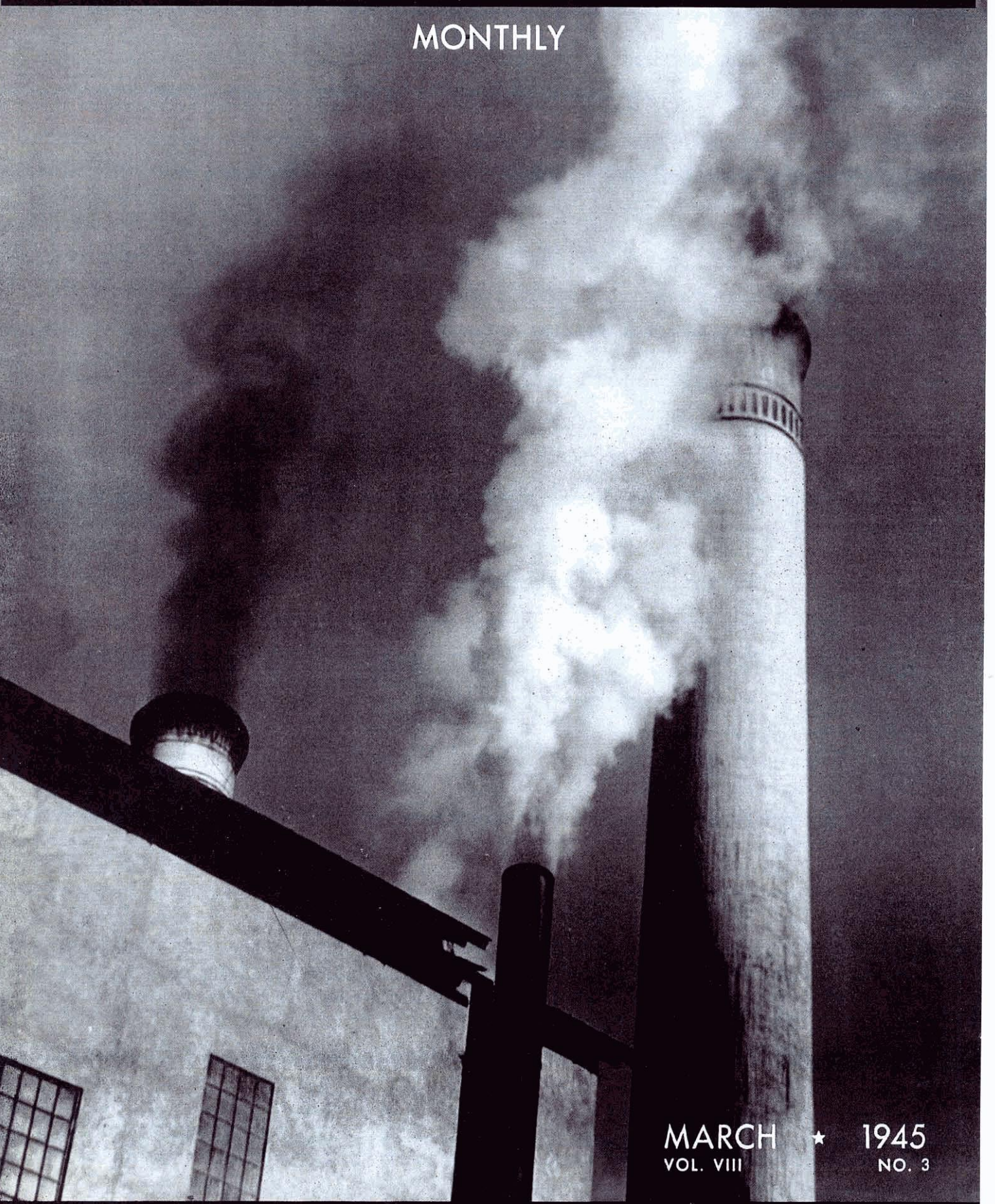
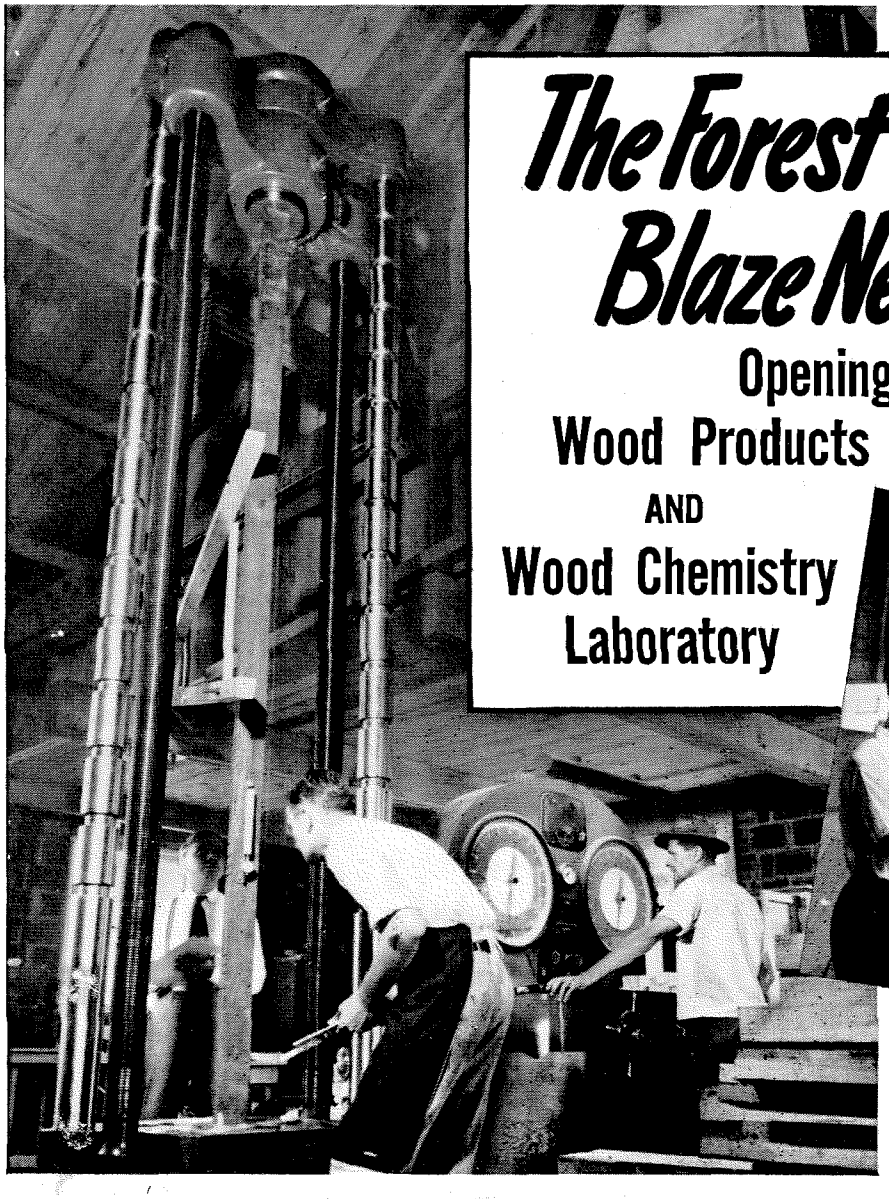
ENGINEERING AND SCIENCE

MONTHLY



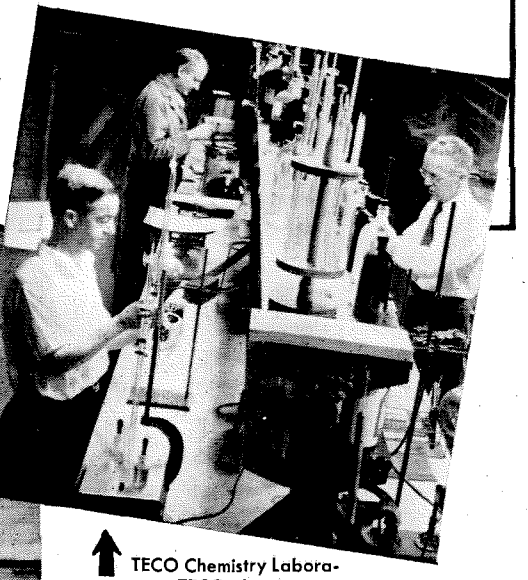
MARCH ★ 1945
VOL. VIII NO. 3

PUBLISHED BY CALIFORNIA INSTITUTE OF TECHNOLOGY ALUMNI ASSOCIATION



The Forest Industries Blaze New Trails

Opening of TECO Wood Products Development Shop AND Wood Chemistry Laboratory



TECO Chemistry Laboratory. TECO chemists are here shown working on lignin derivatives.

200,000 lb. Baldwin-Southwark testing machine in the TECO Shop. Material undergoing test is a small wood column being tested in compression.

Timber Engineering Company announces the opening of its Wood Products Development Shop and Wood Chemistry Laboratory located in Washington, D. C.

The Wood Products Development Shop has a full scale testing rig equipped to handle trusses up to 50′ span; auto-claves and other equipment used in pressure treating; dry kiln and high pressure steam equipment for impregnating; and other facilities for determining the physical and mechanical properties of wood and wood products.

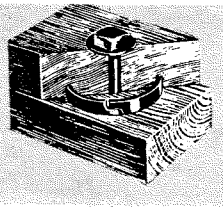
The Wood Chemical Laboratory has modern equipment for investigations in wood chemistry and wood derivatives research. It is giving special attention to lignin research including adhesives, synthetic plastics, etc.

If you have any problems in respect to the physical, mechanical and chemical properties of wood, the technical staff of the Timber Engineering Company may be of assistance on a moderate fee basis. If its own facilities will not solve your problem, it will assist you in locating sources which can.

Consultations at our Washington office may be made by appointment and without obligation on your part. Write us on your business letterhead stating your wood utilization problem.

Timber Engineering Co., Inc. of Washington, D. C.

Monadnock Building, 681 Market Street, San Francisco • Telephone Garfield 6296



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BY-LINES

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Mr. King received his B.S. in civil engineering in 1913 and the professional degree of Civil Engineer in 1926, both from Purdue. He went to China in 1920 to join the staff of the Sze Sao-tseng School of Civil Engineering of St. John's University, Shanghai, and returned to the United States at the end of 1943.

. . .

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. . .

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ENGINEERING AND SCIENCE Monthly

The Truth Shall Make You Free

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ENGINEERING AND SCIENCE MONTHLY

Edited at California Institute of Technology

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The Colling Publishing Company
124 West Fourth Street
Los Angeles, California
Circulation Manager—Victor V. Veysey, '36

ENGINEERING AND SCIENCE MONTHLY is published monthly on the 25th of each month by the Alumni Association, Inc., California Institute of Technology, 1201 East California Street, Pasadena, California. Annual subscription $2.50; 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.

ENGINEERING AND SCIENCE
Monthly

Vol. VIII, No. 3 March, 1945

The Month in Focus

By HUGH COLVIN

West Coast Industrial Leadership

ENGINEERS and scientists differ widely from chambers of commerce and other civic and commercial organizations in their analyses of the problems and possibilities of industrial development in the Far West. Their interest, however, is none the less vital because progressive, expanding industrial activity will provide more jobs for engineers, more research problems for scientists, and more significance to a background of technical education in the West.

The fateful, but as yet unanswerable, question as to whether the Pacific Coast and Rocky Mountain states can actually maintain and nourish large-scale industry in a period of severe postwar economic competition with other geographic areas was raised again recently in an issue of *Fortune* magazine devoted entirely to this section of the country.

Noting that wartime urgencies plus availability of hydroelectric power and other basic resources has resulted in tremendous impetus to Western industry in the last six years, the magazine repeats the locally obvious fact that a major portion of such growth in employment, factory floor space, etc., has been in aircraft, shipbuilding, and other predominantly wartime endeavors. Further, even these industries have relied to an important degree on "imported" parts and materials.

It is imperative for the present that we devote our energies to the successful prosecution of the war. But even in doing so few individuals and almost no private industry can afford to abstain completely from postwar planning. It does not require an academic degree to foresee widespread economic and social turmoil after the cessation of hostilities, and industrial adjustments must also be many and complex.

The interrelationships within industry are extremely significant but frequently difficult to evaluate. The West has shown that in addition to several large-scale extractive industries based in natural resources, it can support many small enterprises producing specialized or locally-needed commodities. Some of these products compete successfully in national and international markets. The manufacture of oil-field tools and equipment, pumps, diesel engines, scientific instruments, gas heating equipment, and other items has shown continued growth. Branch plants of Eastern factories have been established to engage in fabrication and assembly of many products.

