ALUMNI REVIEW

CALIFORNIA INSTITUTE OF TECHNOLOGY

Vol. VI No. 4 June, 1943

Bus to Berlin

EVERY TIME I take the bus in the morning I think, "I'm going home!"

Going home—*by way of Berlin.*

Not for the fun of it, but because that is the way we all must go.

Tom's on *his* way, too—he's going by way of Iceland, and Ireland, and Casablanca.

And I'm on *my* way, too—by way of Elm Avenue, and Main Street, and the Boulevard, to Gate 10 every morning.

For my job in a war plant, and Tom's job in the war itself, are just different parts of the same journey.

It's the *long way* to go, but it's the *only way.*

For home, you know, isn't just a place and a roof.

It's love, and security, and freedom from fear and want and drudgery, and freedom itself!

So I don't count the miles any more, I just count the stops—on the way to Berlin and Tokio.

Because the roads to Berlin all lead home again!

NOT ALL of our progress on the road that leads to Berlin and Tokio, and back home again, can be measured in terms of miles or military objectives—though these are the payoff.

The performance of a single worker in a war industry, or the discovery of a single scientist, is real progress.

Or the production of a single company. General Electric produced a billion dollars' worth of war products in 1942!

Or new problems solved—research in electronics, metallurgy, plastics, television, or incandescent and fluorescent lighting.

For these are things which will shorten the miles, and lengthen the distance between stops, for the boys who are going to Berlin and back.

And they lead to job, and home, and freedom, and opportunity, in a better world tomorrow. General Electric Company, Schenectady, N. Y.

The volume of General Electric war production is so high and the degree of secrecy required is so great that we can tell you little about it now. When it can be told completely we believe that the story of industry's developments during the war years will make one of the most fascinating chapters in the history of human progress.

GENERAL ELECTRIC

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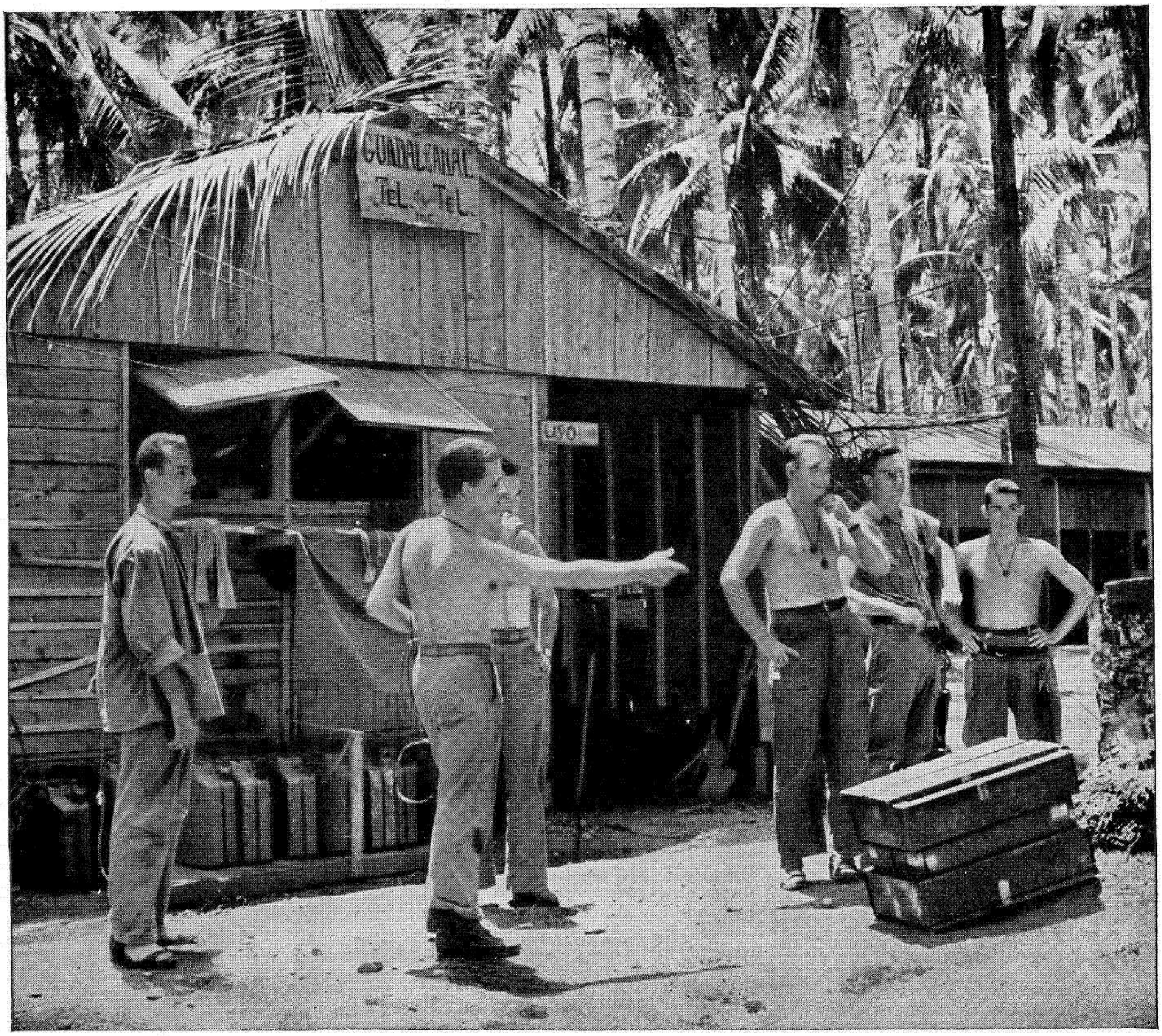


"Just getting the wire laid was a tough problem. Keeping it intact in bombings, shellings and adverse weather is a twenty-four-hour proposition. . . . Wire repair crews are made up of four men. Three stand guard while the other works."
(From story by Sgt. James W. Hurlbut, Marine Corps Combat Correspondent)

Telephone Exchange on Guadalcanal

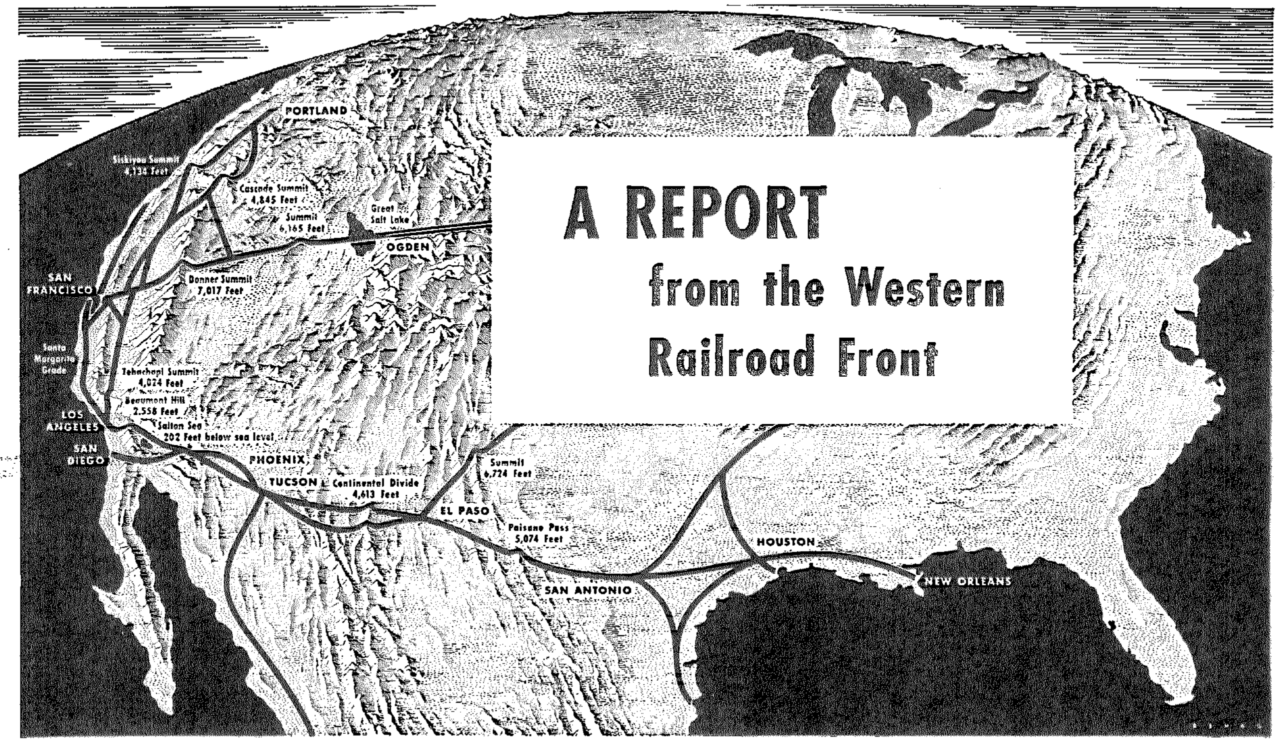
Marine communications men built it under fire. And it has been kept built. The "Guadalcanal Tel & Tel" covers well over a thousand miles of wire.

