INDUSTRIAL DESIGN SECTION OF THE CALIFORNIA INSTITUTE OF TECHNOLOGY

REPORT OF ACTIVITIES, 1941-1942

By ANTONIN HEYTHUM

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

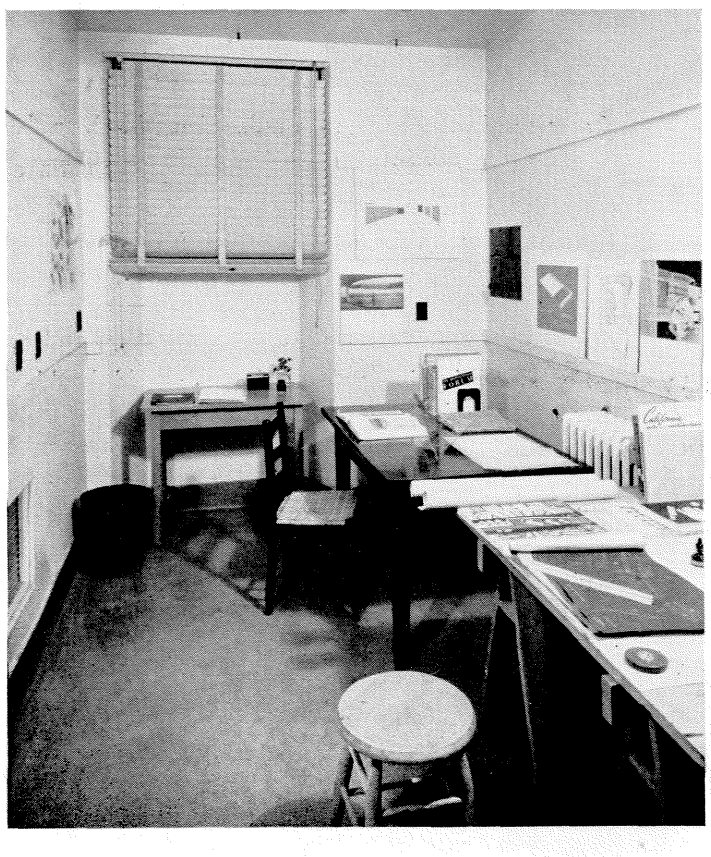
PRINCIPLES OF INSTRUCTION

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

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

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

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



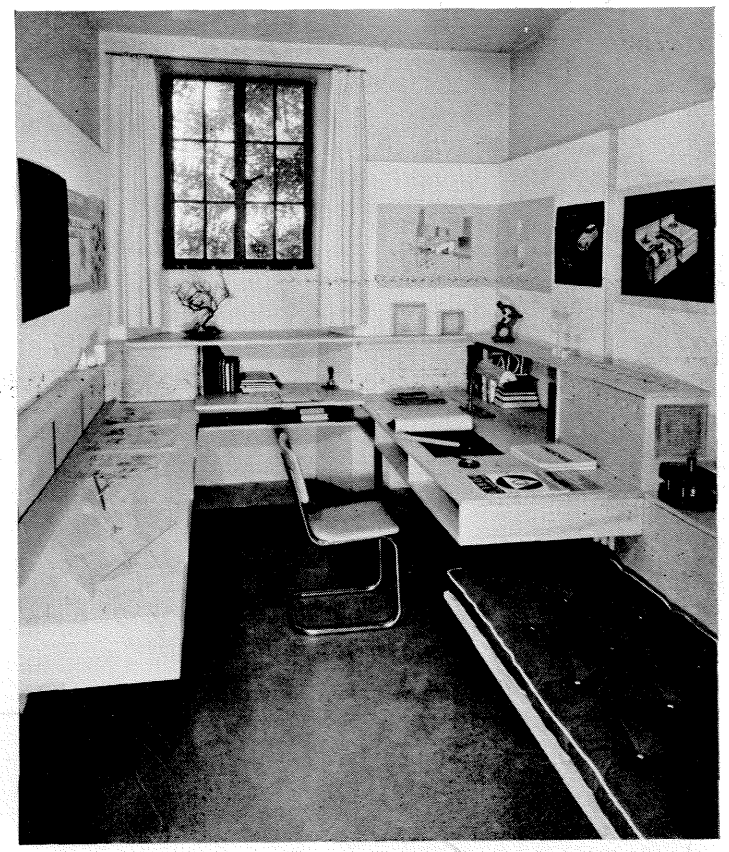


Fig. 2. Before **Fig. 3. After** Photograph by O. K. Harter

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