But will we see heavy industry of the type and importance found in the Pittsburgh, Detroit, Cleveland, Philadelphia, or Chicago areas? Can the steel mills at Fontana and Geneva, the aluminum and magnesium reduction plants, mills, and foundries of southern California and the Pacific northwest continue to operate? Can the West support a modern tin-plate mill? Can its ports retain some of the shipbuilding and ship repair business that they enjoy today? Can an integrated textile industry be established in California? The answers to some of these questions seem already obvious and other answers seem to have become political footballs.

In future articles as it has in the past, *Engineering and Science* will endeavor to cover western industrial and technological developments as thoroughly as is consistent with its policy of editorial balance. This month's contents, for example, all bear rather directly on the future of the Pacific Coast.

China and Her Engineers

The West has always coveted the prospects of the Oriental market as a stimulus to its own industry. The development of industrially primitive China, arising out of the agonies of prolonged warfare, is a hopeful but not yet clearly focused picture. Certain it is that development of a sufficient quota of Chinese engineers, scientists, and technical men must precede any major application of American tools and methods; and that only after modern systems of communication and transportation and trained personnel are available can China become an industrial customer of the West. E. Harrison King's experiences in China and his close contacts with present developments make his article on Chinese engineering interesting and timely. It is a matter of considerable gratification that many of China's most promising young men have received their technical training at the California Institute and that their achievements in and for their native land have shown the greatest degree of capability.

Los Angeles as an Air Center

If they are to maintain their status, the metropolitan centers of tomorrow must be geared to the transportation and communication medium of the times. For an area

(Continued on Page 10)

Some Aspects of Chinese Engineering

By E. HARRISON KING, JR.

CHINA is a country that was coexistent with ancient Egypt. But, unlike the latter, she has had an unbroken history right up to the present. She has been in a position to be a spectator of the rise and fall of the mighty empires of the earth. She has been strong, and she has been weak, but never dead. Today she is again on the way to greatness.

To such a country all the problems that beset a nation have come, and gone, and come again. And the greatest of these problems, and the most persistent, has been that of maintaining the lives of her people and the life of the nation.

The people as individuals require food, clothing, and habitation. The country, to be properly administered, requires facilities for transportation, protective measures against the forces of nature and of man, and a means of ministering to the needs of the people.

The actual satisfaction of their requirements, as in all countries, has demanded industry and engineering. In China the development of these two activities would make a long, long story, covering many thousands of years; too long to be contained in a few books. But it may be interesting to look at some of the more prominent phases of these two types of human endeavor in order to see how they have developed in the past and what changes have come about in the last several decades.

Even a brief glance at the country discloses one or two salient points: (1) the part that the production of food plays in the life of this densely populated country, and (2) the part that water plays in the production and the transportation of the food. Aside from the construction of habitations and temples and protective walls for cities, by far the larger part of Chinese engineering effort has been devoted to the control and distribution of water and its use for transportation. To obtain water at points remote from streams, wells and pits were dug to get water stored in the earth, and canals were constructed to bring water from distant streams and rivers.

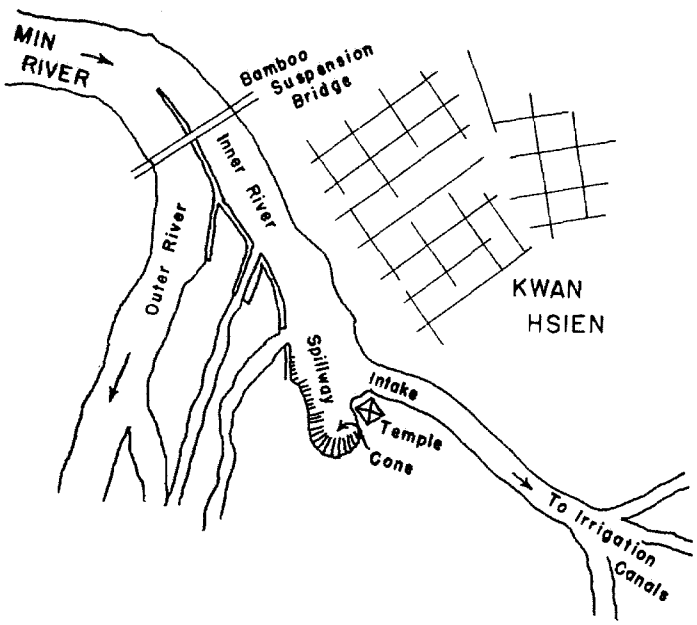


FIG. 1. Plan of Min River Control Works in Szechuan.

To distribute the water where it was most needed, ingenious pumps, operated by man, animal, wind, and water power, were invented, and irrigation ditches and sluices with measuring devices were contrived. Even special water carts and wheelbarrows were designed.

To protect the inhabited districts against the ravages of the great rivers in time of flood, dikes, sluices, and spillways were built.

The construction of so many waterways necessarily interfered with the convenient moving about of the people; so bridges were built to span the watercourses, both artificial and natural.

As more goods could be transported more easily by water than by land, rafts and boats of every description, except those that are self-propelled, were invented, and the amount of thought and ingenuity that went into this phase of engineering will never be known.

Now what has been said above applies to many of the nations of the earth, but through catastrophes caused by nature and by man the results and records of mankind's battle for existence have been lost. The story of China's life is unique in that it has survived through all these years, and because of the peculiar situation of China, geographically, we can see in more or less full flower today those things of which only faint indications remain in other lands. Life ancient, medieval, and modern, can be seen in different parts of China today, each going its practical, untrammeled way. In the older, untouched parts there will probably be only a line or two of telegraph or electric wire to indicate that there is any connection whatsoever with the world as we know it.

Just as an example of what can be found, the author may mention his regular visit at the Chinese New Year, for the past 15 years, to the city of Taichow, just 150 miles from Shanghai, about 40 miles from Nanking, and 17 miles from the Yang-tse River. It has a population of over 130,000, yet, until 1937, there was no road into or out of that city. One reached it through a canal that ended in the moat around the city wall. The only indication of intercourse with the outer world was in the two or three telegraph wires and a few electric light wires. And this was quite a wealthy city, whose leading men had done some traveling.

FLOOD CONTROL AND IRRIGATION

"*To return to our muttons.*" The methods of production of food have followed closely along the lines of all ancient peoples, but the Chinese have applied some interesting engineering thought to the saving of labor, especially in handling irrigation water, from special low head pumps from streams, which are very efficient, to differential axle lifts for wells, bamboo pipe lines, and methods of terracing rice fields in hilly country to conserve soil and water. In connection with this enterprise the Min River Control Works in Szechuan are worthy of mention; these protect the great Cheng-tu Plain.

The Min River has a drainage area above the intake of the control works at Kwan Hsien of nearly 8,000 square miles. Its discharge during flood seasons is often more than 100,000 cubic feet per second. The water from the intake is conducted to a great network of canals

over the Cheng-tu Plain which feed the nearly 1,000,000 acres of rice fields.

Where the river comes from the mountains (see *Fig. 1*), it is divided just above the town of Kwan Hsien into two practically equal channels by an artificial dike or embankment made of cobblestones and gravel, and protected or faced by cobble-filled "sausages," that is, long network tubes of bamboo filled with large rounded stones.

The western channel or Outer River continues in its natural bed until it joins the Yang-tse River. The eastern channel flows down by the town to the intake and the spillway. The intake is a narrow channel cut at an angle with the Inner River by Li Ping through a rocky point to lead the water to a series of canals in the plain to the south and east of the town. This channel was cut quite deep and is so arranged as to prevent excessive flow into it during flood periods.

The spillway is the terminus of the Inner River. It is constructed of sloping banks so that the end of the channel is much like the inside of half a cone with the axis vertical and the apex down. The outer bank leading to this cone, as well as that of the cone itself, is protected by the long rock-filled bamboo baskets or "sausages" mentioned above.

This spillway in time of flood causes the water to rotate in a great eddy, so that before the surface of the stream itself rises above the banks, the centrifugal force throws the outer water of the eddy over the edges of the cone and down to the bed of the outer river, where it can flow away without endangering the rice fields of the plain by overflowing its banks.

Since the river channels may become choked with the sand, gravel, and boulders brought down in flood times, Li Ping made provision for the proper clearing of the channels of the Inner and Outer Rivers at low water seasons by connecting the central dike with one or the other of the main river banks by temporary dikes, thus deflecting all of the water into one channel. The other channel was then thoroughly cleared out to its proper depth. The proper depth was indicated by the exposure of two great pieces of iron which had been placed at the correct depth in the beginning. After one channel had been cleaned, the connecting dike was moved over to the other bank and the second channel was likewise cleaned out.

In order that this cleaning and maintenance should not be neglected over the years, Li Ping built a temple at the junction of the spillway and the intake and put the control of the waters in the hands of the priests, who have continued to make an annual religious ceremony and festival of the work ever since. This has been in operation continuously since its construction under the direction of Li Ping in 250 B.C. No flood or famine has occurred there in that time. It is one of the most remarkable engineering structures in the world.

CONSTRUCTIONAL MATERIALS

In China the "monuments of the past" are rarely the great stone or rock-hewn structures of other civilizations, such as the Egyptian, Greek, or Roman. They are of "earthy" materials and wood, with only a small amount of stone-work for ornament, or where special strength or wearing surface is required. Yet these structures are the work of a cultured, artistic, and civilized people.

The walls of cities, the permanent places, are made of blocks of dried or burned clay, filled in behind with well-tamped earth. In fact, the Chinese character for a walled city (and also for the wall itself) is the character for *complete* with the *earth* radical added. Surrounded by these city walls are temples, palaces, and mansions so well made of "mud," lime, bamboo, timber, and baked clay tile, that they rank as habitations of man on a par with the best of the West.

FIG. 2. Stone and timber construction.

FIG. 3. Single arch stone bridge at Soochow.

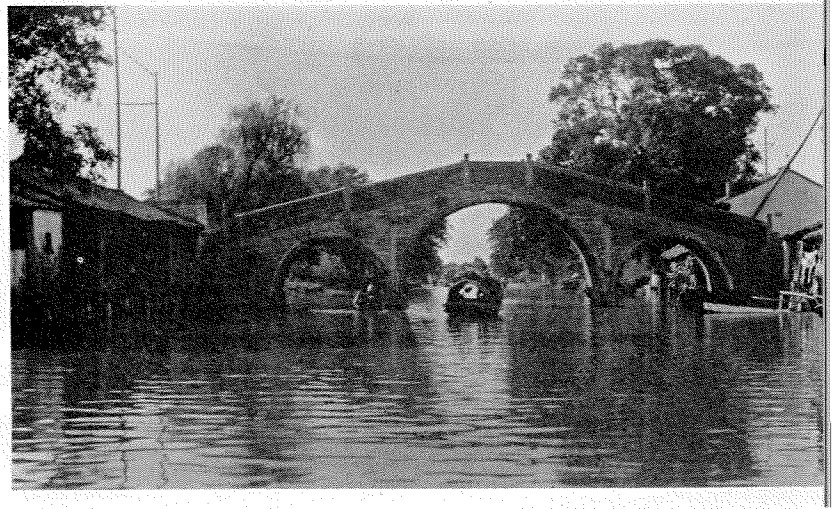


FIG. 4. Triple arch stone bridge at Soochow.

It might be mentioned here that, except in the more rocky and mountainous districts, the use of stone as a

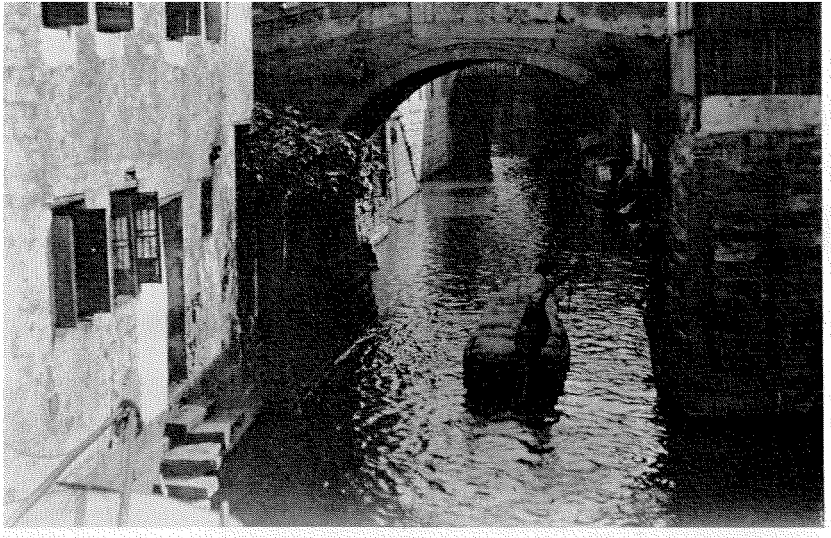


FIG. 5. Stone bridge over canal.