That is where some of your telephone material went. It's fighting on other fronts, too. We're getting along with less here so they can have more over there.

Telephone lines are life-lines and production lines in a war. Thanks for helping to keep the Long Distance wires open for vital calls to war-busy centers.

WAR CALLS COME FIRST

BELL TELEPHONE SYSTEM

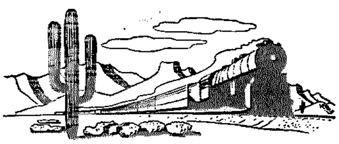


A REPORT from the Western Railroad Front

This map shows the major summits on Southern Pacific Lines.

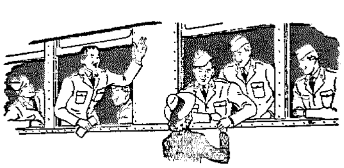
Everywhere on this map the war trains are rolling.

All night long you can hear them whistling to each other in the lonely mountain passes. All day you can see them rumbling across the deserts.



From New Orleans in the deep South to San Francisco by the Golden Gate. From Ogden in Utah's gaunt Wasatch Mountains. From Portland in the evergreen Pacific Northwest, from Tucumcari, from San Antonio, from El Paso on the Rio Grande. Over Donner Summit, Cascade Summit and the Siskiyous. Through Paisano Pass and Carriso Gorge. Across the Sabine River, the Neches, the Pecos, the Colorado. Everywhere on Southern Pacific's 15,000 miles of line, the war trains are rolling.

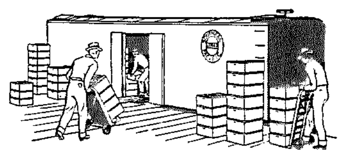
Trainloads of men bound for "somewhere in the Pacific." Trainloads of tanks and guns. Trainloads of steel for the sprawling shipyards in the San Francisco, Los Angeles and Portland areas. Trainloads of engines and parts for the humming aircraft plants. Thousands of war trains rolling westward.



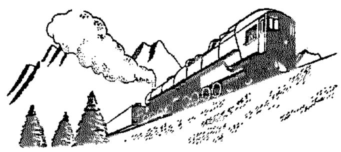
This is a report from Southern Pacific, the West's biggest railroad. Like all American railroads, we need more men, more cars and locomotives to do the job. Like all American railroads, we are doing our best with what we have.

Look at the map. See how our lines converge on the Pacific Coast, the springboard for our offensive against Japan. Add to this the fact that we serve more military and naval establishments than any other railroad, and you can see how grave is our responsibility to our country. The war trains *must* come first.

Yet the other trains must roll, too. Long yellow "reefer" trains loaded with western fruits and vegetables important to the nation's health ... 50,000 carloads of lettuce from California and Arizona ... 60,000 cars of oranges and



lemons and grapefruit from Southern California, Southern Arizona and the Rio Grande Valley down in Texas. Trainloads of lumber from Oregon and Washington for cantonments and emergency housing. Trainloads of salt from Louisiana, sulphur from Texas and potash from Trona for explosives and chemicals. Trainloads of oil and gasoline from California and Texas. Copper from Arizona, Nevada and Utah. Cement. Sand. Gravel. Cattle. Sheep. Thousands of trains rolling east with the war trains insistently pouring west!



We are moving it all over a railroad that crosses more mountain ranges than any other in the country—with ten major summits, from the 2,500-foot hump at Beaumont Hill to the 7,000-foot Donner Pass, where the average annual snowfall is *thirty-six feet,* and great rotary plows whine through the drifts.

Our dispatchers are putting more trains over the line than they ever dreamed they could. And the old-timers don't talk about the "good old days" any more. They're *really* railroading now!

Many people did not believe we could carry the load we are carrying now. Our whole organization of 90,000 men and women is on its toes, thrilled to have an important part in the war effort and determined to keep 'em rolling.

A. T. MERCIER, *President*

S·P

The Friendly Southern Pacific

Headquarters: 65 Market St., San Francisco, California

ONE OF AMERICA'S RAILROADS—ALL TOTALLY MOBILIZED FOR WAR

ALUMNI REVIEW

ALUMNI ASSOCIATION, INC. CALIFORNIA INSTITUTE OF TECHNOLOGY

VOL. VI No. 4 JUNE, 1943

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F. Zwicky, Professor of Astrophysics at the Institute since 1925, received his B.S. and Ph.D. degrees in physics at the Federal Institute of Technology in Zurich, Switzerland. For the past seven years he has done astronomical work at the Palomar Mountain observatory. Since Pearl Harbor he has been associated with the O.C.D. of Pasadena as Technical Advisor.

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Theodore C. Coleman graduated from Caltech in engineering and economics in 1926. He spent three years in civil engineering work, and in 1926 entered the investment banking business. In 1940 Mr. Coleman joined Northrop Aircraft, Inc. as Secretary, and assisted with the organization and financing of the company. He is now Vice-President and is in charge of sales.

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Frederick J. Converse graduated from the University of Rochester in 1914. He has served as designer for the Bureau of Power and Light in Los Angeles and as a consulting foundation engineer. Since 1921 he has been with Caltech as Instructor, Assistant Professor, and is now Associate Professor of Civil Engineering. He is also with Warren and Converse, foundation engineers.

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William Shand, Jr. received his A.B. degree from Princeton in 1940 and is working towards his doctorate in chemistry at Caltech. He is an enthusiastic mountain climber, having climbed in the Alps, Canadian Rockies, Tetons, Yosemite, and Alaska. Mr. Shand is Chairman of the Rock Climbing Section of the Sierra Club, and is a member of the Swiss and American Alpine Clubs.

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Alfred W. Knight received his B.S. degree in Chemical Engineering from the California Institute of Technology in 1922, but later entered practice as a patent attorney with the United States Patent Office. Since 1924 he has been associated with the Western Precipitation Corporation in Los Angeles in its patent department, and is now Vice-President of that company.

AIR POWER AND THE WAR 17

J. E. Wallace Sterling completes, in this issue, a series of articles on current events. The editor, in behalf of the Alumni Association, wishes to express his appreciation to Professor Sterling for the time and effort that he has spent in preparing these analyses of the news for the Review. The articles have contributed greatly to the interest of the magazine.

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Frederick C. Hoff received his B.S. degree in mechanical engineering from Caltech in 1939. He spent three years as engineer at the Savanna Ordnance Depot in Illinois where he developed special equipment and processes for shell and bomb loading and ammunition handling. He is with the A. O. Smith Corp. of Los Angeles, awaiting a call as Navy Special Service Officer.

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COVER *"Pattern in Brass"*

by J. RODNEY FISCHER, '41

Published four times a year—September, December, March and June by the Alumni Association, Inc., California Institute of Technology, 1201 East California Street, Pasadena, California. Annual Subscription $2.50, Single Copies $0.65. Entered as second class matter at the Post Office at Pasadena, California, on September 6, 1939, under the Act of March 3, 1879.

EDITORIAL

This issue of the Alumni Review completes another year of publication and of service to the members of the Association. The editor wishes to express his appreciation to those who have so graciously contributed articles to the Review and to those who have assisted in publication, particularly to Miss Charlotte Tompkins for carrying the burden of the work. The willingness of the alumni to assist in every possible way in promoting the work of the Association is particularly gratifying when everyone already has more than he can do. The common ties established through four years of close association are worth maintaining and it is by devoting a portion of one's time to alumni activities that this is possible. In time of war, each of us is even more interested in hearing about those with whom we have shared some of the most pleasant days of our life. We are being distributed throughout the world and every day it is more difficult to keep track of our friends. The more we become separated, the more important becomes the Alumni publication in keeping together those of us who have believed in the traditions of our Alma Mater and the things for which they stand. The motto, "The Truth Shall Make You Free" and particularly the principles of the honor system are worth carrying to others in these days when agencies are at work attempting to tear down the democratic way of life.