ADAPTATION OF WORKING QUARTERS

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

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

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

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

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

CONTACTS WITH OTHER DEPARTMENTS OF THE INSTITUTE

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

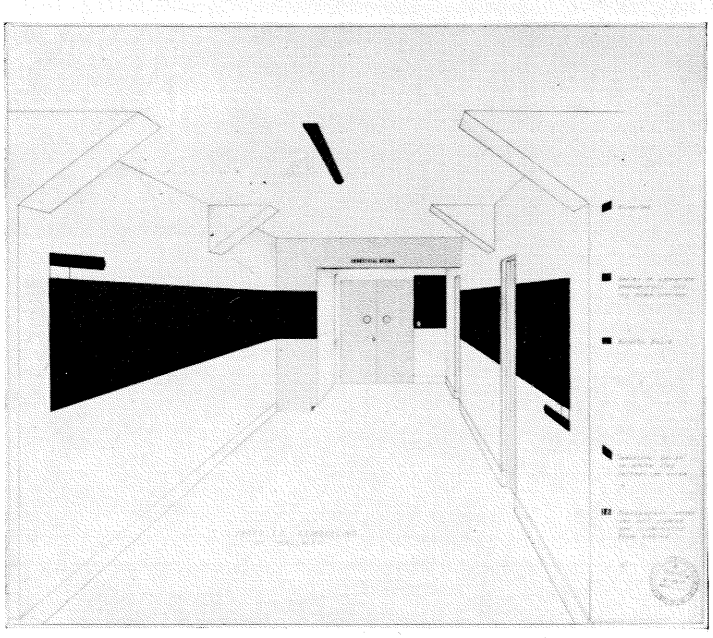


Fig. 4. Proposed remodeling of hallway leading to the entrance of the Industrial Design Section (First year work)
Photograph by O. K. Harter