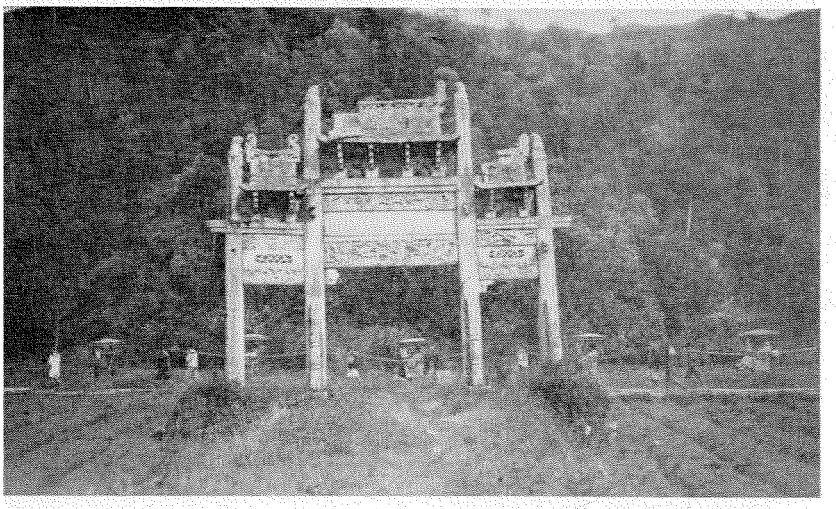


FIG. 6. An old pai-lou or memorial gateway.

major engineering material in China is virtually confined to work in contact with running water, such as bridges, dock and sluice walls, and the facing of some of the dikes. Earth in some form (dried, baked, or as pottery or earthenware), timber, bamboo, and straw are the common building materials throughout the greater part of this vast country. These materials are not the most durable and lasting, yet the Chinese have devised such ways of preparation and construction that structures made of them have lasted several hundred years.

The Great Wall of China itself and the much larger (in section) city wall of Peking are constructed of large clay and clay-lime bricks or blocks, usually six to 10 times the size of ordinary building bricks, or like our concrete blocks, and probably more durable under some atmospheric conditions.

In the Hang-chow area house and garden walls are constructed of tamped earth by means of movable forms that can be raised as the wall goes up, a method almost identical with that used in our modern chimney or high dam construction. These walls are even "reinforced" in a way by horizontal layers of burned tile about a foot apart vertically. Stone or timber is introduced into the construction (see *Fig. 2*) where beams, columns, or wearing surfaces are needed. The roofs are covered with burned clay tile, glazed or unglazed, depending on the wealth or position of the owner. Furniture and decorations of finer quality pottery and porcelain are a further addition, as desired. The walls both inside and out are usually plastered with some mixture of earth, lime, and chopped straw or fiber, and then color washed; in the better buildings they are quite weatherproof.

Stone, as mentioned above, is more in evidence in the construction of bridges (see *Figs. 3, 4, and 5*), dike facings at points where water flows rapidly, and *pai-lous* or memorial gateways (see *Fig. 6*). The bridges and *pai-lous* are often decorated with beautiful and intricate carving. The bridges are of several designs, from the great stone beams or slabs (each about one and one-half feet by two feet by eighteen feet in size), supported by thick stone columns, to lovely single and multiple arch bridges, some of over 50 spans. The famous "camel back" single arch bridges are very beautiful. The construction of the various types of stone arch bridges was carefully specified as to the various details. One of the associations of Chinese architects has studied and preserved the design details of many types of stone and marble bridges in publications put out by the commercial press of Shanghai. Some of these designs show very careful fitting together with keys and dowels of iron.

Timber and wood construction reached a high state of development, as can be seen in the wheelbarrows, carts, furniture, roofs of palaces and temples, and especially in the boats. Whether by simple observation or careful deduction the results of the people's handicraft, both in form and operation, show a very thorough acquaintance with mechanical principles and all phenomena of the forces of nature.

The structural details of the roof frames of the great temples, palaces, and city gate towers are fine examples of strength and beautiful design. In many districts where stone is not available timber bridges of planks on floor beams, supported by long timber piles and bents, similar to our own are used; the traveled way is usually covered with a layer of earth to act as a cushion or shock absorber. In other places suspension bridges of bamboo have been and are still used.

CHINESE BOAT DESIGN

Probably the most scientific and technical use of wood has been in the construction of the Chinese boats. From sea-going junks, or the great boats used on the large, swift-flowing rivers, to the smallest slipper boat and tender the most suitable and practical design has been carefully worked out. These vessels can weather the worst typhoon of the Pacific, with almost no attention from the crew, or make their way through the swift currents and rocky gorges of the great rivers of Asia, of which there are no counterparts. On the other hand they can be handled under many circumstances by old women and boys. A Scottish naval architect has said that they are the most perfectly designed boats in the world.

The ease of handling these vessels is due to many ingenious fittings. To mention just a few: special masts and sails for sea-going craft; high narrow sails for boats used on narrow canals and rivers (see *Fig. 7*), with sheets divided into many strands to obtain every ounce of pull from the wind, and bamboo strips or battens attached to the sails so that they can be raised or lowered quickly, much like a Venetian blind, not requiring to be gathered up and furled by hand; the hinged mast which can be folded down on deck in order to pass under low bridges; the capstan; the long sculling oar which is so bent that sculling the boat is almost automatic; the balanced rudder which requires a minimum of effort; long boats made in two parts and

†See *National Geographic Magazine*, September, 1944, p. 336.

hinged together so that they can be bent to go around sharp curves in narrow canals; warped boats† and also boats straight on one side and streamlined on the other for use under special conditions.

For the preservation of the wood and timber the Chinese have devised excellent waterproof varnishes of tung oil and the famous Ningpo varnish or lacquer, which must be applied in warm damp weather, else it remains sticky forever. The former, together with a lime and tung oil caulking paste, is applied to the hoats used by the guilds for transporting rice and silk so that the transportation of the cargoes in good condition can be guaranteed. The Ningpo varnish can be applied to all woods but is usually applied to Fukien pine, one of the poorest and most porous of woods. This wood is used for making washtubs, water and slop pails, and babies' birth and washtubs. When the utensil is finished, a paste of some reddish earth and oil is worked into the pores, and when this is dry, the Ningpo varnish is applied, which gives a fine waterproof glaze like porcelain, perfectly resistant alike to boiling water and various acids and caustics that would seriously injure other wood finishes.

TRANSPORTATION

The transportation problem is omnipresent, for the people are always moving about and for centuries goods from distant places have come into every district and local products of many special districts have been sent out to the distant borders of the country. When one considers that China has had all sorts of transportation problems, affecting everything that it is possible to transport (barring steam and electricity), it is easy to imagine that many remarkable methods have been devised to suit the conditions. It is true that the people's methods are not always mechanically efficient, but they are usually economically so, and usually sufficient for the purposes and conditions existing.

Water-borne traffic is found wherever water can be used for it. The distribution of the night soil of the country, a very big industry, is water-borne in two ways. In one case it is much diluted with water, then loaded into small tank boats and transported by water

*See *National Geographic Magazine*, September, 1944, for some good illustrations of engineering structures associated with the great salt industry, a government monopoly.

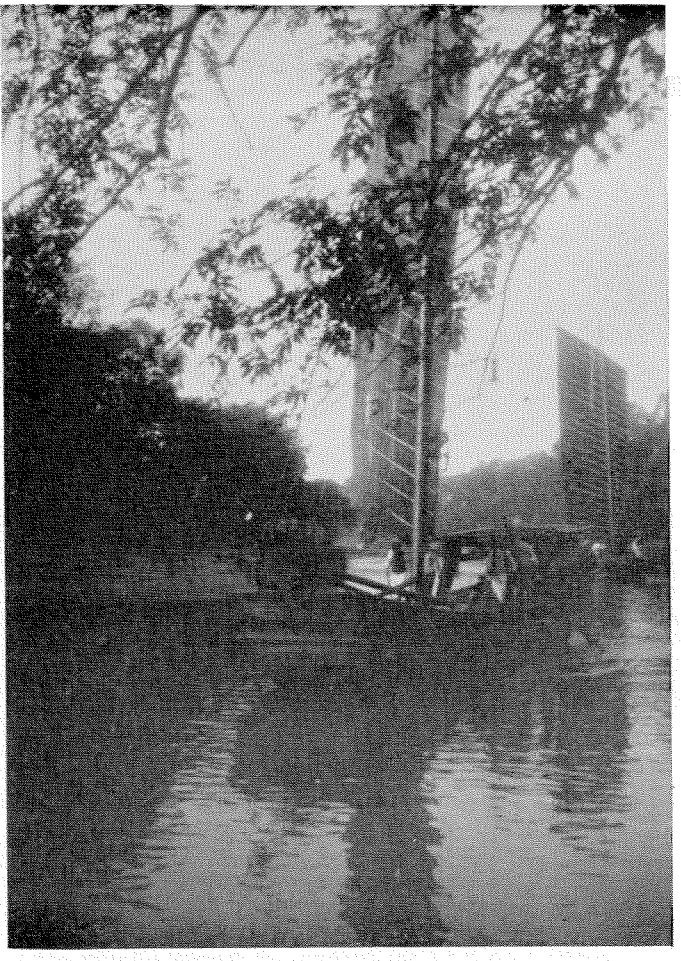
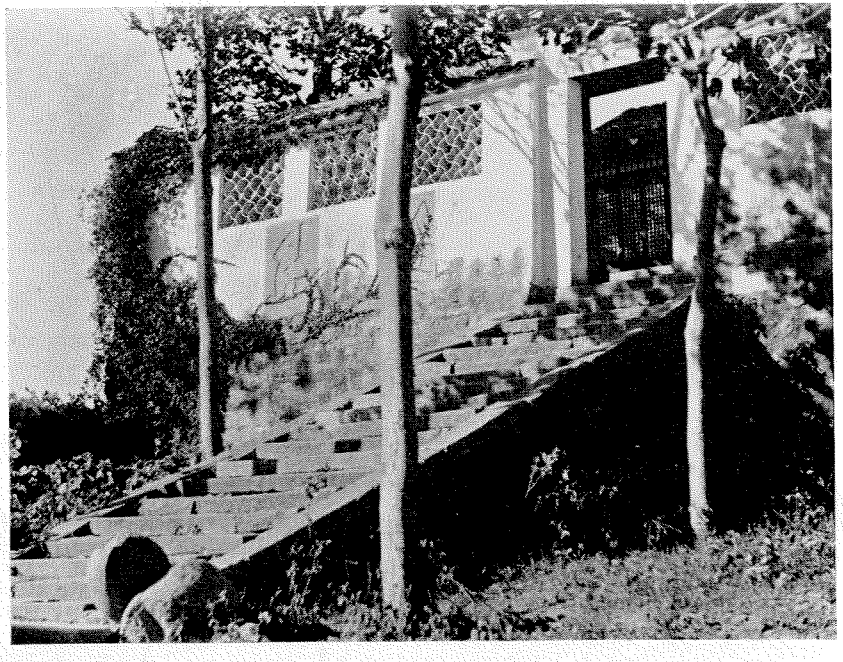


FIG. 7. Canal boats with high narrow sails on Soochow Creek.

to the farmer's fields. Also pipe lines of bamboo, wrapped with narrow bamboo strips, have been used for ages to convey water and transport the brine from the salt wells.*

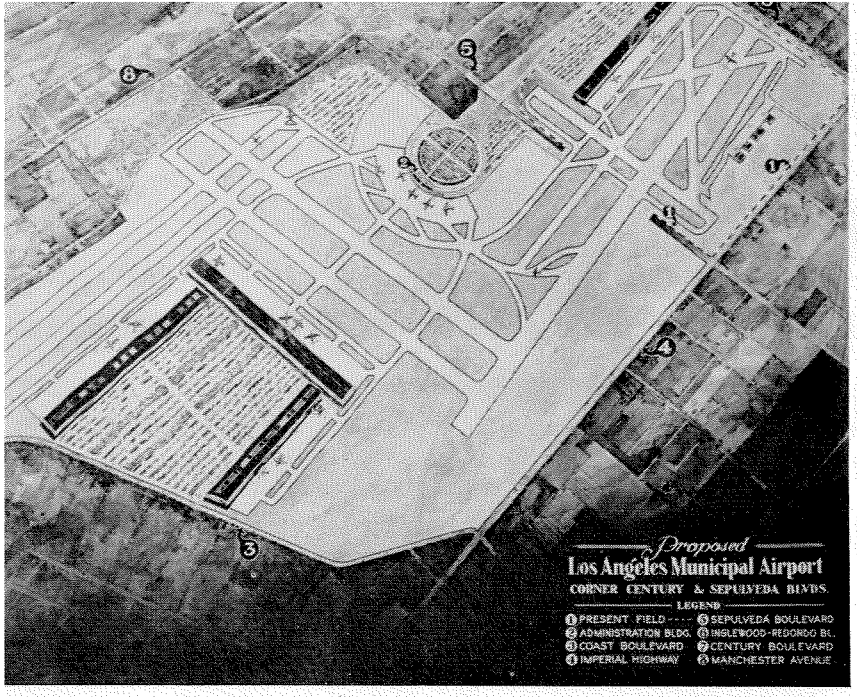
Probably next in importance is transportation by human beings, one man with a bar on his shoulders and two balancing loads, and two men with one bar over

(Continued on Page 14)



AT LEFT:

FIG. 8. Oblong slabs of granite used for pavements and steps.