The Board of Directors of the Alumni Association have made arrangements whereby the Alumni Review may appear monthly. During the past year considerable difficulty has been experienced in securing advertisers, primarily due to the limited time available by anyone who might act as Business Manager. Dave Shonerd has done a good job, and by his efforts the Review has been able to live within its budget. The new arrangement, however, will place the magazine on a more serviceable basis and will not be any more expensive than heretofore. In making this change the Board has also decided to call the new magazine "Engineering and Science." It is hoped that the first issue will appear in September with subsequent issues each month thereafter.

When the March issue of the Review went to press it was announced that the Institute might be a training center for the Navy. The Institute has now received official information that about 500 men will be sent for training in the following courses: Steam and Internal Combustion Engines, Pre-Radar, Electric Power, Civil Engineering and Construetion Engineering. The first term of the next academic year will begin shortly äfter July 1. There will be two terms or semesters of 16 weeks each per academic year in contrast with the present three terms of 11 weeks each. Some of the men who take these courses will be Tech undergraduates who enlisted in the Naval Reserve. By means of this accelerated program, men will be able to complete their engineering education and then to be of service to the Navy. Civilian students will continue their education along with the Navy students on a 16-week semester schedule. The courses prescribed by the Navy are similar to the regular Tech courses; naturally some changes are necessary. Those of the alumni who were at the Institute in 1917 and 1918 will probably remember what it is like to have the Student Body in uniform. Now again this will be the case, except that it will be the Navy.

The training of engineers specifically for the Navy and the Army on such a large scale brings up the question of where the war industries will obtain engineers for engineering the implements of war. The records show that all the older engineers are in important war jobs of one kind or another and many of the younger men have already enlisted in the reserves. Engineering personnel officers are searching the country with a fine tooth comb for every kind of engineer without much success. If industry is to obtain men they must take concentrated action so that an equitable balance of engineer power can be maintained between military and war industry. In our own case there will be about 87 engineers graduated on June 11; of this number 46, or 53 per cent, will enter the reserves and the balance is now signed up with firms engaged in manufacturing implements of war. In the science group about 37 will graduate; 13, or 35 per cent, will join the military and the remainder will go into industry or war research. In view of present indications there will be fewer civilians available for March graduation and the number available by the next graduation will be even smaller. This situation may be looked at in another way; industry is beginning to settle down to a high production unit and may continue to produce with its present staff of engineers, thus freeing the younger men for the military. This idea seems to be passive and to be dodging the issue. We must improve production methods, increase production, and improve our present weapons—all this requires engineers. Men should be placed wherever their training and experience best fits the job to be done; all engineers and scientists will agree in that; who is to decide where they should be placed?

Believe it or not, a discussion of an article which appeared in the last issue of the Review was received. In order to show what can be done and to stimulate more discussion the comments and answer are included in this issue.

PROTECTION OF CIVILIANS AGAINST GAS ATTACKS

By F. Zwicky

Professor of Astrophysics, California Institute of Technology

During the week after Pearl Harbor a number of chemists, biologists and physicists of the faculty of the California Institute met with the Pasadena Health Officer, Mr. Charles Arthur, and with Dr. Alvin G. Foord to organize a special technical committee to be associated with the Pasadena Office of Civilian Defense. Some of the aims of this committee were as follows:

1) To give advice, if possible, to the local authorities and to the public on questions concerning the defense against attacks with high explosive bombs, incendiary bombs and chemical and bacterial agents.

2) To give lectures and seminars on the various problems involved in Civilian Defense, and to train a number of students at the Institute in the handling of practical means of defense.

3) To help in the efficient adaptation to local conditions of defense equipment furnished by the U.S. Federal Government.

4) To experiment with new devices for the civilian defense in instances where the government did not or could not provide for any equipment, and to put into operation any of these devices which would be found most effective.

Unfortunately this ambitious program could not be carried through in its entirety because of various reasons. First, many members of the original committee were drafted into projects important to the conduct of actual warfare. Secondly, since neither financial aid nor any priorities could be secured from the central office of the O.C.D., it was necessary to mobilize the needed funds, materials and labor locally and to work with a very limited number of basic materials, engines and gadgets of various kinds. Thirdly, great, and in the face of past disasters, incomprehensible inertia was often encountered, which apparently sprang from a lack of vision to take the possibility of an enemy attack on this coast seriously.

On the other hand all of the City departments, as well as a great number of individuals and industrial and commercial concerns, have lent us their moral and material aid unstintingly and generously; and hearty thanks are herewith expressed to them on behalf of our committee. A whole book might be filled by mentioning all of the names of the contributors and the work done by them. But I must confine myself to a short description of the equipment, the design and construction, or supervision of construction of which I have been personally responsible. I hope that such a discussion may pave the way in this and other communities towards the realization of some of the other projects which our committee had originally envisaged.

The following discussion will be essentially restricted to the problem of the defense of the City of Pasadena against war gas attacks. This problem has naturally two aspects, dealing with collective protection and with individual protection respectively.

Those concerned with means of collective protection should before all else keep in mind that an attack is most likely to be delivered from the air, and that with modern methods of dispersal of persistent war gases, large areas and large volumes of

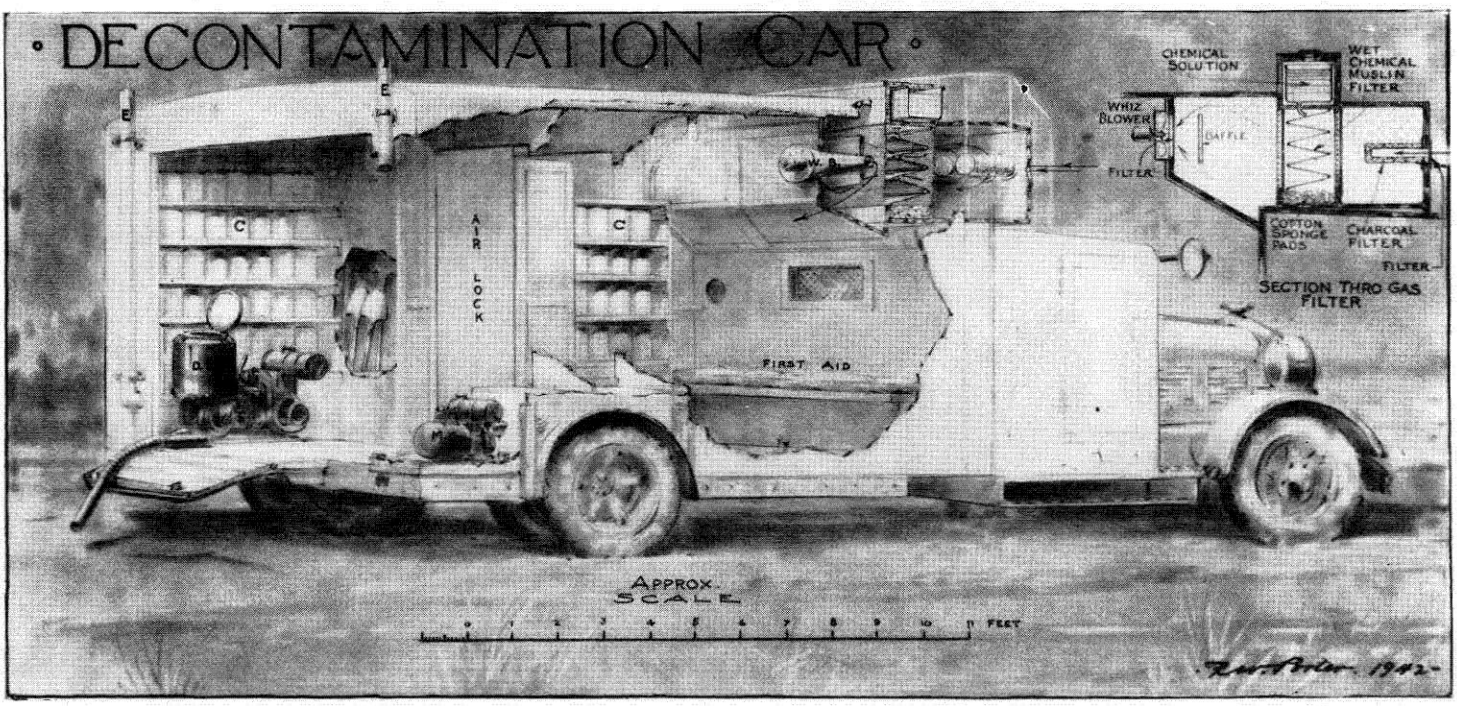


Fig. 1

air may be infested in a short time. A highly *mobile defense* is therefore needed. We cannot hope that only a few gas bombs will be dropped here and there and that we shall be allowed to conveniently ignore their contents until the next day and then to proceed leisurely to decontaminate a few localized spots.

