1932

C. J. BREITWIESER, whose address has been lost to the Alumni Association for some time, is living at present in San Diego, California.

1933

ARTHUR MATHEWSON has taken a position with Pacific Airmotive Corporation in Burbank, California as chief engineer. He found two Techmen, WILLIAM C. MCFADDEN '34 and ROLAND SAYE '43, already employed with Pacific Airmotive.

1934

WARREN L. PATTON, registered patent agent, is now associated with the law offices of ROBERT W. FULWIDER '25 in the practice of patent, trademark and copyright law.

1935

FREDERICK PEHOUSHEK is living at present in Chatsworth, California.

1937

JAMES R. SEAMAN, JR. recently moved to San Gabriel, California.

1938

YUAN LEE is now residing in La Habra, California.

1939

BYRON F. BEANFIELD, MS '39, has accepted a position with the Knudsen Creamery Company.

JOHN H. CARR is the father of a baby girl, Nancy Caroline Carr, born February 15, 1947.

1942

KENNETH SCHUREMAN has obtained a position with the Bechtel Corporation as junior estimator with the Industrial Construction Section.

1943

DAVID R. ARNOLD writes that he was gunnery officer on the USS Mr. McKinley, AGC 7, the flag ship for both atomic bomb tests at Bikini. He was released in August and is now attending the Graduate School of Business at Stanford University.

1944

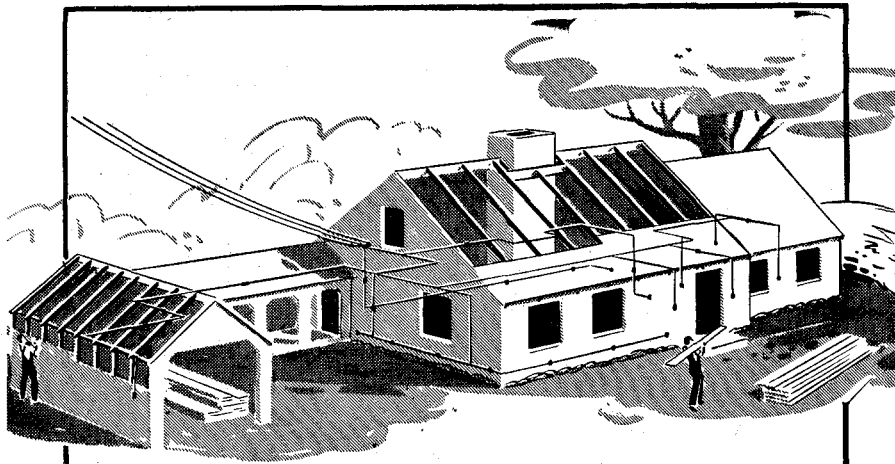
ALLEN E. WOLFE has recently taken a position with the Ballistics Research Laboratory at the Aberdeen Proving Grounds, Maryland, as an electronics engineer.

1945

ARTHUR LEON LOWELL is now associated with the McDonnell Aircraft Corporation at St. Louis, Missouri, in their Pilotless Aircraft Division.

1946

DOUGLAS ELLIS is attending Occidental College, studying for his master's degree in psychology. Doug was married in July to the former Winifred Lambert of Pasadena.



★ ADD TO ITS SELLING VALUE WITH ADEQUATE WIRING

Proper electric wiring adds far more than its cost to the value of a house. By providing circuits, outlets, and switches adequate in size, number, and location, proper wiring permits the full use of electrical equipment upon which modern living depends. Any home that is *not* adequately wired is out-of-date. *Good electric wiring keeps a home modern for many years.* Yet, on the average, it costs only 4% of the total building budget!

Phone or write your nearest Edison office for information about our free domestic wiring advisory service. No obligation.

SOUTHERN CALIFORNIA EDISON COMPANY



PRESIDENTIAL SILVER CO.

"Research and Development Machine Shop"
223-227 West Redondo Blvd. Inglewood, Calif.
Call ORegon 8-2555

ARMY AND NAVY ACADEMY

"WHERE THE CAMPUS MEETS THE SURF"

If you are interested in a school of distinction for your son, investigate this fully accredited military academy—one of the West's oldest. Successful guidance program. The only school in the West located on the ocean.
For Catalogue: Box ES Army and Navy Academy, Carlsbad, Calif.