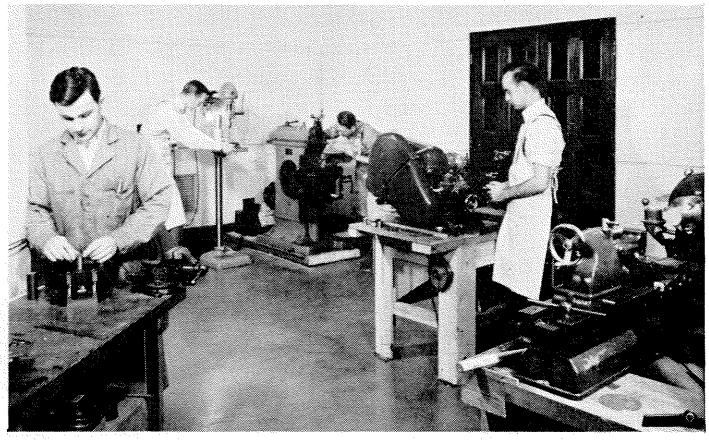


Fig. 5. Workshop of Industrial Design Section.
Photograph by O. K. Harter

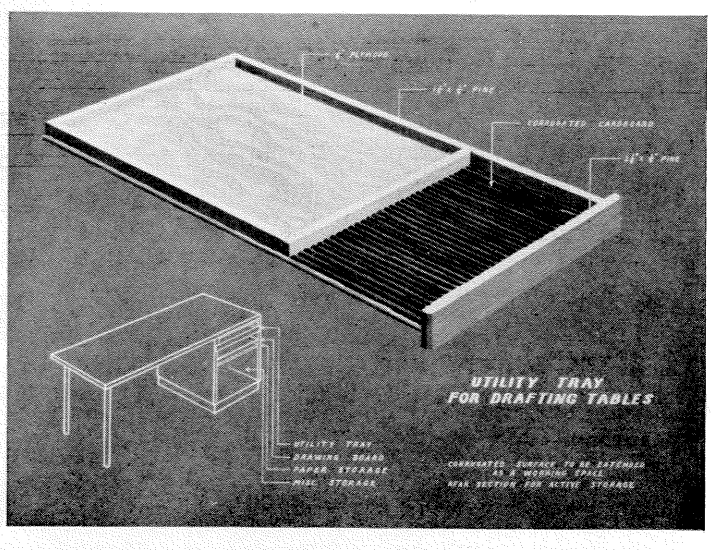


Fig. 6. Drawer-tray for drafting utensils designed for students' tables. (First year work)
Photograph by O. K. Harter

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

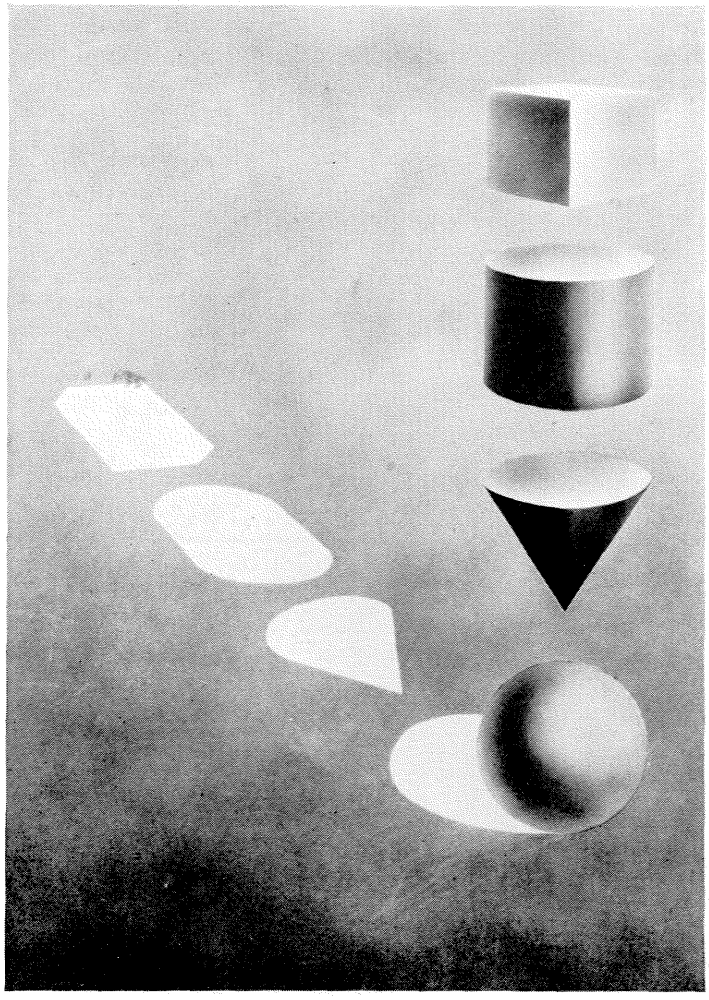


Fig. 9. Study of basic forms in basic colors. (First year work)
Photograph by O. K. Harter