In the design and construction of mobile decontamination units for the City of Pasadena the following points were therefore constantly kept in mind:

A) To build units which, if necessary, could counterspray air and ground with chemical and physical neutralizing agents if the enemy should succeed in dispersing war gases over extended areas and through large volumes of air;

B) To meet, if possible, an attack of a combination of gas and incendiaries;

C) To provide for a mobile first aid station to be carried along with the decontamination trucks in order to safeguard as far as possible the highly exposed members of the mobile decontamination squad and to render first aid to civilian victims, at least in some of the most severe instances.

To meet the stated requirements, the use of small planes and of automobiles equipped with dust blowers comes to mind immediately. Autogyros or helicopters from which neutralizing chemicals in the form of either dust or liquid droplets could be blown into the poison gas clouds would obviously provide an ideal means of defense. Nevertheless, because of the impracticability of carrying large amounts of liquids, such aerial counterspraying would have to be coordinated with ground crews operating fire hoses with voluminous water sprays for the purpose of precipitating the whole mixture of poison gases and neutralizing agents out of the air. Needless to say, the benefactor who will furnish us with the desired aerial vehicles is still around the corner. It might, however, be suggested that a district like the County of Los Angeles seriously consider the introduction of some such vehicles as the autogyro or the helicopter equipped with gadgets similiar to those to be mentioned in the following discussion of the decontamination truck No. 1 of the City of Pasadena. The use of small planes for first aid purposes and communications would have its additional advantages, provided that the necessary permission from the Army could be obtained.

Since no flying machines were available for our use, we set out to construct a fleet of three decontamination trucks with whose help the following operations could be carried out:

a) Decontamination of hydrants to which hoses have to be attached either by the firemen or the gas decontamination squads;

b) Dispersal in the air and over the ground of large volumes of suitable mixtures of chemicals which neutralize the poison gases;

c) Precipitation of the gas clouds out of the air and hosing down the ground with water sprays from the hydrants;

d) A thorough, final check up of contaminated spots outdoors and inside of buildings.

Operations a) and b) are to be carried out by the crew of the decontamination unit I, while the operations c) and d) are to be taken care of by the units II and III respectively. These latter units, as well as the equipment carried by them, are more or less of conventional design, so we shall mention them only briefly. We propose to discuss the decontamination unit I in more detail. A drawing of this unit, which I owe to the kindness and skill of Russell W. Porter, is reproduced in Fig. 1.

Decontamination unit No. 1 is a large truck with three compartments, the driver's cabin, a *first-aid cabin* and a semi-enclosed rear platform. One of the older service trucks of the Light and Power Department of the City of Pasadena was generously turned over to us by its director, Mr. Benjamin De Lanty. The truck was stripped of its unnecessary trimmings. Most of the subsequent construction work was done in the shops of the Light and Power Department, to whose engineers and workmen I am indebted for many pleasant days of work together on this construction. Much of the work was

(Continued on page 22)

Fig. 2

Unit No. 1 with the blower in action

POST WAR AIRCRAFT MANUFACTURING IN SOUTHERN CALIFORNIA

By T. C. Coleman, '26

Vice President, Northrop Aircraft, Inc.

Aviation manufacturing in Southern California has matured more rapidly than most people outside the industry realize. This is not surprising when we consider the necessity for restrictions on production information which might give aid and comfort to our enemies. However, now certain facts can be told which most decidedly do not aid and comfort them—in fact they should give him plenty to worry about. This is not intended to sound boastful. We have had enough of that, but let the figures speak for themselves.

You probabaly have read that in our own backyard we have equaled aircraft production rates in all of Germany and doubled Japan's output. These ratios will be doubled again in 1943. By weight, the proper way to measure aircraft production, well over 50% of all aircraft delivered to our armed services are coming from companies with headquarters here.

To give you some idea how this industry has grown, remember that the industry around Los Angeles in 1939 consisted of four major companies employing about 16,000 workmen. At that time Detroit had about 191,000 automotive workers, the movies employed 30,000 people, furniture manufacturing about 20,000.

By the end of 1942 the number of men and women employed by aircraft plants, parts suppliers and subcontractors in our country greatly exceeded those building automobiles in Detroit. In fact, they made up a huge family entirely capable of supporting an entire city the size of Cleveland, itself the sixth largest city in the United States.

In dollar value of aircraft manufactured here, our companies produced in 1942 a value equivalent to almost two-thirds the total automobile passenger car volume for the United States and Canada during that industry's best year. This year we will exceed in dollar value automobiles and trucks. This is most significant when we consider that the aircraft industry must work to much closer tolerances than in building automobiles. A modern airplane more closely resembles in precision the operations of a huge watch.

When we consider what has happened to the aircraft industry here in four short years, we can be sure that nothing in the industrial history of the world has paralleled the rapid growth in manufactured output of airplanes, not only here, but elsewhere in the United States.

To concern ourselves with the airplanes themselves, Southern California companies are producing two of the standard fighters or pursuits in production for Army, Navy and British; both standard four-engined bombers; three out of six dive bombers; two out of three patrol bombers; the only attack bomber; three out of five medium bombers; six out of eleven cargo transports and seven out of twenty-six trainers, liaison and gliders. From this information you can clearly see that the majority of the large and hard hitting combat airplanes are made here.

Now that we have the picture of war production, what may we expect in the post-war era? So much has been written on this subject that your author hesitates to enter the arena with the numerous prophets and oracles who already dominate the stage. The only thing which gives me courage is the rather muddled thinking which many of these prophets seem to be reveling in, and the fact that most of our better qualified observers are so busy turning out planes and operating airlines for the Army that they have not taken time out from these more important duties to give us some real insight into what we may expect.

Raymond Moley, one of our more reliable columnists and writers, expressed some interesting views regarding post-war aviation in the March 8 issue of the Newsweek magazine. In his discussion he stated that, after a recent trip to Los Angeles where he had occasion to talk with aircraft executives, he felt that the viewpoints of these men were very similar concerning the possibilities of future commercial developments of their product. He made special reference to the opinion of one executive that the helicopter was not only adaptable to private use, but also for passenger and freight transportation for relatively short distances. The drawbacks in such equipment are recognized, but it is believed that they are overbalanced by the safety factor.

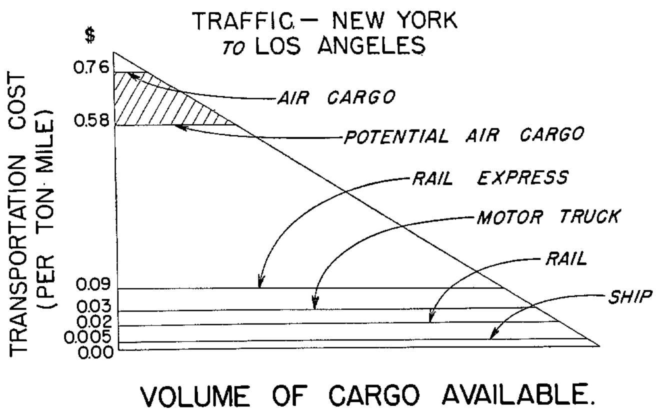
Mr. Moley reports that these men realize the important results which will come from the development of larger bombers and transports toward further development of long distance passenger and freight transportation. They are, however, giving some thought to the possible adverse situation which may be created by the conversion of war planes to civilian purposes. Mr. Moley reports that it is the general feeling that the war is removing certain obstacles which heretofore restrained invention and experimentation. The present developments would appear, therefore, to be contributing to the design and development of improved equipment which would be highly beneficial to commercial air transportation after the war. Mr. Moley also pointed out the importance of our developments in the utilization of wood and plastics, as well as light metals. He is a strong supporter of the belief that metal will probably play the most important part in future developments.