ENGINEERS BOOK STORE

Textbooks Reference Books Handbooks
Drafting Equipment Slide Rules
713 W. Jefferson Blvd. Los Angeles 7
PRospect 1695
"Largest stock of higher math. books on Coast"

ALLEN MACHINE & TOOL CO.

Designers and Builders of Special Machinery and Tools
Also General Machine Work
13409 S. Alameda Street Compton, California
Phones: NEVada 6-2707 • NEWmark 1-8190

BLEITZ CAMERA COMPANY

"The West's Largest Photo Supply House"

A Complete Store for the Professional and Amateur
5338 Hollywood Blvd. Phone Hillside 8201 Hollywood 27
DON BLEITZ

Pacific Manufacturing Co.

1918 East Colorado Street :: Pasadena 8, Calif.
SYcamore 6-8579

PATENT DEVELOPMENT
SPECIAL INSTRUMENTATION

L. FAIBISH

H. M. LIGHTBURN

SPECIAL TOOLS AND MACHINERY CO.

4625 Pacific Boulevard, Los Angeles
KImball 3246 - 3247

PAUL F. VOKAL
Owner Manager

Since 1924
Designing and Building of
Special Tools and Machinery

GLASS BLOWING

Laboratory Apparatus and Chemical Glassware
GLASS INSTRUMENTS, INC.
SYcamore 9-3934
301 Pasadena Avenue, South Pasadena, Calif.

ATKINSON
LOS ANGELES
Photographic
Research



LABORATORY
CALIFORNIA
Photographic
Chemicals

RALPH B. ATKINSON '30

FOR SALE

U. S. PATENTS FOR AIRCRAFT FLAPS
AND CONTROLS
Re 20075, 1974407, 2005965, 2026727, 2026728,
2041688, 2070705, 2158686
Non-exclusively licensed to U. S. Government
GEORGE E. BARNHART
425 E. Green St., Pasadena

Process Industries Steam Plants Municipal Works

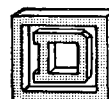
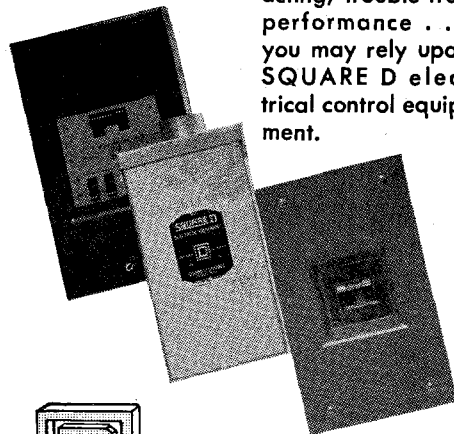
MERRILL BERKLEY

INSTRUMENTS AND CONTROLS
Recording • Integrating • Indicating • Regulating
PRospect 8693 1151 SOUTH BROADWAY
PRospect 9136 LOS ANGELES 15



FIRST MARK OF Modern Electrical Control

The mark of years of experience . . . of
outstanding service to industries the world
over. For sound, ex-
acting, trouble-free
performance . . .
you may rely upon
SQUARE D elec-
trical control equip-
ment.

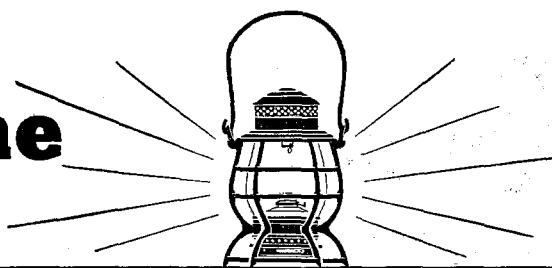


ELECTRICAL EQUIPMENT

SQUARE D COMPANY

LOS ANGELES DETROIT MILWAUKEE

The Main Line



MARCH, 1947

When our operating men go to bed at night they dream of a railroad without grades or curves, in a land where it never rains or snows.

Obviously they're not dreaming about the West!