LIBRARY

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

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

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

OUTSIDE CO-OPERATION

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

DESIGN PROBLEMS

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

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

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

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

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

REDESIGNING OF KITCHEN EQUIPMENT

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

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

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

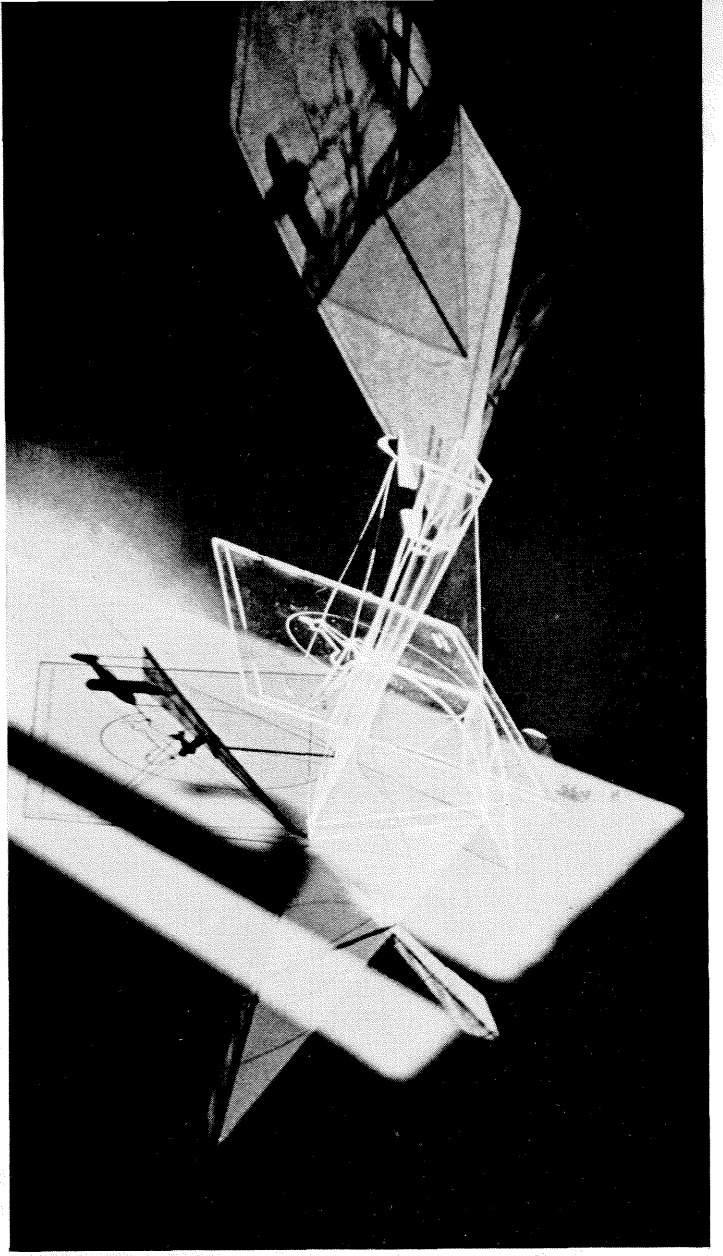


Fig. 10. Fundamentals of perspective construction demonstrated in an abstract composition in glass and wire. (First year work)
Photograph by A. Heythum

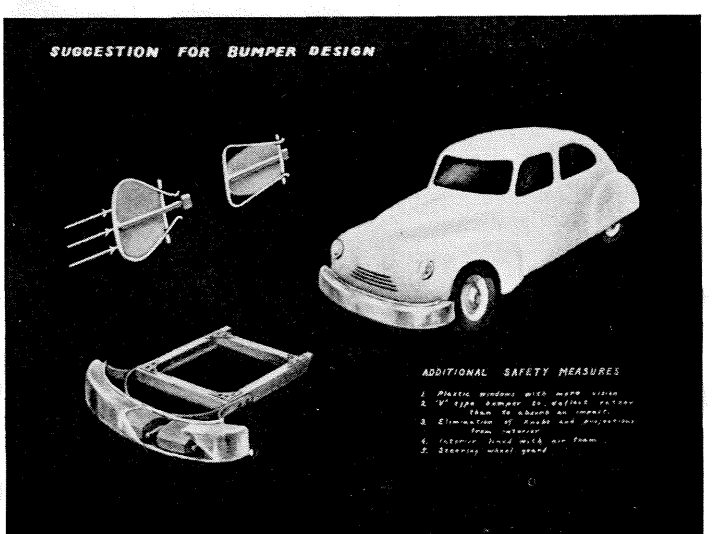


Fig. 8. Suggestion for bumper design. (First year work)
Photograph by O. K. Harter