The author is in complete agreement with Mr. Moley's comments. In connection with that opinion, we may expect that the helicopter will in time give the automobile the only real competition it may expect from the airplane, as far as providing a private means of transportation. Capable of vertical ascent and descent, hovering over one spot, coming to a complete stop from speeds of 50 miles per hour or greater in less space than that required by the average car, movement from side or back—this development of Sikorsky's which has been accelerated by the war, may be the answer to the man who seeks safe, short range transportation and economical transportation at speeds up to 100 miles per hour. If the motor fails, this machine merely floats or parachutes to the ground. No landing field, with time lost and expensive maintenance, would be involved. While such a machine may not be made available from mass production plants for five years, certainly Army experiments publicized to date would indicate that it is on the way. This development will probably not be a factor in long haul commercial air transportation, but it could change the commuting and vacationing habits of large segments of our population.

The higher speed, conventional airplane, as we have known it in the past, will, in the opinion of the author, remain in the category of the yacht. Sportsmen, ex-military pilots and the well-to-do may buy a large number of airplanes in the category of our primary, basic, and advance trainer class, but here the market should rapidly reach the saturation point, with no basic economic reason to support it, and many manufacturers scrambling for the comparatively few number of prospective buyers. With the laws of gravity still at work, accidents will continue to be frequent, as it takes a considerable amount of skill and judgment to fly an airplane, which requires high forward speed to produce sufficient lift. Navigational aids to help overcome hazards in bad flying weather are constantly being developed, but these are likely to be expensive. Congestion around airports will force a ban on their use of commercial terminals by the private pilot and force him out to more remote and less accessible locations. Strict traffic control near all large cities, to safeguard commercial, as well as private flying, will be just as necessary as the present highway patrolman and stop signs. The essential difference, except for the helicopter, between the motor car and the airplane is that low speed is the friend of the automobile and the enemy of the airplane. As long as a wing is used for lift, and the economic advantage of air travel lies in speed, the human element remains dominant, as far as accidents are concerned.

The military market for our airplanes will undoubtedly remain, particularly for those favored few who have new models in production, or are well advanced in their experimental stage when the war is over. Most Americans agree that we will still require a sizeable air force to police the world. The average military plane is obsolete in from three to five years—hence a potential market for those manufacturers with the best designers and greater military experience. However, the most wishful thinkers cannot grant that this field will consume more than a fraction of the present capacity. The business will probably go back to a few companies, of which Southern California should have a higher proportion than any other single section of the country. Big mid-western assembly plants and many automotive operations probably will be discontinued, or converted to other types of manufacture.

We now come to a consideration of the cargo and commercail transport field—one which is receiving much public attention. To properly understand the potentialities in this field, it is necessary to understand the nature of the cargo or transport airplane itself, and its limitations. Today our ocean shipping lanes are seriously menaced by enemy submarines. Sources of fuel are in the hands of our enemies, particularly in the far Pacific, making necessary the shipment of high octane aviation gasoline over great distances by tanker. In a survey made by the Standard Oil Company of New Jersey, it was found that most cargo planes now in transoceanic service require more tankers to keep them in operation than they replace in freight ships. In spite of this inability to carry a payload, plus sufficient fuel to make return trips, saving in time and war demands for extreme flexibility make their use highly necessary. In peace time the problem of fuel supply becomes less complicated, but, nevertheless, the economic considerations, temporarily makes less transportation.



Let us visualize a triangle with the transportation cost per ton mile plotted vertically and the volume of potential traffic plotted horizontally. It is clear that the volume of goods available at the highest ton mile rate (air transportation) is an infinitesimal fraction of the volume available at the lowest ton mile rate (ocean shipping). For example, between New York and Los Angeles it now costs 96c per pound to transport steel by air, about 3c per pound by rail freight and, if the service were available, about 1½c by ship through the Panama Canal. This is true in spite of the fact that the respective distances are somewhere in the neighborhood of 2500 miles by air; 3000 miles by rail, and 6000 miles by ship. Obviously, except in cases of extreme emergency, steel would never come to Los Angeles by air. On the other hand, where speed is essential, and when rate differentials are slight, due to the higher costs in transporting by railroad or ship, that is, in the passenger mail, light weight cargo and perishable goods field, potential traffic is great. However, the tonnage or volume of this type of traffic is small when we compare it with bulk shipments.

Looking again at our triangle you will see that, as ton mile costs of air transportation are reduced, potential volume goes up, not in direct proportion, but at a much more rapid rate. Therefore, a cut in rates for air transportation by one-fourth might expand volume of traffic, not by one-fourth but, let us say by ten times. Therefore, let us examine the possibilities of effecting such a reduction in air transportation costs. To do so we must understand the fundamental limitations of the airplane.

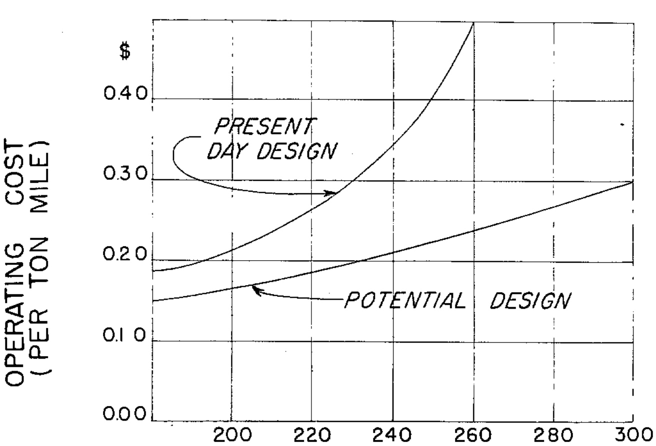
The best study which I have seen on the economic aspects of transport airplane performance was reported in Volume 7, No. 6, April 1940 edition of the Journal of Aeronautical Sciences. The article, written by W. C. Mentzer and Hal E. Novise, engineers with United Airlines, makes use of numerous mathematical formulas and many charts, from which certain conclusions are drawn. All data has been taken from actual operating experience and theoretical calculations are based on improvements in airplane design which may be available to the airlines when the war is over.

The study makes it possible to arrive at the following conclusions:

1. *Commercial operators can afford to pay almost any price within reason for new equipment which reduces ton mile operating costs—particularly for use on the long-haul routes.* This answers the question; how are the manufacturers going to compete with the hundreds of cargo and transport airplanes now in service with Army and Navy and likely to be made available to commercial operators after the war? Continued improvement in design will make it impossible for present day equipment acquired at *no cost* to the airlines to compete commercially with new equipment available after the war at a *substantial acquisition cost.*

2. Costs per ton mile increase greatly in lengthening distance between stops. Because increased gasoline weight for longer trips reduces the pay load which can be transported, it is easy to see how ton mile costs would rise. Carrying this to an extreme, it is easy to see that a trip length equal to the maximum range of the airplane would preclude the carrying of any payload—its entire lifting capacity would be used in transporting crew and its own fuel. A cargo plane just capable of flying the Atlantic, with adequate reserve fuel, would be unsatisfactory for commercial use on this run. Improvements in design now known to be possible pay increasingly bigger dividends as the non-stop trip is lengthened.

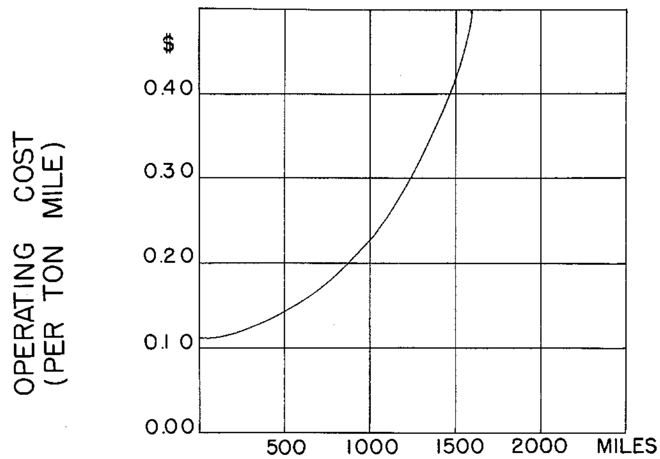
3. Costs per ton mile increase greatly as the speed of a given airplane is increased beyond its most economical cruising speed, or as the time schedule is cut for any given equipment. This



BLOCK SPEED (MPH)
TRIP LENGTH-1200 MILES.

difference in operating cost due to increased speed is less in an airplane of clean design at 200 miles per hour on a trip 1200 miles in length may be 15c per ton mile. If the speed is increased to 240 miles per hour the cost increases to 21c, or an increase of 6c, or 40%. If a more obsolete airplane is operated with larger power plant at the same two speeds on the same trip the cost per ton mile increases from 18c to 36c or by 100%.