Criss-crossed by mountain ranges, the west has relatively few level spots.

This circumstance results in some unparalleled scenery for our passengers, but it makes the operation of trains costly. So since the pioneer line was begun in 1863, the history of Southern Pacific has been a series of epic battles with geography and Nature, in an effort to straighten the line, reduce grades and minimize delays caused by weather.

Some of the battles fought by Southern Pacific engineers attracted nationwide attention. One of these was the short cut across Great Salt Lake.

The Lucin Causeway

When the Central Pacific (forerunner of Southern Pacific) was racing eastward to meet the Union Pacific, Great Salt Lake stood in the way. Central Pacific had to detour to the north, in a mountainous region requiring steep grades and many curves.

For years Southern Pacific engineers dreamed of a straight, level track across the lake.

The idea of building more than 30 miles of railroad across open water may have seemed fantastic, but the engineers were convinced it could be done. They knew that the maximum depth of the lake on the course selected for the short cut was 32 feet. Thus long piling could be driven to support the track, with rock fills where the water was shallower.

The job was started on March 17, 1902. Thousands of carloads of rock and piling converged on Great Salt Lake, and a struggle began which is still remembered as one of the great classics of railroad construction.

There were many difficulties. Whipped up by winter storms, the heavy salt water of the lake hit with terrific force and sometimes tore away piling as fast as it was driven. The lake bottom proved to be treacherous and unstable. Piling that appeared to be solid would sometimes sink under the weight of a locomotive.

One by one the problems were solved, mainly by pouring enormous quantities of rock into the lake. In one place alone—the Rambo Fill—75,000 carloads of rock were dumped before the roadbed found firm support!

On November 13, 1903, the tracks from east and west met in the center of the lake, and on March 8, 1904, the line was opened for traffic. The cost, \$8,358,833.

Today, when miracles are taken for granted, Overland Route passengers still get a thrill out of crossing Great Salt Lake by train. We call it "going to sea by rail", and you will have to look far to find a more unusual travel experience.

All because Southern Pacific engineers wanted to eliminate some grades and curves, and shorten the line.

Million Dollar Miles

Spectacular though it is, the causeway across Great Salt Lake cost less than the much shorter Bayshore Cut-off from San Bruno into San Francisco.

Replacing the original line via Colma (built in 1863), the Bayshore Cut-off was begun in October, 1904, and took more than three years to finish. It is precisely 9.81 miles long, saved 2.65 miles and cost \$9,273,055—nearly a million dollars a mile.

One item in the project was boring five tunnels with a total length of nearly two miles.

Taming the Colorado

Long before Boulder Dam brought the stream under permanent control,

Southern Pacific tamed the Colorado River.

This unruliest of western rivers went on a rampage in the flood periods of 1905 and 1906. Deserting its natural course for a new channel, the river poured millions of gallons of water into the Imperial Valley, threatening to inundate more than a million acres of rich farm land and drive about 10,000 people from their homes.

Southern Pacific engineers sprang into action, and by November 6, 1906, had tamed the river at a cost of nearly \$2,000,000. But the heart-breaking task was only temporarily finished. The following month the river broke loose again. The flood waters poured irresistibly through a gap 1100 feet wide and 40 feet deep.

Again Southern Pacific men sprang to the assistance of the beleaguered Imperial Valley.

Three times they drove pilings for a trestle across the break and three times the mad torrent swept them away. But the fourth time the pilings held, and trains began dumping rock.

From then on it was simply a case of pouring rock faster than the river could carry it away. Never before had rock been handled so fast—about 80,000 cubic yards in 15 days. The break was closed on February 11, 1907.

Today only the Salton Sea—formed by the water that poured through the gap remains to remind Sunset and Golden State Route travelers of Southern Pacific's historic fight against the Colorado River.

New Streamliner Named

The new Southern Pacific-Rock Island streamliners planned for 39¾ hour service between Los Angeles and Chicago have been officially named the *Golden Rockets*.

We'll let you know later when the *Golden Rockets* will be inaugurated, also the *Shasta Daylights*.

—H. K. REYNOLDS

S·P *The friendly Southern Pacific*