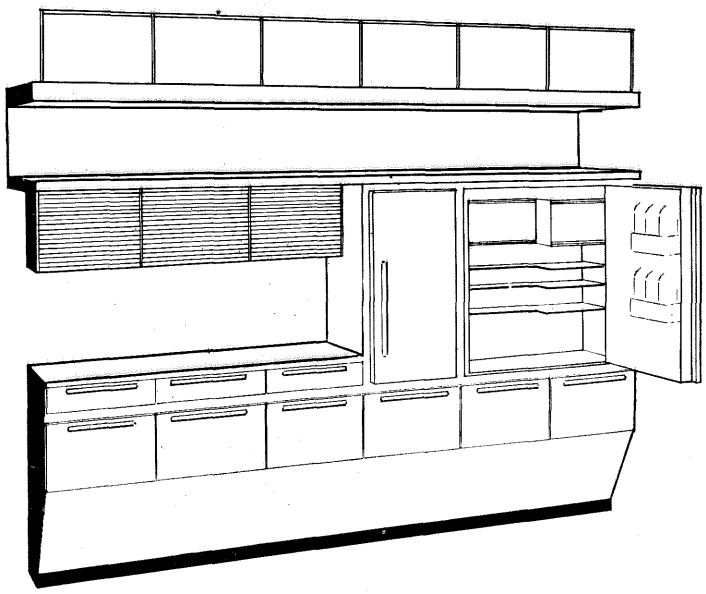


Fig. 11. Part of kitchen equipment showing the cupboard unit and refrigerator combined with cooler. (Second year work)

Photograph by O. K. Harter

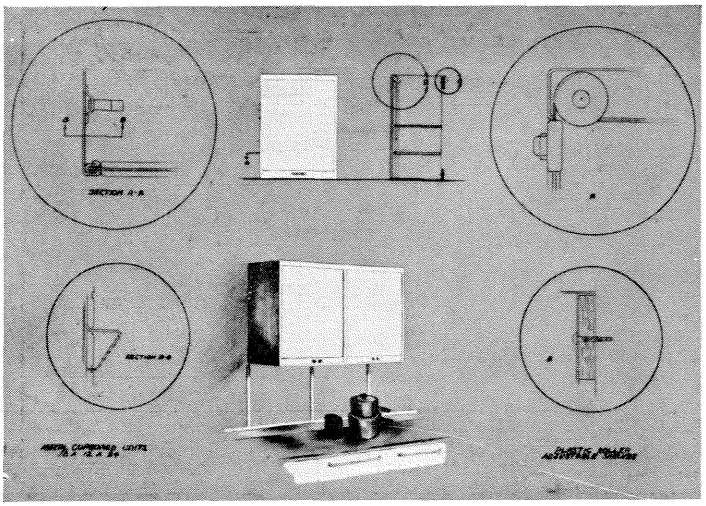


Fig. 12. Metal cupboard units with plastic rollers, designed for collective project of kitchen equipment. (Second year work)

Photograph by O. K. Harter

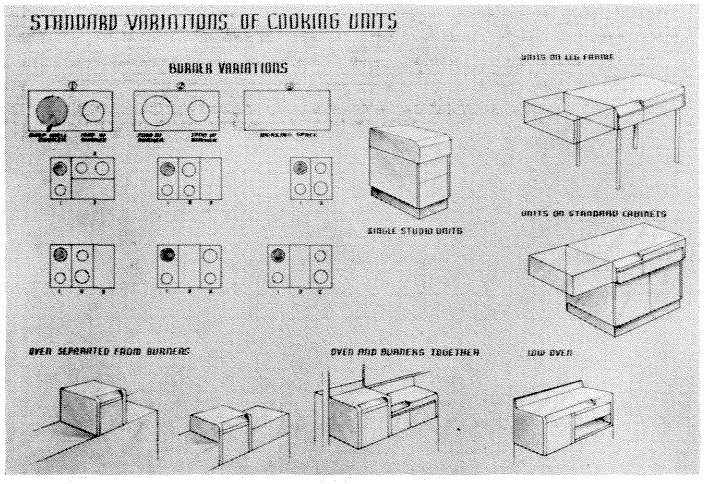


Fig. 13. Standard variations of cooking units designed for collective project of kitchen equipment. (Second year work)