LOS ANGELES NEEDS *An Airport Program*

By T. C. COLEMAN

UNLESS we have more intelligently directed action in planning for and acquiring sites for airports in California during 1945 and 1946, it is likely that California will no longer remain the "10 per cent State in Aviation." For many years our state has been the home of about 10 per cent of the airplanes of the country and over 10 per cent of the pilots. In January, 1939, with 4 per cent of the nation's population, we had 1,179 airplanes based in the state, or 10 per cent of the total non-military aircraft, and 4,207 licensed pilots, or 18 per cent of the total. No other state had as many airplanes as California and only five states had more than the 501 planes based in Los Angeles County. In California 84 per cent of the airplanes were light, privately-owned craft.

INSURE LEADERSHIP IN FLYING

Most people assume that Los Angeles will lead in postwar flying because we are likely to continue to lead in building airplanes. But where are the estimated 30,000 airplanes in California going to take off, land, and be serviced and stored if we reach the five-to-10-year national forecast of 300,000 airplanes and maintain our 10 per cent position? In earlier studies made before the outbreak of war in Europe it had been more conservatively estimated that if the rate of increase in private flying continued on a straight-line basis, there would be 5,000 airplanes in Los Angeles County by 1950 and 9,000 by 1960. This estimate is based on a population of 5,000,000 in 1960 (we have nearly 3,350,000 now) and the ratio of one airplane per 600 persons. No provision is made for visiting airplanes in these estimates. The author assumes that California will continue to be a popular destination for out-of-state private fliers, if we have airports to handle them.

HOW MANY AIRPORTS DO WE HAVE?

Just before the war we had the following airport facilities in Los Angeles County: (See map)

Class 4 (Major Air Terminals)—3

Map Key

(1) Los Angeles Municipal Airport; used by: North American, Douglas, El Secundo, Military.
(2) Union Air Terminal (now Lockheed Air Terminal); used by: Airlines, Lockheed.
(3) Long Beach Municipal Airport; used by: Douglas, Military, Airlines.

Class 3 (Feeder Airports)—5

(6) Santa Monica Airport; used by: Douglas.
(7) Metropolitan Airport, Van Nuys; used by: Timm, Military.
(9) Lancaster Airport.
(10) Reeves Field, San Pedro; used by: Military.
(8) Vail Field, East Los Angeles.

Class 2 (Feeder Airports)—11

(11) Compton Airport.
(12) Alhambra Airport; used by: Harlow Aircraft.
(13) Grand Central Airport.
(16) Culver City Airport; used by: Hughes Aircraft.
(17) Gardena Valley Airport.
(18) Los Angeles Eastside Airport.
(20) Pomona Airport.
(22) Newhall Airport.
(23) Palmdale Airport; used by: Military.
(25) Monrovia Airport.
(36) Wilmington Airport.

Class 2 (Feeder Seaplane Bases)—1

(41) Avalon Seaplane Landing.

Class 2 (Factory Airports)—3

(31) Vultee Airport, Downey; used by: Vultee.
(32) Lockheed Airport, Burbank.
(33) Northrop Field, Hawthorne; used by: Northrop.

From the above tabulation of 23 airports of all descriptions, it was apparent to the Los Angeles County Regional Planning District engineers that this number was hardly adequate for the prewar needs of our community. Therefore, a study was undertaken by that organization and the results of the study made public early in 1940, when the "Master Plan of Airports" was published under the direction of Colonel Wm. J. Fox, Chief Engineer, and sponsored by the Los Angeles Chamber of Commerce, Lockheed Aircraft Corporation, and the California Air Industries Association, Ltd.

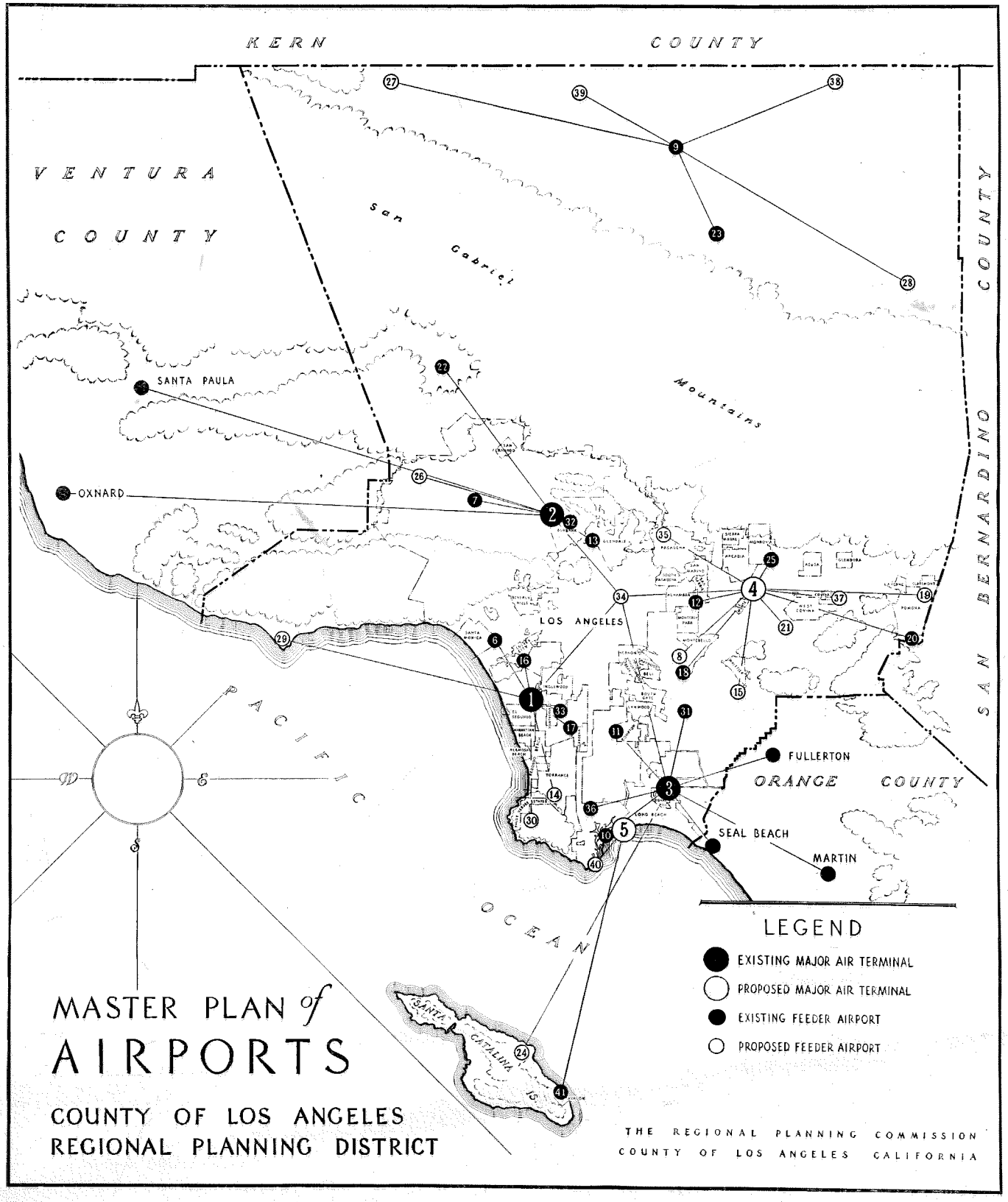
At that time the maximum length of concrete runway for any airport in the county was 5,000 feet (Los Angeles Municipal). The average length of runway for Class 4 (Major Terminals) airports was 4,200 feet and for Class 2 (Feeder Airports) under 2,000 feet. Pavement was the exception rather than the rule in the latter case, and most airports were far from presenting a pleasing appearance. Only three were at all suitable for commercial use.

NEW AIRPORTS PROPOSED

The "Master Plan of Airports" in 1940 proposed many new sites, shown on the accompanying map. None

of these sites has been acquired for airport purposes, to the author's knowledge, with the possible exception of military installations which are not announced publicly. Most of the development of military airports since the war has been in remote sections of the state, which are practically inaccessible by automobile to the large centers of population—a condition prohibitive to the private flier. Furthermore, some of the airports listed as available in 1940 may continue to be used exclusively by manufacturers or commercial operators, and some of the privately-owned small airports have been abandoned because of the recent restrictions on private flying while the war is in progress.

With the trend so decidedly away from providing facilities for the private flier (a trend which was in evidence long before the war began), unless some of the sites named below, or others, are acquired and improved, it is hard to visualize the healthy revival of private flying in and around Los Angeles. The "Master Plan" suggested the following additional airport im-



provements; they are listed in recommended order of priority:

Class 4 (Major Air Terminal)—1

Map Key

(4) San Gabriel Valley Airport.

Class 4 (Seaplane Terminal)—1

(5) Los Angeles-Long Beach Seaplane Base.

Class 2 (Feeder Airports)—15

(14) Lomita Airport.
(15) South Whittier Airport.
(19) Pomona-Claremont Airport.
(21) Puente Airport.
(24) Buffalo Springs Airport (Catalina Island).
(26) Reseda Airport.
(27) Quail Lake Airport.
(28) Black Butte Airport.
(29) Point Dume Airport.
(30) Palos Verdes Airport.
(34) Downtown Landing Field.
(35) Arroyo Seco Landing Field.
(37) Covina Airport.
(38) Joshua Airport.
(39) Antelope Airport.

Class 2 (Feeder Seaplane Base)—1

(40) Cabrillo Beach.

HOW MANY AIRPLANES WILL THIS PLAN HANDLE?

This number of additional airports (18), together with expansion and improvement of existing airports, may sound ambitious, but when one considers the fact that only one additional major air terminal, one new major seaplane terminal, and 16 Class 2 (small feeder type) terminals are involved, it may not even be adequate for immediate postwar needs. Of the less than 40 land airports listed, one was used before the war exclusively by the Navy, nine are remote, and three are private factory fields, leaving only 25 for ordinary civilian and commercial use. "These 25 must harbor practically all civil airplanes in the county. At least two of the major air terminals will be required to accommodate transport planes, and heavy transport traffic may ban the private flier from their use. Two feeder airports are proposed as taxi or local stations with limited storage facilities. One is a special site more adaptable for factory or military use. Therefore, about 20 airports can provide accommodation and hangar space for private flying," says the "Master Plan."

The planners further estimated that the capacity of these airports, if provided with single runways, is: 3 large airports—300 airplanes; 17 smaller airports—1,000 airplanes.

This number of airplanes is little more than twice the number of civil airplanes in use in Los Angeles County in 1939. Further expansion would be possible by improving and expanding all existing airports, or adopting a more ambitious plan. Some airports have been improved since the war.

SOME PLANNING NOW UNDER WAY

On the more optimistic side, it is encouraging to note that such civic groups as the aviation committees of the Los Angeles and Pasadena Chambers of Commerce have succeeded in getting the Los Angeles County Board of Supervisors to appropriate funds for a revision of the "Master Plan for Airports," now under way at the Regional Planning Commission's engineering office under the able direction of Taylor Suess. Also, the City of Los Angeles Department of Airports, under the guidance of the Board of Municipal Airport Commissioners and the newly created Aviation Ways and Means Committee, is planning a large-scale expansion for the Los Angeles Municipal Airport.

WHERE DO WE GET THE MONEY?

The stumbling block is, of course, money. To complete the full plans for the expansion of the Los Angeles Municipal Airport alone will call for at least $25,000,000. Investments in private and municipal airports in Los Angeles County by 1940 had reached only about $12,000,000, and the Regional Planning Commission originally estimated that an additional $16,000,000 (exclusive of the Los Angeles Municipal Airport) would be required to complete its plans.

This is still a modest sum when compared with the cost of improving harbors and highway systems. Private capital cannot do a large part of this financing. Except for some of the large ones, few airports can be made entirely self-supporting. Various proposals for federal aid, state and local bond issues, aviation gasoline tax, and license fees are currently being made. Because aviation has rapidly become big business, the whole issue of airport development may get well snarled in politics.

A FEW SUGGESTIONS

The creation of a County Airport Authority with power to act, soliciting the help of the Federal government, adequate planning, land acquisition before speculation in land for airports can become too prevalent, and a realistic approach to the fact that the aviation industry is already paying a big local and state tax without benefit of state and local funds for airports are a few of the first steps which can be taken now. We must get down to earth before we can get Los Angeles into the air.