4. The cost per ton mile decreases as the operator is able to improve the utilization of his equipment, or in other words, improve his load factor. This point is so obvious that it should require no further explanation.



DISTANCE BETWEEN STOPS.

5. For a trip of 900 miles in length a modernized airplane costing two and one-half times as much as an obsolete one will reduce relative ton mile costs at cruising speeds of 240 miles per hour and up by a much greater proportion than the same airplane operating at lower speeds. That is, assuming of course that bigger power plants were installed in the more obsolete airplane to make the higher speed possible. From this we can draw the logical conclusion that as the time schedules for all trips are cut down it becomes increasingly difficult to compete with the present day equipment. With any equipment, at speeds above the 200 miles per hour rate, it would seem that ton mile costs for transportation would advance, but the advance in cost as speeds increase will be less than with present day transport airplanes.

Thus, we see the importance of continued improvements in design by our companies—in fact, it is so necessary in the cargo and transport field that those companies without the best engineering brains may find it impossible to compete. The volume of this business should be great, but still nothing like our present manufacturing capacity.

To summarize the author's views, it would appear that the helicopter may ultimately be the most common privately owned aircraft. This may come within the first five years following the war. It may have a profound effect upon many of our living habits. Private airplanes of conventional design will be sold in lesser volume—to the sportsman and the wealthy—those who can pay for speed.

(Continued on page 24)

APPLIED SOIL MECHANICS

By Frederick J. Converse

Associate Professor of Civil Engineering, California Institute of Technology

Soil mechanics is essentially the study of the behavior of soil masses under the forces which act upon them. The study includes the determination of stress distribution from the loads through the soil and the corresponding deformations in the soil, together with the factors which determine the resistance of the soil to failure.

The object of the study is to help the Engineer solve problems of construction. In its present state of development, soil mechanics can not provide all of the answers, but it may be of very great value when properly used by one familiar with its limitations. The backbone of practical soil mechanics is adequate field investigation and correct sampling. The natural underground is seldom uniform either horizontally or with depth. The extent of the variations must be known before any correct stability analysis can be made. One who has not made detailed studies of soil conditions naturally thinks of the soil as uniform over wide areas. Nothing could be farther from the facts. Deep, moderately uniform strata are the exception rather than the rule. This may be illustrated by an experience on the Tech campus in the early days of soil research here. A study of the effect of the size of a footing on the bearing capacity of soil was being undertaken. A strip of soil near the present Athenaeum garages was selected as the site for the studies. When excavations had been made and load was applied, a plate 1 sq. ft. in area settled only 0.1 inch under a load of 30,000 pounds. Search for a more suitable location indicated much softer material on the southwest corner of the campus: At this location only 1,000 lb. was required for 0.1″ settlement, and at a load of 3000 lb. the settlement exceeded 1 inch. Investigations of foundations under school buildings after the earthquakes of 1933 indicated an astonishing amount of variation throughout almost every site. In one case (by no means unique) one wall was resting on firm sand capable of sustaining a safe load of four tons per square foot, and the opposite wall, 50 feet away, was on soft clay good for 1 ton per square foot.

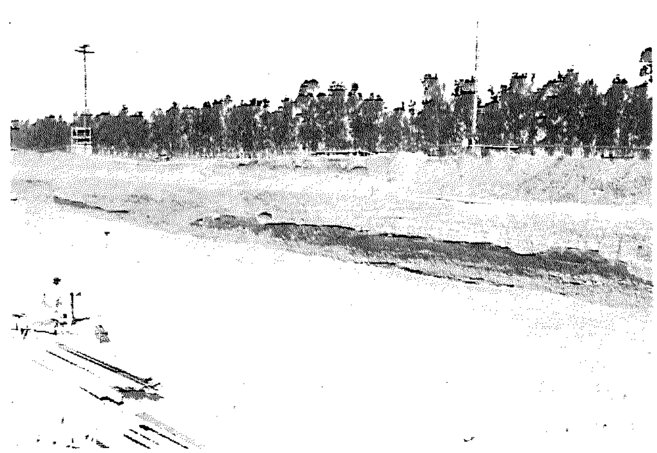


Fig. 1. Silt lense in dense gravel.

Figure 1 shows a cut for the foundations of the soaking pits at the Kaiser Steel Mill. Most of the material is good sand and gravel, but the dark material in the center is soft silt into which one could easily push a pencil. This is typical of this area and of Pasadena soil also. Former stream beds, filled in either by nature or by man, are a frequent source of striking and unexpected variations. A good example is the situation disclosed by the investigations at the Roosevelt Fleet Base on Terminal Island. The Island at this location is composed mainly of fine sand and silt, but at one point a channel 800 feet wide had evidently been cut clear through the Island and later filled with soft black mud. The mud deposit is up to 28 feet thick and is still soft and unconsolidated, although buried under at least 30 feet of sand.

The necessary depth of an investigation depends on the type of the structure as well as the character of the soil. For relatively light structures, a depth below the footing equal to 2½ times the width of the footing is adequate, providing the soil is not so soft as to require piles. Where piles are necessary the investigation should extend far enough below the pile tips to insure stability against excessive settlements. This requires that either a thick firm strata has been reached or that a depth at least equal to 2 times the least width of the pile group has been explored without locating excessively soft material.

SAMPLING

In order to determine the strength and physical characteristics of soil by means of laboratory tests, it is necessary to obtain samples in as nearly natural field conditions as possible, without disturbance of grains, swelling, compaction, or change of moisture content. A committee of the American Society of Civil Engineers has been working on the problem of sampling for the past three years. Intensive study by a full time research staff, and extensive co-operation by the U.S. Army Engineers, has resulted in the development of some important principles of sampling. The usual method of sampling frequently results in excessive disturbance, especially in soft clay and silt, or loose, fine sand. The usual method of sampling consists in driving a tube into the soil at the bottom of an open hole to a penetration of from 1 to 3 feet. The soil within the tube is brought to the surface, extracted from the tube, transferred to the laboratory and prepared for test. The process of driving the tube is a frequent source of error. A thick tube may compact the soil ahead of it so that the sample is denser than the soil in place. Long cores may have a similar effect, due to friction on the inside of the tube. Driving a thick tube into dense sand causes the sand to flow into the tube in a loosened condition, due to the fact that dense sand may expand before it can be displaced.

The thinnest, sharpest tube possible takes the best cores, other conditions being equal. The minimum thickness that can be used is dependent upon practical conditions. The tube must be strong enough to withstand driving and keep its shape. Pebbles easily damage a thin cutting edge, and distort the tube. It is frequently impossible to bring up a sample in a simple tube, because it slips out due to its weight and to suction from the bottom. A retaining device, or core catcher, is necessary in this case, but requires a thick point to enclose the mechanism. Extraction of the sample from the tube may cause disturbance if the soil adheres to the tube. Split tubes are used to overcome this difficulty, and these are of necessity moderately thick. Thin liners within the drive tubes are very desirable, since they permit the sample to be extracted from the tube, transferred to the laboratory, and tested, without disturbance other than that of the original driving. The proper thickness of tube is a compromise between necessity and desire, the practical requirements of sampling modifying the desire for a small thickness—diameter ratio.

The manner of driving has an important effect on the sample. A few heavy blows are better than many light ones, because the vibrations set up by driving tend to split or shatter the specimen, especially if the blow is at the top of a long length of pipe or drill rod. Drill jars apply the blow at the top of the sampling tube and eliminate much of the vibration. Continuous steady forcing of the sampling tube into the soil by means of jacks gives excellent results.

Figure 2 shows how sampling may disturb the material sampled.

LABORATORY TESTS

The most important laboratory tests are for the determination of the shearing strength, the relative density, and the time consolidation characteristics of the soil. An accurate knowledge of the shearing strength of the soil is essential to the determination of allowable bearing values for foundations, safe pile loads, stability of slopes and any problem involving failure of the soil. There has been a great deal of careful research in an attempt to establish the true relationship between shearing resistance as determined by various methods in the laboratory, and the strength of the soil under field conditions. Direct shear tests are the simplest to perform and have been used extensively in soil laboratories. They operate by sliding one portion of the soil relative to another in much the same way that a rivet connecting two plates is sheared by pulling the plates in opposite directions.