Photograph by O. K. Harter

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

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

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

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

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

Winterbottom specialized on the *stove unit.* He solved this

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

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

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

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

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

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

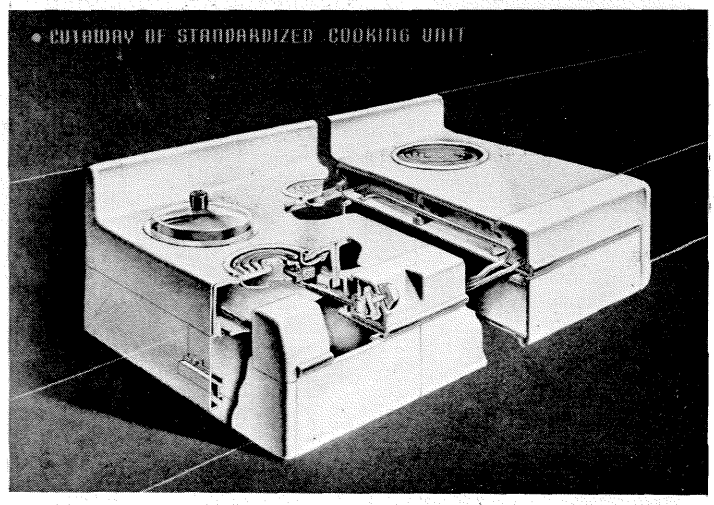


Fig. 14. Cutaway drawing of standardized cooking unit for a collective project of kitchen equipment. (Second year work)
Photograph by W. A. Martin

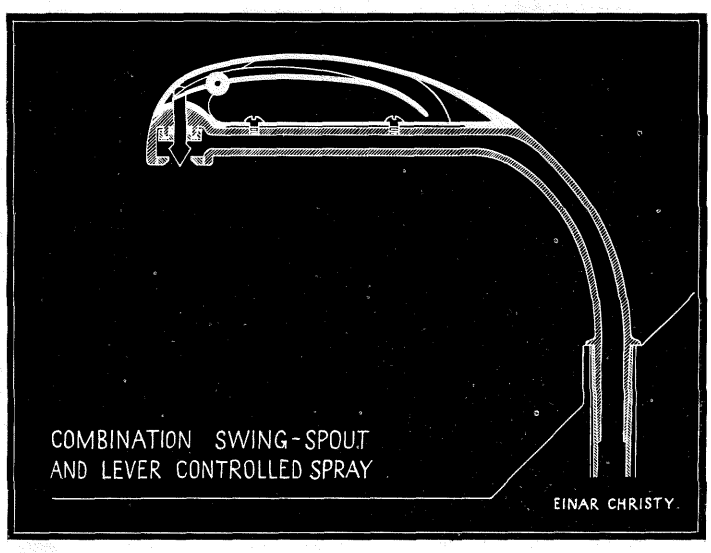


Fig. 15. Cross-sectional drawing of swing spout for a sink, designed for collective project of kitchen equipment. (Second year work)
Photograph by O. K. Harter

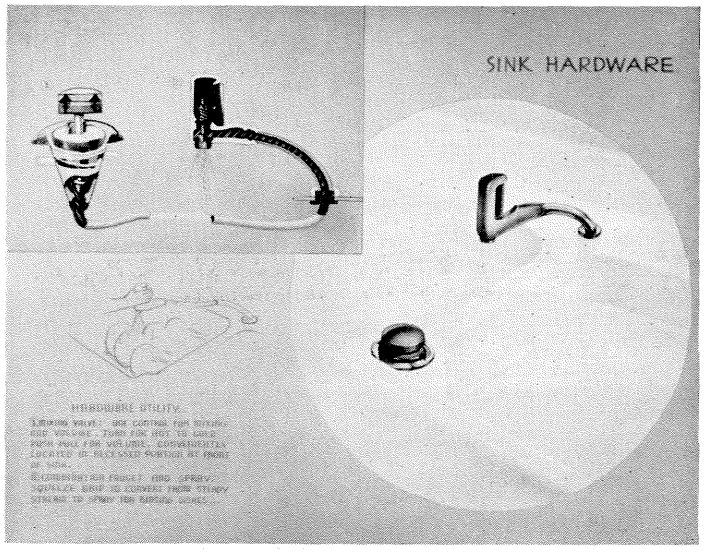


Fig. 16. Sink hardware with cutaway drawing for mixing valve and combination faucet and spray. From collective project of kitchen equipment. (Second year work) Photograph by W. A. Martin