The Month in Focus

(Continued from Page 3)

which has grown up literally with the aircraft industry, Los Angeles' air terminal situation is notoriously unsatisfactory. T. C. Coleman's authoritative article relates the problem of providing suitable freight and passenger handling facilities, then presents some possible solutions. It has been said that only a dozen fields in the world are adequate for handling B-29 bombers, and that postwar commercial transports will be even larger than these giants of the sky. The strategic value of early action to attain Mr. Coleman's objectives is thus quite apparent.

ELECTRIC UTILITIES MEET WARTIME PROBLEMS

The article by Alex A. Kroneberg, senior electrical engineer for the Southern California Edison Company, appearing in this issue, discusses problems met by Mr. Kroneberg's company in satisfying ever-increasing demands of war industries for electric power. The April issue will present a very informative discussion by Alan Capon on the solution of municipal utility problems arising from the dramatic aircraft-accelerated growth of Burbank. Ten years ago Burbank was a typical residential, marketing, and small-scale manufacturing center in the suburban fringe of metropolitan Los Angeles. Today it is a booming aircraft-production center with greatly enlarged domestic and industrial demand on its municipal utilities. Tomorrow, what?

War Problems of Electric Utility Engineers

By ALEX A. KRONEBERG

THE increased demands for electric power created by war industries and the parallel scarcity of critical materials and manufacturing facilities for making generators, transformers, and wire needed in a corresponding expansion of utility systems have imposed severe operating problems on electric utilities. The increase in use of electric energy is illustrated in *Fig. 1*, where the total annual generation of energy in the states of Arizona, California, and Nevada has been plotted, beginning with 1900. Actual statistics are not yet available for the year 1944 but current records permit the estimate of approximately 23 billion kilowatt-hours generated in these states in 1944. The output in 1941 was 14.4 billion kilowatt-hours, which means that energy use since Pearl Harbor has increased 60 per cent.

INTEGRATED OPERATION

Early in 1942 it became apparent that the materials required for United States participation in the war and the production of equipment for the Allied countries were causing a critical shortage of certain materials. The War Production Board was given the task of conserving critical war materials. At the same time the Pacific southwest area faced an increased electrical demand of approximately one million kilowatts of new war load, consisting of the production of electrolytic aluminum and magnesium, steel, synthetic rubber, airplanes, ships, and high octane gasoline, and for military camps, new housing, and miscellaneous small industries. Preliminary studies indicated that if the generating capacity scheduled for installation by utilities serving the area was deferred because of the critical material and manpower situation, the Pacific southwest would become one of the most critical power regions in the United States. Accordingly, J. A. Krug and V. M. Marquis, officials of the Power Branch of the War Production Board, came to southern California to study the problem. A meeting of utility executives was called by Mr. Krug. A program based on full integrated operation of all electric utilities was outlined which would assure continuous electric service to the war industries and still permit the deferment of 715,000 kilowatts of generating capacity then scheduled for installation. This program was agreed upon by all utilities.

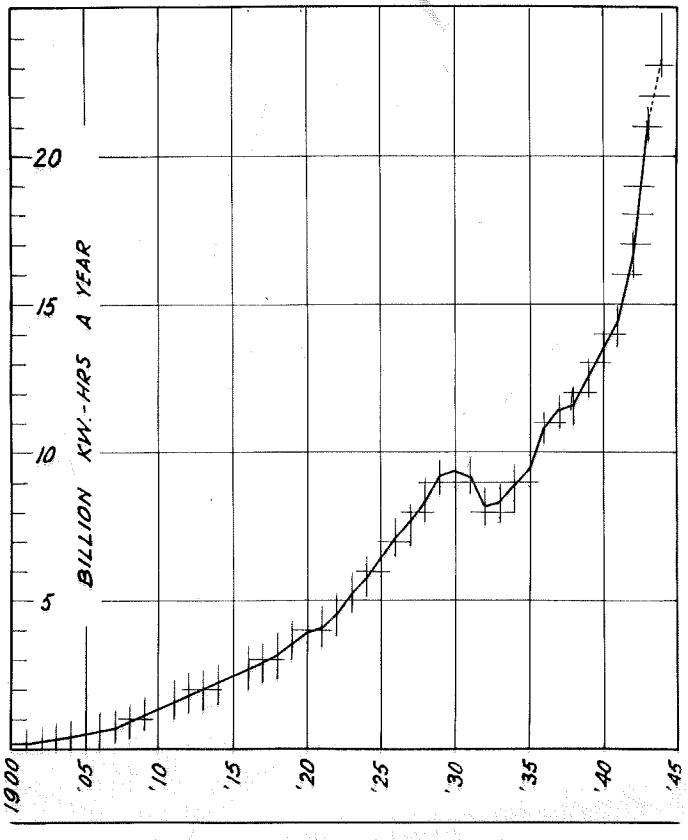


FIG. 1. Annual generation of energy in the states of Arizona, California, and Nevada.

A committee was organized in May, 1942, consisting of engineers familiar with operating problems and representing all utilities in the area. The first task of the committee was to make a study of the resources and loads of all utilities in the area. In general this was accomplished by having a representative of each utility submit the load and resource estimates for his system to Southern California Edison Company's engineers, who compiled the information on an area-wide basis. Copies of the completed tabulation were distributed to the War Production Board and the several utilities for final analysis. The completed studies were analyzed as to estimated load growth, adequacy of generating capacity, and adequacy of interconnections with neighboring utilities. A study of contractual arrangements between adjacent utilities was made to ascertain their adequacy for maximum interchange of power.

Upon completion of the load and resource studies an analysis of system facilities was made for the entire area, which now consists of all of California and practically all of Arizona and Nevada, with the object of charting an operating program which would assure adequate resources to carry the wartime loads of every utility in the area with a minimum use of strategic materials. Recommendations were made for additional generating capacity and for increased interchange capacity only where unavoidable. It was the further objective to operate the entire area on an integrated basis in order to assure a minimum use of critical fuel oil. After completion, the original studies were continually kept up to date in accordance with changes in load estimates and hydrological conditions.

Under the guidance of the committee all the interconnected generating facilities in the area have operated as an integrated single system in order to insure the maximum use of water power and to save fuel oil. The increased interchange of power among utilities has saved critical materials which would have been required for construction of new generating equipment. Since the new loads totalling approximately one million kilowatts were added, the generating capacity has been increased by only 550,000 kilowatts, excluding the 90,000 kilowatt generator which was released for operation at Boulder Dam on November 1, 1944. The present-day generating capacity in the area is approximately 4,590,000 kilowatts.

TIME CHANGE A FACTOR

In the states of Arizona, California, and Nevada the sales of electric energy nearly doubled between 1939

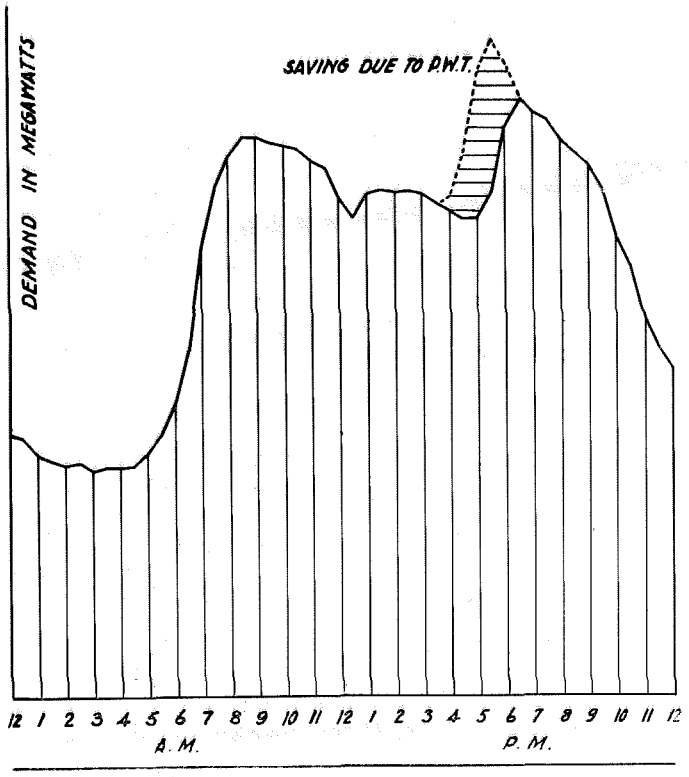


FIG. 2. Typical winter day load curve of an electric utility showing the estimated effect of change from Standard to War Time.

and 1944. This increase, however, was handled by an increase of only 25 per cent in generating capacity. Such a record was possible only through the close cooperation and integrated operation of all electric properties. The utilities have been greatly assisted in the effort to supply energy to the growing load at a minimum of new generating installations by the change from Standard Time to War Time. The effects of the change cannot be accurately evaluated but a reasonable estimate shows that the peak demands of utilities have been reduced by approximately 10 per cent. *Fig. 2* shows a typical winter-day load curve of the Southern California Edison Company and the estimated saving in demand due to Pacific War Time. The reduction in demand may have saved the installation in the Pacific southwest of generating capacity to the amount of some 250,000 kilowatts and the installation of distribution transformer capacity in residential areas that is even more difficult to evaluate.

GAS, OIL, AND WATER INTEGRATED

In January, 1944, it became apparent that the water resources of California and the Colorado River would be subnormal for the year, necessitating a large consumption of critical fuel oil to cover the deficiency. A meeting was arranged in February, bringing together the electric utilities, oil and gas companies, the War Production Board, and the Petroleum Administration for War. As a result of a cooperative program worked out at this meeting, fuel oil use for power has been cut by about 50 per cent. The Southern California Edison Company steam plants have in effect operated as a regulating valve for southern California gas systems, increasing and decreasing load to enable the gas transmission lines to operate at full capacity at all times. This has made it possible to operate oil wells at full output continuously without wasting gas. Thus to cooperation among individual electric utilities was added cooperation with oil companies and gas utilities.

The accomplishments of the cooperative efforts under the direction of the committee can be summed up as follows:

1. Integrated operations have saved critical war materials which would otherwise have been required for additional generating equipment and transmission lines.

2. Fuel oil was saved by the use of all water power resources in the whole area in lieu of power generated by fuel oil.

3. Additional savings in fuel oil were achieved by the use of surplus gas fuel regardless of its location in the area.

UPRATING OF EQUIPMENT

In the field of transmission and transformation utility engineers faced the same conditions, *i.e.*, increasing currents and restrictions on material. The practice of uprating equipment has been widely followed throughout the country as a wartime measure. The current-carrying capacity of overhead line conductors in the past has been based on a 40 degree Centigrade rise above ambient in still air. Experiments showed that slight air movements such as two feet per second lower the temperature of conductors considerably and allow them to carry more current for the same temperature rise. For example, a 4/0 stranded copper conductor would carry 360 amperes in still air and 450 amperes with a two-foot-per-second air movement around it with the same temperature rise. It has been very seldom, however, that the capacity of overhead lines has been limited by the current-carrying capacity of the conductors. The limitation has been as a rule the more or less arbitrary standard of voltage regulation. The war emergency has compelled utility engineers to sacrifice some of the high standards set for voltage regulation of transmission and distribution lines in order to carry the added load on existing lines.

On existing self-cooled transformers it is possible in practically all cases to obtain an increase of 25 to 33 1/3 per cent in capacity by the application of fans or blowers for forced-air cooling. This, however, as in the case of overhead transmission lines is obtained at the expense of voltage regulation and for this reason has been limited in practice. The past practice of the Southern California Edison Company in installing large power transformer banks has been that of installing four transformers, three of them in a bank and the fourth as a spare. When load required additional capacity at the same location, two new transformers would be purchased and banked with the spare one to make a second bank. During the war emergency the spare transformers scattered among the various substations enabled the company to furnish service to new plants and military loads without delay by combining three spare transformers of similar characteristics removed from different locations into an active bank serving the new load.

In a number of cases it has been possible to shift or to exchange transformer banks between lightly loaded and overloaded substations and thereby to put idle transformer capacity to work. Approximately 100,000 *kva* of transformers have been shifted on the lines of the Southern California Edison Company in order to load them up. In some cases as many as three or four substitutions were made to release additional capacity. As an example, a new 75 *kva* transformer would displace a lightly loaded 150 *kva* transformer. The latter would in

turn be substituted for a lightly loaded 250 *kva* transformer, releasing it for service to a new load. A program of this sort involves much careful study of detail, of load records over long periods of time, and of prospective load increases in all locations involved, but as in the case of integrated operation of generating facilities it has resulted in the carrying of increased loads with the addition of transformers equal to but a small fraction of the increase in load.