From a number of shear tests at different normal loads, the values of the cohesion and the angle of internal friction are established, thereby providing information from which the shearing strength may be determined for any stress condition within the soil. Considerable variation in the shearing values may result from different ways of performing the test especially in the case of clay. This has lead some investigators to abandon the direct shear method in favor of the "Triaxial Compression Test." In this test, a cylinder of soil is placed under lateral hydrostatic pressure at the same time that longitudinal compression is applied. By this scheme the principal stresses at any point in the soil can be duplicated, and the load to produce failure determined. Since failure is in shear, the shearing stress and angle of friction may be found from one test. Time effects are very important, especially in the case of saturated clay. The increase of load develops hydrostatic pressure within the pores of the soil. Clay being relatively impermeable, this pressure may persist for some time before drainage permits equalization of stress. The rate of loading, therefore, has an important effect on the resulting shearing strength. Knowledge of the conditions to be met in the field should determine the rate of loading of the test sample. The triaxial compression test requires a much larger specimen than the direct shear test, takes longer to prepare and run, and is subject to uncertainties such as end effects and internal pore pressure. It undoubtedly gives more accurate results than the direct shear, when properly in-

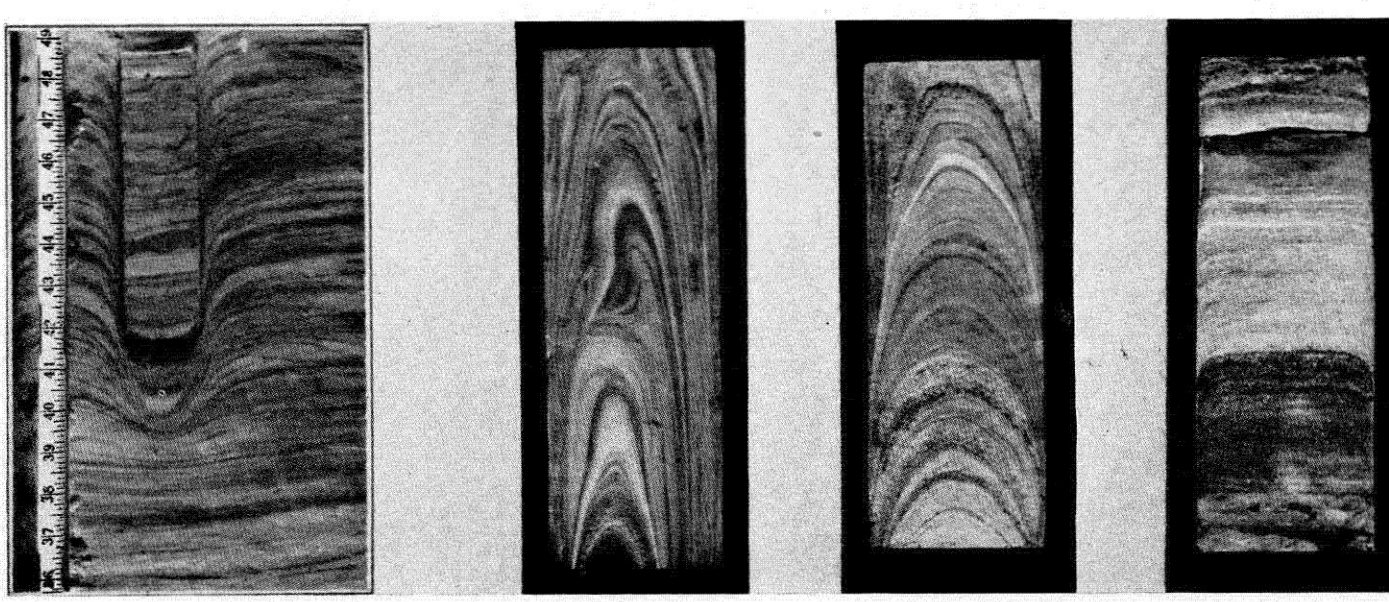


Fig. 2. Soil disturbed in sampling.

terpreted, and is particularly desirable for research work. The direct shear however gives values which are sufficiently accurate for most construction problems and if in error are on the safe side. The fact that the direct shear test requires only a small sample of undisturbed soil is very much in its favor. Figure 3 shows a shear testing machine at Caltech.

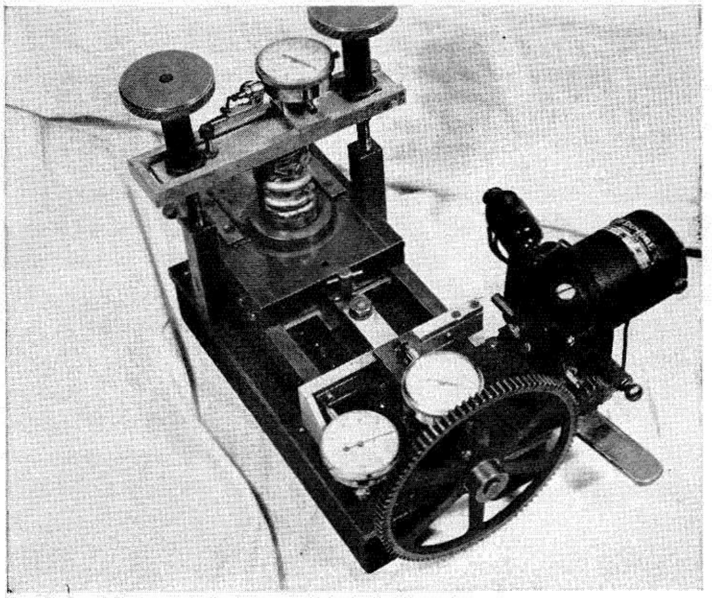


Fig. 3. Shear testing machine.

The consolidation test determines the load-deformation and the time-deformation characteristics of the soil. It is performed by placing a thin slice of the soil in a tube or cylinder, and applying load through a piston. Porous stones are placed on each side of the specimen in order to permit the water to drain out. Data from the consolidation tests may be used in calculating the settlement of the structures. In most cases the values will be only approximate but in certain types of soil, such as thick uniform beds of clay, very accurate time-settlement determinations may be made. Figure 4 shows a consolidation machine.

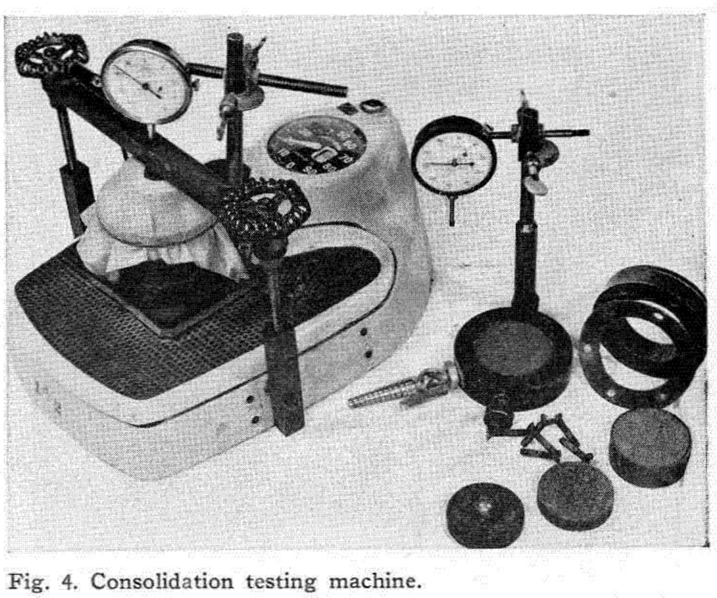


Fig. 4. Consolidation testing machine.

CONSTRUCTION PROBLEMS

One of the main problems of building construction is the determination of bearing values for spread footings of buildings. Soil mechanics investigations can usually provide reasonably close values of safe loads and corresponding settlements, but frequently conditions exist which make exact solutions impossible. In such cases the correctness of the result depends on the skill with which assumptions and approximations are made. One assumption involves the stress distribution from the footing through the soil. In some simple cases, this can be calculated accurately by means of the equations of elasticity, but many soils are not completely elastic, and frequently the boundary conditions are such that no solutions to the intricate mathematics have been obtained, even for the elastic theory. Many soils become disturbed for some distance below the footing, and adjust their internal structure by flow or plastic action. Formulas similar to those of the elastic theory have been proposed for such cases. They give values close to test results and are adequate for construction work.

Another uncertainty is the stress distribution from one layer or strata of soil to another of radically different type, as from sand to soft clay. This becomes very important in the case of highways and airport runways, and no satisfactory method of analysis has been developed which stands the tests of time in the field. At present most highway and airport design is empirical, being based on certain soil bearing tests which are compared with a standard established by experience. Extensive research in this field is in progress by a number of agencies including the Army Air Corps, the National Public Roads Administration, some state highway departments, and the A.S.C.E.