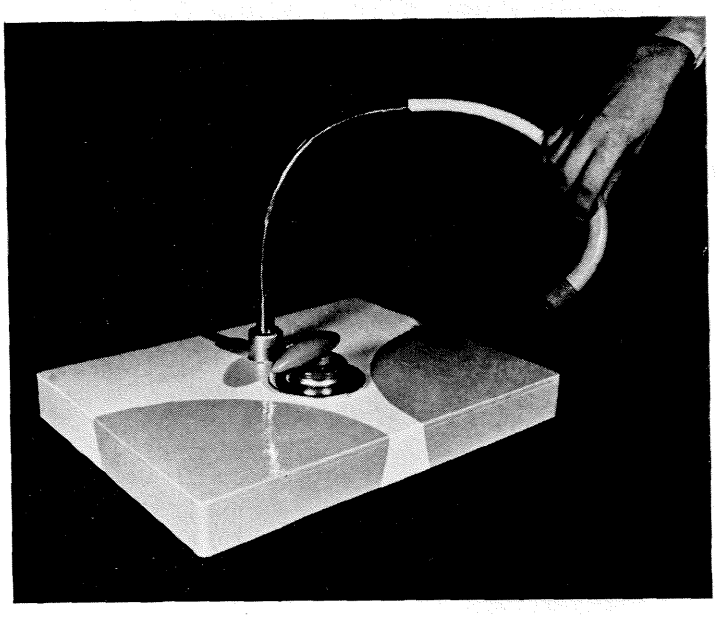


Fig. 17. Sink hardware model. Swing spout with spray attached to an elastic hose. From a collective project of kitchen equipment. (Second year work) Photograph by O. K. Harter

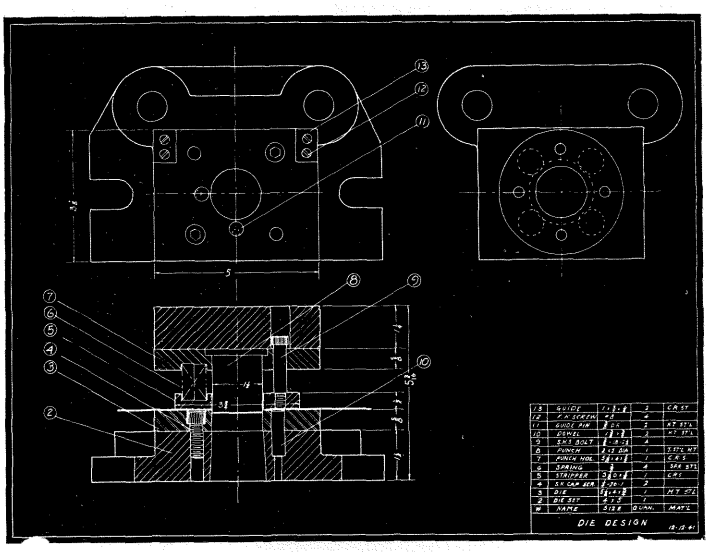


Fig. 18. Die design made during shop practice instruction. (First year work) Photograph by O. K. Harter

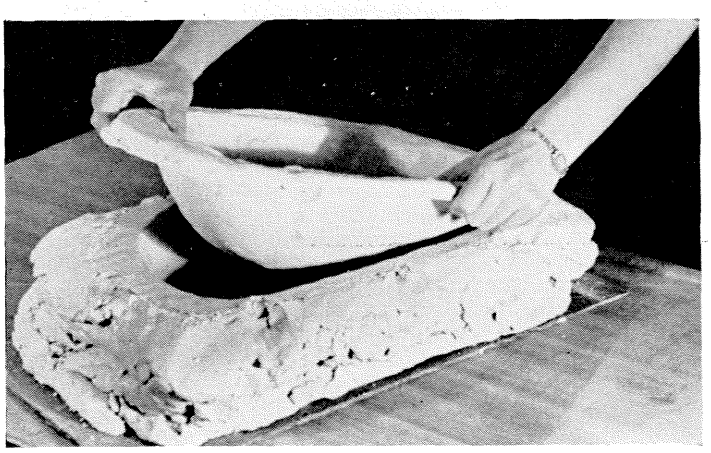


Fig. 19. Making of plaster mold in workshop of Industrial Design Section. (Second year work) Photograph by B. Morant