Among problems created by scarcity of critical materials the substitution of iron wire for copper and wood for structural steel should be mentioned. The substitution of iron wire for copper is highly unsatisfactory, since the resistance of iron wire is in the order of 10 times for the same size of copper wire. Fortunately the crisis in copper production was overcome before any extensive installations of iron wire had to be made. A number of substations were built, using lumber in place of structural steel. During the last year, however, the situation has been reversed and lumber has become more critical than steel.

LEND LEASE AND REPLACEMENT

Late in 1942 the procurement division of the United States Treasury Department requisitioned two 42,500-kilowatt 50-cycle turbine generators from the Long Beach steam plant of the company for lend-lease shipment to one of the United Nations. This nation had suffered so heavily in production capacity as a result of the loss of a large power development that relief was considered necessary in less time than would be required for the manufacture of new machines. Under existing conditions, earliest possible replacement of the requisitioned generators was highly important from the standpoint of the Southern California Edison Company as well as the Pacific southwest area. With the excellent cooperation of all interested parties, including the W.P.B., replacement has been effected in record time. The work of removing two units and replacing them required a total of approximately 10 months from the time the first turbine was posted by the government representatives to the time of admitting first steam to the new machine.

The requisitioned equipment, and hence the equipment that it was necessary to replace, comprised the turbine and generator, condenser, and all auxiliary equipment from the main steam header to the boiler feed pumps, with the exception of the circulating pumps and piping. The latter pumps were not taken with the units because their head characteristics did not conform to the requirements of the foreign station site.

Representatives of the Office of War Utilities, W.P.B., offered lists of available equipment. Included was information that manufacture of an 80,000-kilowatt machine had been undertaken for a Midwest utility as part of an expansion program that had recently been canceled. Investigation developed that although this machine had been designed for 850 *p.s.i.*, 900 degrees Fahrenheit, manufacture had only been started, and the machine could still be adapted to Long Beach steam conditions. To adapt the original design to 375 *p.s.i.*, 700 degrees Fahrenheit steam conditions, the manufacturer increased turbine steam-admission areas and provided two steam supply lines.

Each of the two generator windings has been connected to a separate 39,000 *kva* transformer bank remaining from the original installation. The generator is totally enclosed and equipped with self-contained heat exchangers, permitting the use of hydrogen as a cooling medium and condensate as a coolant. The direct connected exciter is air cooled.

Because of the short time and production schedules, Allis Chalmers Company built the condenser to C. H. Wheeler Company design, originally prepared for the unit when on order for the Midwest location, the latter company cooperating by releasing its drawings. Most of the auxiliary system was assembled from leftovers, from secondhand material taken from existing piping in the plant wherever it could be spared, and partially fabricated material for canceled projects. The condensate pumps and air-removal equipment were manufactured by Allis Chalmers. The job is an example of tailoring the feed-heating cycle to fit available equipment. The engineers did this satisfactorily and, with the aid of the W.P.B., obtained and installed all necessary equipment for initial operation with the turbine.

SECURITY

In addition to the major problem of meeting increased load demands in the face of shortage in new facilities there were a number of other problems created by war conditions. A few of these deserve brief mention. War conditions introduced new hazards to operation such as possible sabotage, barrage balloons breaking loose from their moorings and pulling their cables across transmission lines, airplanes out of control contacting transmission lines, target-towing cables falling into transmission lines, etc. Since electric power-supply is an essential element in war production, the safeguarding of generating and transmitting properties of all utilities was a matter of concern not only to the utilities themselves but to the Army, Navy, law enforcement agencies, and regulatory commissions. A high degree of cooperation was maintained with the above agencies. Telephone installations and line extensions were made from the company's private communication system to Army, Navy and civilian defense headquarters. Installations were made for street-light blackout controls, and, in addition, the Army has been permitted to use company poles and in some cases company telephone lines for communication between guard posts. Installations were made for bomb splinter protection at key stations. Oil level alarms on outdoor transformers, fences, etc., were installed for sabotage protection. The company hired, trained, and installed armed guards at major stations on the system to augment the military guard. The utility repair corps was organized and equipped with gas masks, steel helmets, decontamination units, and pumps. Some 363 automobiles and trucks were equipped with approved blackout lights for this service. Men were trained in bomb reconnaissance and decontamination of war gases and were in a position to handle this type of emergency work. In 1944 the Southern California Edison Company received the National Security Award for the maintenance of a superior standard of protection and security.

In concluding this brief outline of war problems of electric utility engineers, not the spectacular job of developing radar, rockets, etc., but still a big job that had to be done, the author quotes from an address by J. A. Krug to T.V.A. distributors at Chattanooga, Tennessee, on February 16, 1943: "The power men—public and private, in this area and throughout the country—should be proud of the job that has been done in providing power supply. Power has never been 'too little, or too late.' There is today no shortage of power. This is in sharp contrast to the situation as to many other vital necessities. I do not know of a single instance in which the operation of a plant has been delayed by lack of electric power supply. . . . I repeat, the power men of the country can be proud of the job that they are doing."

Chinese Engineering

(Continued from Page 7)

their shoulders and the load between: this last method can be multiplied so that one large heavy load can be carried by as many as 50 men using a composite arrangement of their shoulder bars. Then come various wheelbarrow and cart methods, using men and also animals as the motive power. These last are the least efficient in many ways and the most destructive to the roads, as the barrow and cart tires, being made narrow and concave like a shallow pulley, cut into the earth-road surface and literally chew it up, making deep ruts and hollows. The explanation given for the use of such tires is that they made it easier for the vehicle to climb out of deep ruts and gutters than a flat tire. For that reason many of the roads and cartways of the northern and western plains of China are literally deep trenches which become veritable canals in the rainy season. When they become too deep or muddy, the carters detour at the sides through the farmer's field. To circumvent this practice the farmer digs shallow, grave-like pits or fox holes perpendicular to the road to act as obstacles, thus instituting a sort of economic tank trap.

Usually in the larger towns and near the temples and in the area of the residences and offices of officials the roads are paved with oblong slabs of granite (see *Fig. 8*). This is probably a financial measure rather than an engineering one, as the temples at the various festival times are the centers of big markets and many fees are collected then and at the officials' *yamens;* paving facilitates the easy movement of large crowds, especially in wet weather.

MECHANICAL EQUIPMENT

The foregoing are only a very few examples of the old engineering developments of the Chinese. Contact with Western merchants, manufacturers, seamen, engineers, and others in the treaty ports has brought new and different ideas to their attention. When to their critical minds these new ideas have shown desirable qualities, and if they could be utilized cheaply, the Chinese have not hesitated to adopt them. Before several specimens of their adaptations and adoptions are described, let an instance be given of how some of them came about. One of the large American engineering firms in Shanghai put on quite an exihibit of American machinery and equipment, including even a large tractor-drawn plough, one turn of which would have turned over an average Chinese field. Off in one corner, as a sort of filler to the exhibits, was a small kerosene-driven water pump giving a two-inch or two and one-half-inch stream from a small pool. It was not advertised in any way, but a lot of old farmers were hanging over the railing surrounding it, just looking. Within a very few months the small stock of these pumps (which the writer later learned had been imported for the use of contractors to empty pits and foundation excavations) was exhausted. Another 40 or so were ordered from the United States and these were quickly sold, and another lot of 80 were sold before they arrived in Shanghai. The pump was small, cheap, and used kerosene, a commodity used for lamps and distributed over all of China by the big oil companies. The canny old farmers saw a satisfactory solution to their irrigation problems, since one pump, mounted on a small sled or frame, could be transported anywhere and would serve many farmers.

Secondhand machinery is bought, repaired or altered, and put to some good use. Old steam launches or small tow-boats soon pay for themselves by towing long strings of hand- or wind-propelled boats through the long canals, dropping them off as freight cars are left at sidings in this country, but in this case the "freight cars" can then go where they are required under their own power.

Secondhand electric motors are more and more taking the place of handpower in the many small shops in many of the towns.

One of the most sensible and rapid adoptions is the collecting of old motorcar and truck tires and putting them on the man- and animal-drawn carts. Their use spread like wildfire, for two to four times the former loads could be drawn by about one-half of the men or animals required for the old narrow tires, and these rubber tires helped immeasurably to preserve the roads. Though too far gone to serve on motor vehicles, they would give long service on the soft earth roads at the very slow speed of operation on the carts.

Wealthier and more progressive companies, noting the advantages, began replacing worn-out equipment with new, foreign machines, so that today in the treaty ports and larger cities one may find anything ranging from the ancient method and machine to factories as up to date as many here in the United States. Motor busses and trucks have definitely proved themselves to the Chinese and they are adopted wherever possible. The use of little things, such as watches, fountain pens, kodaks, and the like, has spread to all corners of the country, for not only have the Chinese recognized the convenience of their use, but the possession of such things confers a sort of scholarly distinction on their owners, a very important consideration in China.

The use of concrete, plain and reinforced, has been growing steadily over the last 20 or more years, and one of the good cement mills of the world is located at Shanghai. It is owned by Chinese but is under Swiss supervision and is based on the operations of one of the best of the plants in Switzerland. The raw material, which is excellent for the purpose, is found near by.

In fact, when the demand is great enough, Chinese companies will produce a great many of the things which we produce in the United States. The quality may not be as good to begin with as the quality of our goods, but if the competition is keen enough, and there is still a chance for profit, the quality will be improved. It is doubtful if many very large corporations as we know them will be established for some years, as the family instinct is strong and the desire to keep all profits in the family will act as a deterrent. However, the vicissitudes of the war and the almost complete shake-up in the life of the people may produce unforeseen changes.

The story of the technical accomplishments of the Chinese has come nowhere near being told. Many more will be exposed to Western eyes as the result of the recent influx of outsiders to the old conservative parts of China, where the old methods and tools are still regularly used. If this short sketch serves to arouse even a little interest in the life and lives of the Chinese people, it will have served its purpose.

The eighth Annual Seminar of the Alumni Association will be held on Sunday, April 22. Announcements will be mailed out the first part of the month.

C. I. T. NEWS

SUBSTITUTE FOR BLOOD PLASMA DEVELOPED AT CALTECH

THE California Institute of Technology announces that a group of investigators at the Institute, headed by Professors Dan H. Campbell and Linus Pauling, have developed a new substitute for blood plasma. Tests have shown that this material, which is called oxypolygelatin, can be satisfactorily used as a substitute for human plasma in the treatment of shock. Preliminary studies of the material are very promising, but the final physiological and clinical testing has not yet been completed, and the material has not been released for public use.

The development of this plasma substitute has been carried out during the last three years under a contract with the Committee on Medical Research of the Office of Scientific Research and Development. The proposed plasma substitute is made by the treatment of gelatin with certain chemicals. Gelatin itself, specially prepared and purified for this purpose, has been used to a small extent in recent years as a plasma substitute, with some success. When the gelatin is treated with two chemicals, glyoxal and hydrogen peroxide, chemical reactions occur which lead to the production of oxypolygelatin, which has improved properties as a plasma substitute. The gelling tendency is reduced, permitting the solution of oxypolygelatin to be injected at room temperature, without preliminary warming; the material is available for injection at any time. The number of acidic and basic groups on the molecules is changed in such a way as to make the material resemble closely a normal constituent of plasma, serum albumin. The chemical treatment also increases the time of retention in the blood stream, and in this way improves the effectiveness of the material as a plasma substitute.

The investigators at the California Institute of Technology have expressed the opinion that oxypolygelatin may be of special value in peace times for the emergency treatment of burn shock and shock due to wounds. Since the material does not contain any red blood cells, it is not a satisfactory substitute for whole blood. Moreover, although oxypolygelatin is designed to serve as a plasma substitute, it is not believed to be as effective as human plasma, and no plans have been made for general use of this new material in place of human plasma.

DU PONT COMPANY OFFERS 35 RESEARCH FELLOWSHIPS

THIRTY-FIVE postgraduate fellowships at 29 universities are offered by E. I. du Pont de Nemours and Company for the academic year of 1945-46.

This is an increase of 13 over previous years and for the first time includes two fellowships in physics, reflecting the increasing need for physicists in the chemical industry. Five of the fellowships are in chemical engineering and 28 in chemistry.

Two changes have been made in the fellowship plan this year. First, in order to equalize the value of fellowships among the various universities, where tuition rates differ, the company is paying the tuition in addition to the stipend. And second, the amount of the stipend has been increased from $750 to $1000. Women as well as men are eligible, and selection of the recipients and the subjects of their researches are left to the universities. Holders of these fellowships are not restricted in any way in their choice of position when the fellowship expires.

This plan was adopted by the company to encourage and assist graduate students at a time of acute shortage of trained research people. It was felt that this was one way in which it was possible to help universities in the task which all of them face in rehabilitating and rebuilding their graduate schools. The Du Pont fellowships were established in 1918, another period in which there was a shortage of well-trained chemists, and have been maintained with but one interruption ever since.

It is expected that a number of veterans, returning to school after discharge from the armed services, will be eligible for the fellowships this year.

Eight universities were added to the fellowship list this year, and the universities and the subjects in which the fellowships are offered follow: Brooklyn Polytechnic Institute, chemistry; Carnegie Institute of Technology, chemical engineering; University of Indiana, chemistry; University of Iowa, chemistry; University of Nebraska, chemistry; University of Notre Dame, chemistry; University of Rochester, chemistry; and University of Texas, chemistry.

The universities at which several fellowships are offered and the fellowships to be granted at each are as follows: Columbia University, one each in chemistry and chemical engineering; Massachusetts Institute of Technology, one each in chemistry, chemical engineering, and physics; University of Chicago, one each in chemistry and physics; University of Michigan, one each in chemistry and chemical engineering; University of Wisconsin, one each in chemistry and chemical engineering.

One fellowship in chemistry is being offered at each of the following: California Institute of Technology, Cornell University, Harvard University, Johns Hopkins University, Northwestern University, Ohio State University, Pennsylvania State College, Princeton University, Purdue University, Stanford University, University of California, University of Illinois, University of Minnesota, University of Pennsylvania, University of Virginia, and Yale University.

"ELECTRICAL THINKER"

Dr. G. D. McCann, '34, in a talk given before the American Institute of Electrical Engineers at their annual meeting in Pittsburgh, told members that Westinghouse Electric and Manufacturing Company's engineers have developed an "electrical thinker" to solve mechanical stress problems heretofore too complex for mathematical analysis. Dr. McCann said the apparatus had been evolved to meet problems in the design and construction of turbo-generator units for production of electricity.

Dr. McCann pointed out that "with the newly developed analyzer, engineers can determine the worst condition under which the apparatus might operate and carry out the design in line with such data."

Designed primarily to meet problems in the construction of power station equipment, the analyzer can be used "for almost any mechanical stress problem," Dr. McCann said.

DR. MILLIKAN WINS ARTHUR NOBLE MEDAL

IN recognition of his contributions to the city of Pasadena, Dr. Robert A. Millikan was nominated for the Arthur Noble medal by a committee appointed by the Board of City Directors to select Pasadena's most useful citizen for 1944. The medal will be formally presented at the annual banquet of the Chamber of Commerce.

This honor was bestowed on Dr. Millikan by the

committee for his contributions to the war effort through the medium of the California Institute of Technology. The war program of Caltech has been outstanding in the United States, for it was here that rockets, termed as "the" weapon of the second world war, were developed and produced.

Also cited by the committee was Dr. Millikan's part in the development of synthetic quinine and other scientific experiments used in the war effort which cannot be divulged at this time.

In 1923 Dr. Millikan won the Nobel Prize for Physics because of his important discoveries in the composition of matter.

Other important medals won by Dr. Millikan include the Comstock, Faraday, Edison, Franklin, and Roosevelt Memorial Medals, the decoration of Commander of the French Legion of Honor, and the Chinese Order of the Jade.

CALTECH CLUB OF NEW YORK MEETS

With 27 members present, the Caltech Club of New York held its second meeting of the year at the Hotel Holley on January 31.

Clyde Keith, the chapter's vice-president, gave a very interesting talk on high-speed motion pictures, illustrated by actual high-speed studies taken at photographing speeds up to 6000 frames per second. The pictures included the popular milk drop formation study, written up in "*Life*" magazine, the flight of birds and insects, and the more practical study of telephone and selecting gear.

The Caltech Club was particularly glad to welcome several new members in attendance and hopes that future meetings will be attended by more of the new men in that area.

Evan A. Johnson
Secretary-Treasurer

ATHLETICS

By H. Z. MUSSELMAN,
Director of Physical Education

MEETING the strongest teams in southern California, Caltech's basketball quintet finished the season with a record of eight wins and 11 losses. However, this record does not present a true picture of the season, for all of the games were thrillers. Three games were lost by three points or less, and even in the three games lost by 10 points or more the Engineers threatened all the way.

The strong Pepperdine five copped the league championship, dropping only a game to U.C.L.A. in six starts. U.C.L.A., in second place, split with Pepperdine, won two from Caltech and dropped a pair to Oxy by one point margins. Caltech and Oxy tied for third with only two wins each.

Tech's dual victories over Oxy were the best games on the Engineer schedule. In the first game the Beavers held a slight lead early in the second half, but were forced to come from behind in the closing minutes, with Jack Cardall's free throw breaking the tie to give Caltech a 44-43 victory. In the return match, which Tech won 53-45, the first half was a repetition of the first game. Both teams matched each other basket for basket, never being separated by more than three points, and with the half again ending in a tie. However, the Engineers took a quick lead in the second period and were never headed. This was Tech's first double victory over the Tigers since 1924.

In another feature game U.C.L.A. nosed out Caltech 29-28. A tight Beaver defense held the Bruins, who had a 21-11 half-time advantage, to four free throws and two field goals in the second half—both field goals coming in the closing minutes of play.

In non-league games, Tech took a pair from Redlands, won one each from Vultee and Los Alamitos Naval Air Station, split with Camp Ross and Santa Ana Army Air Base, dropped two each to U.S.C. and March Field, and one to San Diego Naval Training Center.

John Pryor, who played at guard or center, led the team in scoring. Transferring from the "B" squad in mid-season, Pryor rolled up the impressive record of 124 points in 10 games.

The season's results are:

Caltech	84	Vultee	36
U.S.C.	46	Caltech	39
Santa Ana A.A.B.	55	Caltech	52
Caltech	47	Camp Ross	43
Camp Ross	58	Caltech	51
U.C.L.A.	42	Caltech	37
Caltech	55	Los Alamitos N.A.S.	54
Caltech	44	Occidental	43
March Field	57	Caltech	44
Pepperdine	52	Caltech	44
Caltech	55	Redlands	31
U.S.C.	42	Caltech	36
Pepperdine	45	Caltech	33
Caltech	42	Redlands	25
March Field	70	Caltech	68
U.C.L.A.	29	Caltech	28
Caltech	53	Santa Ana A.A.B.	37
Caltech	53	Occidental	45
San Diego N.T.C.	69	Caltech	52

With the opening of the new semester on March 5, five spring sports will swing into action. Five schools—Occidental, Pepperdine, U.S.C., U.C.L.A., and Caltech—will compete in league play, with at least three of the schools having teams in all five sports.

Spring schedules are as follows:

BASEBALL

Sat. March 31	Caltech	at Pepperdine
Sat. April 7	U.S.C.	at Caltech
Sat. April 14	To be arranged	
Sat. April 21	Occidental	at Caltech
Sat. April 28	Caltech	at U.S.C.
Sat. May 5	Caltech	at U.C.L.A.
Sat. May 12	Pepperdine	at Caltech
Sat. May 19	U.C.L.A.	at Caltech
Sat. May 26	Caltech	at San Diego State (tentative)
Sat. June 2	Caltech	at Occidental

GOLF

Fri. April 20	U.S.C.	at Caltech
Fri. April 27	Caltech	at U.C.L.A.
Fri. May 4	To be arranged	
Fri. May 11	U.C.L.A.	at Caltech
Fri. May 18	Caltech	at U.S.C.
Sat. May 26	Intercollegiate Tournament	at U.S.C.
Sat. June 2	Intercollegiate Tournament	at U.S.C.

SWIMMING

Fri. April 6	U.C.L.A.	at Caltech
Fri. April 13	Caltech	at U.S.C.
Fri. April 20	Occidental	at Caltech
Fri. April 27	U.S.C.	at Caltech
Fri. May 4	To be arranged	
Tue. May 8	Caltech	at Occidental
Sat. May 12	Caltech	at U.C.L.A.
Sat. May 19	Intercollegiate Meet	at U.C.L.A.

TENNIS

Sat. March 17	U.C.L.A.	at Caltech
Sat. March 24	U.S.C.	at Caltech
Sat. March 31	To be arranged	
Sat. April 7	Pepperdine	at Caltech
Sat. April 14	Caltech	at U.C.L.A.
Sat. April 31	Caltech	at U.S.C.
Sat. April 28	Occidental	at Caltech
Sat. May 5	To be arranged	
Tue. May 8	Caltech	at Pepperdine
Sat. May 12	Caltech	at Occidental
Fri. May 18	Intercollegiate Tournament	at U.C.L.A.
Sat. May 19	Intercollegiate Tournament	at U.C.L.A.

TRACK

Sat. March 24	Combined J.C.'s	at Caltech
Sat. March 31	Caltech-Pomona-U.C.L.A.	at U.C.L.A.
Sat. April 7	College Relays	at Compton
Sat. April 14	Caltech-U.S.C.-Pomona	at Caltech
Sat. April 21	A.A.U. Meet	at Coliseum
Sat. April 28	Caltech	at Occidental
Sat. May 5	Conference Meet	at Caltech
Sat. May 12	Caltech-U.S.C.-U.C.L.A.-California	at Coliseum
Sat. May 19	Fresno Relays	at Fresno
Sat. May 26	Coliseum Invitational	at Coliseum
Sat. June 2	Modesto Relays	at Modesto
Sat. June 9	Pasadena Games	at Caltech

ULTRA-HIGH FREQUENCY CONCEPTS

DR. SIMON RAMO, who is research engineer at General Electric's Schenectady research laboratory, has written a short book, "Introduction to Microwaves," which will soon be published by McGraw-Hill Book Company. The publication of a number of articles on ultra-high-frequency concepts by Dr. Ramo created such an extensive demand for reprints and lectures that he decided there was considerable need for a book giving a qualitative treatment of electrical concepts that are important at high frequencies.

The book gives a completely nonmathematical description of the physical basis for all microwave phenomena, covering transit-time electronics, velocity modulation, radiation, transmission lines, resonant cavities, and wave guides. Dr. Ramo correlates microwaves with lower frequency electricity in simple language and with a large number of explanatory diagrams.

Dr. Ramo received his Ph.D. degree at California Institute of Technology in 1936, where he did high voltage research. Immediately afterward he started work at General Electric Company. In 1941 he was honored by Eta Kappa Nu, electrical engineering fraternity, as "one of the most outstanding young electrical engineers in America." At General Electric Dr. Ramo continued his association with academic work by organizing the advanced course there in high-frequency engineering. Although he is no longer actively in charge, he is still a frequent lecturer. His current work is in ultra-high-frequency generation, modulation, and reception, and in electronoptical studies. Dr. Ramo holds a number of patents in electron microscopy and has been granted over a dozen patents in the high-frequency field.

CALTECH PROFESSOR RECEIVES HONOR

Dr. Chester Stock, professor of paleontology at the California Institute of Technology since 1926, was elected president of the Paleontological Society of America at its annual meeting held in New York in December. Dr. Stock has been serving also as a member of the Council of the Geological Society of America, to which office he was elected for a three-year term.

Engineering and Science has had the privilege of presenting several articles by Professor Stock. His work in the field of paleontology has been outstanding.

PERSONALS

IT WILL be helpful if readers will send personal items concerning themselves and others to the Alumni Office. Great interest has been shown in these columns, but more information is required. Do not hesitate to send in facts about yourself, such as change of position or location, present job, technical accomplishments, etc. Please help.

—Editor.

1922

GEORGE C. HENNY is on the faculty of Temple University Medical School, Philadelphia, Pa., as the head of the department of physics.

WILLIAM D. POTTER is a hydraulic engineer for the Soil Conservation Service, Washington, D. C. Mr. Potter lives at Alexandria, Va.

1924

LIEUTENANT-COLONEL EDWARD D. LOWNES, U.S.A. Engineers Corps, was in southern California recently on a 30-day leave. He has been stationed in Alaska, North British Columbia, and the Yukon territory, in charge of construction projects.

1925

ALFRED L. ERICKSON holds the position of vice-president of J. T. Thorpe, Incorporated, Los Angeles, Calif.

JOHN TEMPLETON is superintendent of the Brandy Forging Company, Los Angeles, Calif.

1926

JOHN E. MICHELMORE was acting Exalted Ruler of the Glendale Elks Lodge No. 1289 when they paid honor to the men in the armed services at a special program on January 29.

BRUCE H. MILLS is packing house manager for Rancho Sespe, Fillmore, Calif.

WALLACE C. PENFIELD holds the position of public works director of the County of Santa Barbara, Calif.

MAJOR ORRIN H. BARNES and Miss Shelia Jane Hiler were married January 14 at Post Chapel, A.P.O. 956.

1927

LEE W. RALSTON is director, division of trade and industrial education, Los Angeles County Schools.

ARCHIE P. KING is associated with Bell Telephone Laboratories, New York, as a research engineer.

ROBERT M. MOORE of the Western Electric Company, formerly stationed at San Diego, has been transferred to the New York office.

1928

MARTIN E. NORDBERG is employed by Corning Glass Works, Corning, N. Y., as a research chemist.