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

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

COORDINATED CLASSWORK

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

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

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

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

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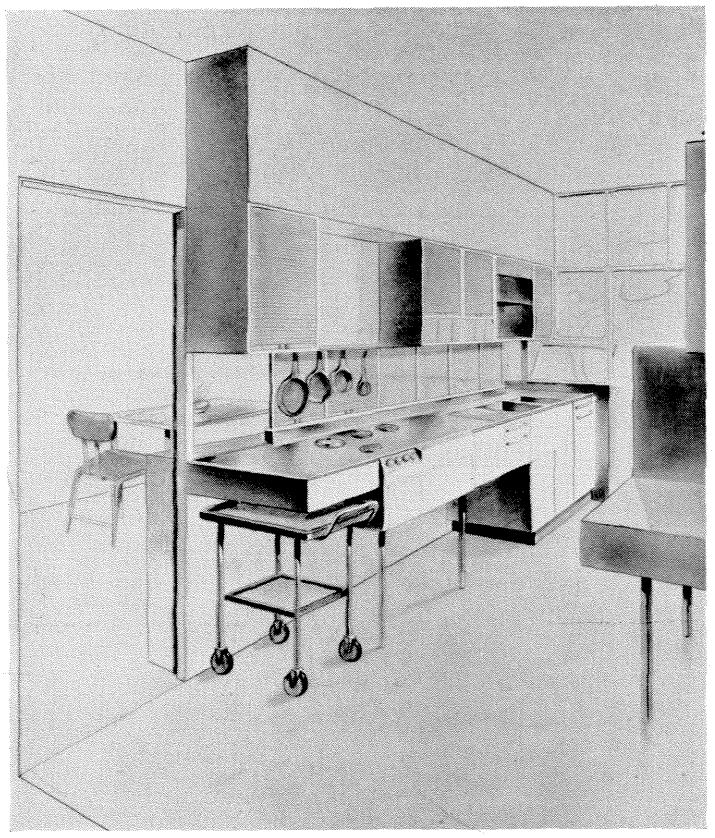

Fig. 20. Perspective drawing of the collective project of kitchen equipment. (Second year work) Photograph by O. K. Harter

quired for maintenance and repair and for minor capital betterments. These latter are limited to a material cost for any one job of $1500 for underground construction and $500 for above ground construction. Extensions to supply new consumers are limited to a total length of pipe (including that on the consumer's premises) of 250 feet.

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

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

(Continued from page 10)

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

CONCLUSION

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

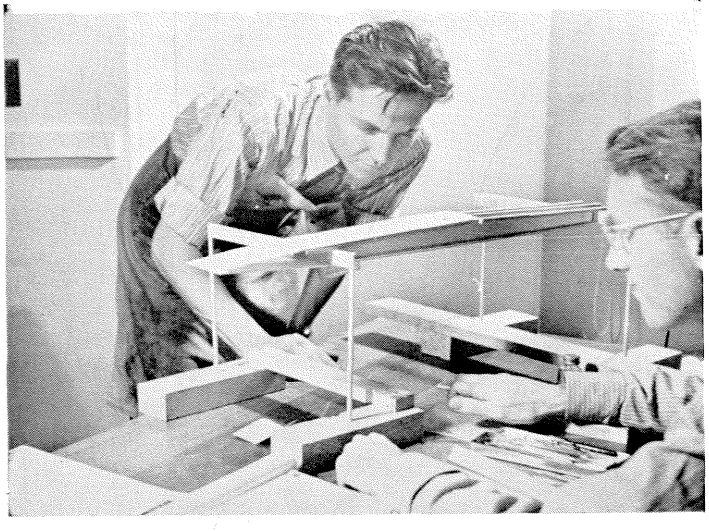

Fig. 21. Work on model of prefabricated house. (Second year thesis work) Photograph by B. Morant

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

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

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

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