MAJOR ARTHUR P. BANTA is chief of the War Planning Section, stationed in Oahu. He finds his work most interesting and enjoys the climate of the islands.

RALPH M. WATSON holds the position of chief engineer, centrifugal division of the Worthington Pump and Machinery Corporation, Harrison, N. J.

S. B. BIDDLE, JR., is a field engineer for Leeds and Northrup Company, San Francisco, Calif.

1929

KNOWLTON R. BIRGE holds the position of senior electrical engineer for the Municipal Light and Power Company, Pasadena, Calif.

WILLIAM W. BOOTH is on the faculty of Claremont High School, Claremont, Calif., as a mathematics teacher.

1930

DR. JOSEPH URMSTON, one of the nation's foremost orchid hybridizers, has arranged to exhibit rare orchids, never before shown to the public, at the spring flower show, Brookside Park, Pasadena. The orchid fancier is an Army corporal in the Medical Corps, attached to a hospital at Ogden, Utah. The entry was arranged during Corporal Urmston's furlough.

LIEUTENANT-COMMANDER FREDERICK T. SWIFT is in the radio material office of the Navy Yard in Honolulu.

DR. JOHN M. PEARSON is physicist and manager of the Susquehanna Pipe Line Company, Philadelphia, Pa.

1931

LELAND D. PRATT is superintendent of Kelco Company in San Diego, Calif.

1932

WILLIAM PICKERING was made chairman of the electronics division of the Los Angeles section, American Institute of Electrical Engineers.

DR. JOHN A. LEERMAKERS is technical assistant to the director of research, Eastman Kodak Company, Rochester, N. Y.

RAY T. OELSCHLAGER is with Douglas Aircraft Company, Incorporated, Santa Monica, Calif., in the capacity of a stress analyst.

HOWARD W. FINNEY holds the position of senior accountant for Lybrand, Ross Brothers and Montgomery, Los Angeles, Calif.

1933

ROBERT L. SMALLMAN was made vice-chairman of the electronics division of the Los Angeles section, American Instiute of Electrical Engineers.

D. DWIGHT TAYLOR announces the establishment of an office for engineering calculations and consultation in physics in Pasadena, Calif.

LIEUTENANT-COLONEL JOHN C. MONNING, formerly employed as a structural engineer for the city of Los Angeles, recently was awarded the Legion of Merit for outstanding services in clearing the Port of Piombino, Italy, in order that it could be used by the Fifth Army. Lieutenant-Colonel Monning has been overseas since January, 1943.

1934

GUY O. MILLER is a design supervisor for the Phillips Petroleum Company, Bartlesville, Okla.

1935

DR. PAUL GENATCHE, assistant to the general manager of the Mexican Light and Power Company, Ltd., Mexico City, for the past six years, is back in southern California with his family.

J. B. STODDARD is a chemical engineer for the Arabian American Oil Company, San Francisco. Calif.

1937

F. H. ALLARDT is associated with Douglas Aircraft, Long Beach, Calif., as supervisor of tool design.

HAROLD ALWART is in charge of research and development work at Clayton Mark and Company, Evanston, Ill. Mr. and Mrs. Alwart are the proud parents of a baby boy, Stephen, nearly three months of age.

DR. DEAN NICHOLS, having graduated from Yale Medical School in '43 and interned at Baltimore City Hospital, has a fellowship in dermatology and syphology at Mayo Clinic. On account of his health, he is taking a year's leave of absence which is being spent at La Jolla, Calif.

1938

DR. NEWMAN A. HALL is associated with United Aircraft Corporation, East Hartford, Conn., as a research engineer.

PAUL SIECHERT was recently elected president of the Junior Chamber of Commerce of Alhambra, Calif.

1939

WILLARD M. SNYDER, U.S.N.R., recently was promoted to the rank of lieutenant. Lieutenant Snyder is a junior pilot for Air Transport Squadron Eleven, which, under the Pacific Wing of the Naval Air Transport Service, flies 2,000,000 miles a month to deliver war materials to advanced area bases. Prior to service, Willard was employed as a junior engineer in the Central Valley Project Headquarters of the U. S. Bureau of Reclamation at Sacramento.

EDWIN F. SULLIVAN, assistant engineer, U. S. Bureau of Reclamation, Sacramento, Calif., has been elected secretary-treasurer of the Sacramento section, American Society of Civil Engineers.

KENNETH R. BRAGG and Miss Lee Goodwin were married recently and intend to make their home in Manhattan Beach, Calif.

QUIDO M. SHULTISE is now communications engineer for the Standard Oil Company of California and expects to be located in the northern part of the state.

1940

O'DEAN ANDERSON is now associated with the Raymond-Morrison-Knudsen Company, Barcelona, Venezuela, South America.

CLAUDE DAVIES, formerly with Vega Aircraft, is now employed by Packard-Bell in Los Angeles, Calif.

LIEUTENANT-COLONEL PIERRE M. HONNEL is assistant professor, Department of Chemistry and Electricity, U. S. Military Academy, West Point, N. Y.

LIEUTENANT (j.g.) WILLIAM LAWSON, U.S.N.R., is in the ordnance department of the Mare Island Navy Yard.

1941

DAVID S. WOOD and Miss Constance Loret Simonsen of Portland, Ore., were married on January 20 at Santa Fe, N. M. Since the outbreak of war, Mr. Wood has been engaged in research work for the government.

GEORGE K. ZEBB and Miss Martha MacDermid were married recently in Pasadena. Mr. Zebb is employed at the Institute.

MAJOR GREENUP B. PATTERSON, JR., assigned as a pilot with the 19th Weather Squadron, has arrived in Egypt to take up duties in the Air Forces. Before entering service, Major Patterson was a chemist with the Caminol Oil Company in Santa Fe Springs, Calif.

ENSIGN JEREMY A. JONES, U.S.N.R., is stationed at the Aviation Supply Office, Philadelphia, Pa.

1942

IRVIN SEEGMAN is in the Rubber Laboratory, industrial department, at the Mare Island Navy Yard.

ROY C. VAN ORDEN, civil engineer, is a stress analyst for the Douglas Aircraft Company at Long Beach. He and his wife, Betty, are the proud parents of an 18-months-old daughter, Darole Ann.

LIEUTENANT WARREN HALL, U.S. N.R., is in the industrial department at the Mare Island Navy Yard.

LIEUTENANT LEIGHTON R. MOORE, U.S.N.R., is in the ordnance department at the Mare Island Navy Yard.

WILLIAM G. KENNEDY holds the position of research division engineer for United Aircraft Corporation, East Hartford, Conn.

LIEUTENANT G. R. DALL is stationed on Saipan with the U. S. Air Forces.

PRIVATE PHILIP O. JOHNSON is assigned to Wright Field, Dayton, Ohio.

LIEUTENANT (j.g.) JOHN McCLAIN is with the Eleventh Naval District, San Diego.

LIEUTENANT JACK ALFORD is an engineering officer in the assembly and repair department, Naval Air Station, San Diego.

PRIVATE HARRISON A. PRICE, U.S. Army, is now at Ann Arbor for a six-months' training period in sanitary engineering.

VICTOR G. BRUCE is a staff member at the radiation laboratory, Massachusetts Institute of Technology, Cambridge, Mass.

1943

EDWARD A. WHEELER received an honorable discharge from a U. S. Marine Corps officers' candidate class last year and is now assistant personnel manager of the Western Felt Works of Chicago.

DR. HERBERT ELLIS has resigned his position with Rheem Manufacturing Company and has accepted a position as industrial engineer with O.S.R.D. headquarters in Washington, D. C.

SEAMAN (1/c) ROLFE LA FORGE is at the radar school in Del Monte.

LIEUTENANT (j.g.) W. LAWSON JONES is with the Navy in Guam, in charge of maintenance of a group of Navy planes. As a side line he is studying the fish and vegetation of Guam and doing some painting.

CHESTER D. MILLS, JR., is stress analyst for Consolidated Vultee Aircraft Corporation in San Diego, Calif.

LIEUTENANT (j.g.) DAVID ARNOLD, U.S.N.R., is in the ordnance department at the Mare Island Navy Yard.

ENSIGN DAVID A. ELMER has just received a promotion to lieutenant (j.g.).

1944

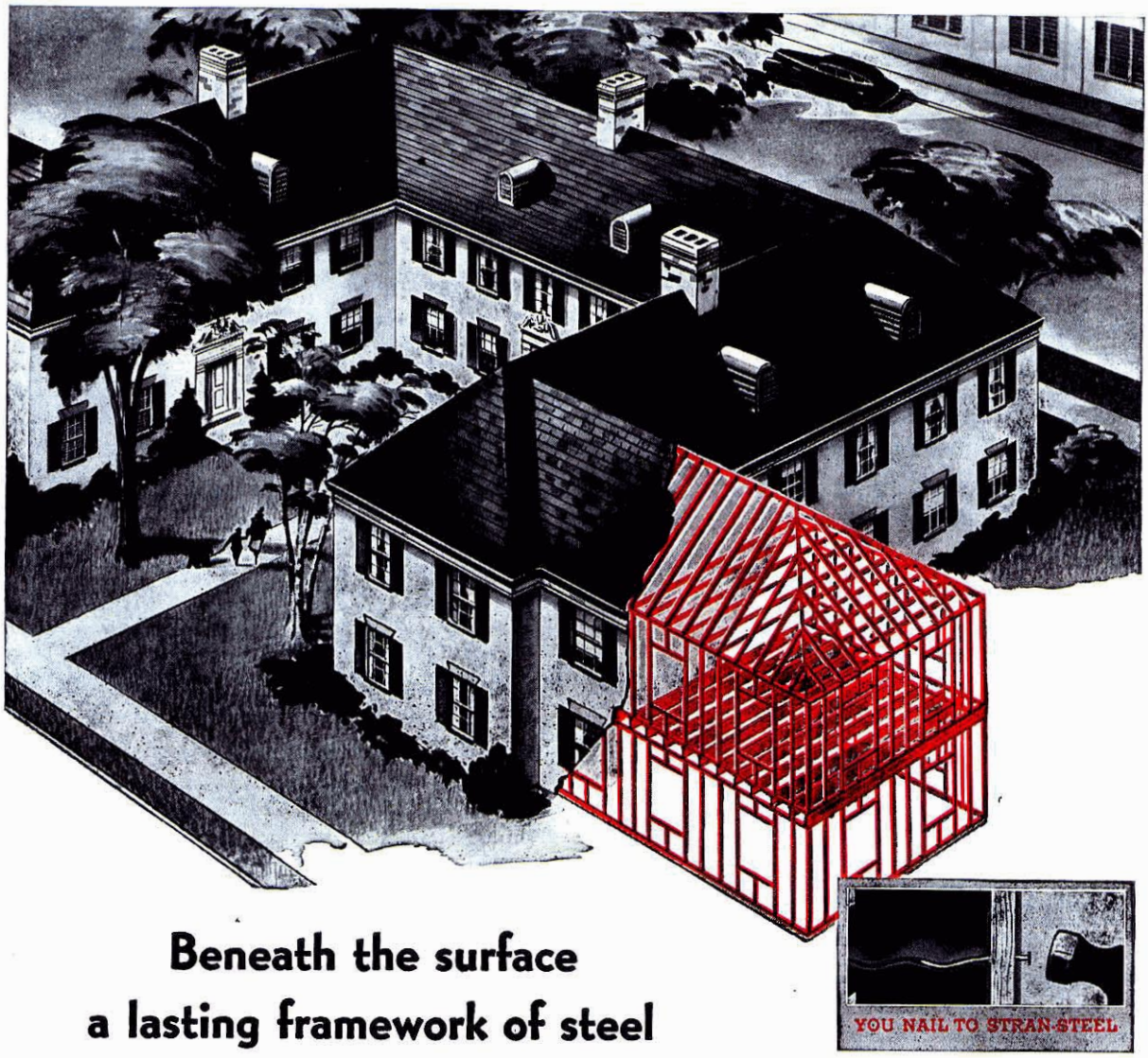
PRIVATE JACK KETTLER stopped in at the Institute on a furlough, after which he was to report to Fort Meade, Md. Jack has been stationed at Camp Maxey, Texas.

ENSIGN F. A. BEHRENS, JR., U.S. N.R., is now engineering officer of the U.S.S. YMS-407, motor minesweeper, operating in the Pacific, after a two-months' tour of duty in the Atlantic area.

FRED MORRIS has recently been commissioned a second lieutenant at Ft. Monmouth, N. J.

Ex-1947

PRIVATE INGARD M. CLAUSEN, now in Germany with an armored engineering division of the 10th Armored Division, has been awarded the Bronze Star Medal. The citation said that "Private Clausen, while in the vicinity of Kerling, France, advanced in front of a task force and, with utter disregard for his own safety, located enemy mines by means of a mine detector until he was seriously wounded."



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