Formulas for the determination of the ultimate bearing capacity of spread footings are available, but they should be used with caution. Most of them include some approximations which must be recognized before the formulas are applied to a problem. Nearly all of them assume (without mentioning it) that the density of the soil is greater than a certain critical value. If the density is less than critical, the formulas do not apply, and failure occurs at a much lower value. This value can be easily calculated if the shearing resistance of the soil is known.

Settlement rather than ultimate strength is frequently the determining factor in establishing allowable bearing capacity. For the case of saturated clay and silt, the time-settlement relations may be determined with accuracy by calculations based on the results of the consolidation test. Where the soil consists of sand or loam, the calculations are approximate, the degree of accuracy depending on available empirical data. Frequently field load tests on different sized plates will furnish the required information. This latter process, however, is expensive and time consuming, and is little used except on large jobs. Much experimental and analytical work is still necessary before settlement calculations from laboratory tests can be made with accuracy and confidence from laboratory tests alone, for the case of granular soils. Fortunately the strength of such soil in shear is usually the controlling factor, rather than the amount of settlement.

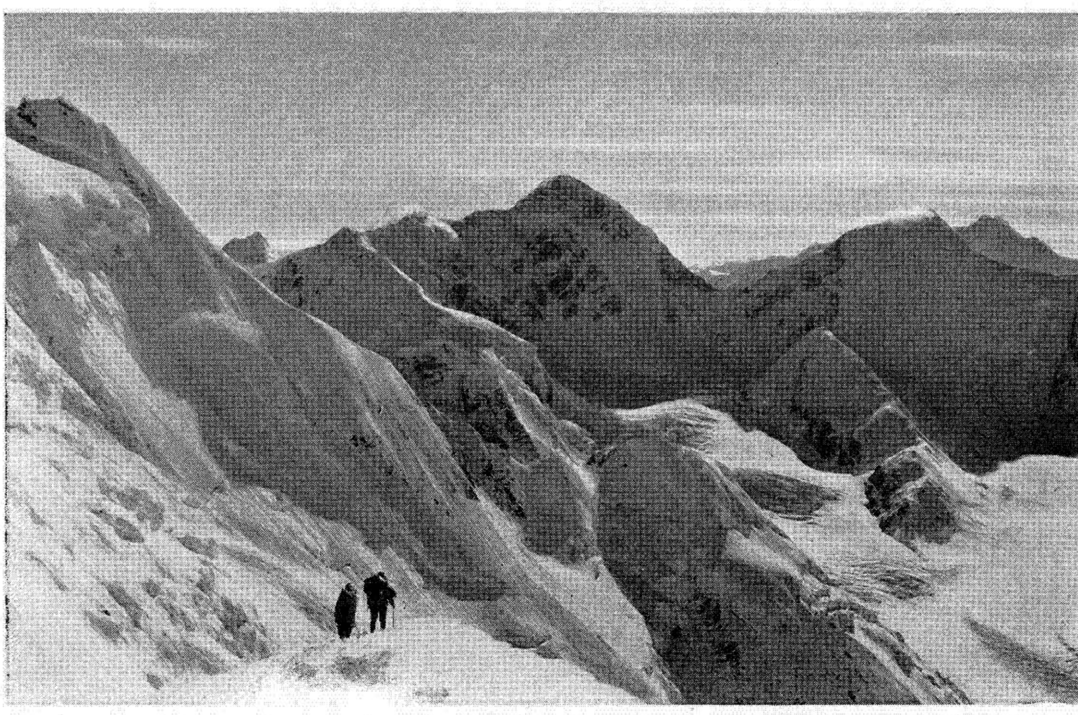
(Continued on page 27)

ALASKAN ADVENTURE

By William Shand, Jr.

It was my good fortune to accompany the Hall-Washburn expedition to the central Alaska Range during the summer of 1941. The purpose of the party, besides the ascent of Mt. Hayes, was to explore and map this little known mountain area, and to investigate the Black Rapids-Susitna Glacier system. Besides Barbara and Bradford Washburn and Henry Hall, the climbers included Ben Ferris, Lt. Robin Montgomery, Sterling Hendricks, who received his Doctorate in Chemistry at Cal Tech in 1926, and myself. Mt. Hayes, 13,740 ft., is the highest peak of the Alaska Range east of Mt. McKinley, lying between the Richardson Highway and the Alaska Railroad some 100 miles south of Fairbanks, and 200 miles south of the Arctic Circle. Earlier attempts on the mountain had ended in failure, the party of Oscar Houston reaching 11,000 feet on the north ridge in 1937 under very adverse weather conditions. Several approaches are possible, the easiest being from the north by airplane. The supplies were flown in from Fairbanks and dumped or parachuted near the Base Camp, while the members of the party landed 13 miles to the north at Conradt Field, a somewhat level gravel bar beside a turbulent glacier torrent. We gathered at the Base Camp for the attack on the mountain on the 20th of July, the five previous days having been employed in backpacking food and equipment across the glacier from the slope where it had been parachuted. The weather, which had afforded us only a few brief glimpses of the summit since we had arrived, took a turn for the worse, but we continued to establish the higher camps.

From the Base Camp at the foot of the north ridge, the long axis of the mountain runs roughly north and south, rising at first steeply to a shoulder at 6500 feet and a peak at 8500 feet, then running along a series of humps nearly two miles to a definite peak at 9800 feet. Here the ridge is deeply notched, forming a natural campsite at the foot of the 12,800 foot shoulder, a mile beyond which the summit looms. Further to the south, beyond the summit is the 13000 foot south shoulder, with its beautiful frost-fluting and granite cliffs. In spite of snow and bad weather, by July 26th we were all at Camp I at the 8500 foot level; on the 28th we were in the 9500 foot notch with food reserve for ten days. The following day the weather was reasonably clear, so we set out to reconnoiter the route on the ridge, and if possible, to make the summit. From the notch a very steep and narrow snow ridge leads upwards 400 feet to where the ridge broadens into a slope, broken at places by bulging masses of ice and crevasses, or cracks in the snow. The only difficulty was a steep cleft near the upper end of the slope: Hendricks cut a few steps in the ice and we were soon on the 12,800 foot shoulder. The snow varied from hard crust to waist-deep powder, where each took his turn at the exhausting task of breaking trail. The weather began to look worse, and a strong wind sharpened the cold. Dark clouds began to pile in from the southwest, but we continued onwards. The ridge beyond the shoulder was a veritable knife-edge: great double-cornices festooned the rocks which appeared through the snow. On the right the west face dropped 7000 feet to the Hayes glacier, and on the left a precipice of equal depth fell away into another vast glacial amphitheater, "Avalanche Cirque." The others waited while Brad, Barbara, and I pushed on towards the base of the summit cone about 13,000 feet. The clouds closed in on the south peak and began piling up over the summit; the powder snow whipped from the ridge in biting streams of whirling snow-devils, and forced us to turn about. Carefully we traversed the narrow ridge and returned to the shoulder, hurried over the crevasses and reached the shelter of the tents just as the storm struck the notch.



Climbing from the North Ridge of Mt. Hayes towards Camp No. 2.

Washburn photo

The wind howled and the tents flapped ceaselessly throughout that night and the following day, but by noon of the 31st the storm had blown itself out, and blue sky appeared in the west. We prepared everything for an attempt the next day. At 6:15 a.m. all except Hall left Camp II prepared for the final push: we had 200 willow trail -markers and two rapelle pickets for use in case of bad weather, and food enough for several meals. The storm had blown the powder snow from the slopes, and solidified our steps of three days previous; we reached the 12,800 foot shoulder in half the time it had taken before. The knife-edge ridge was safely passed, and soon we were at the base of the summit cone. Rather than break trail through deep powder snow on the main slope, we stayed on the hard edge of the cone along the west face. The weather continued clear above, although clouds filled the valleys and obscured the view somewhat. At 2:15 p.m. we reached the summit. The temperature was 12° F., there was a slight wind. The jagged Cathedral Peaks to the west, and Mt. Bagley to the east rose majestically above the clouds. Mt. McKinley, the highest peak of the Continent, was obscured, but occasional rifts revealed the vast expanses of the Susitna, the West Fork, and the Black Rapids Glaciers to the south. The wind increased in violence, and we did not tarry long on the peak. A great snow plume was forming from the top as we crossed the ridge, and occasional clouds sailed up from the cirque below, casting weird lighting on the cornices, whose ghostly shapes appeared and disappeared in the fog ahead and behind. By 6:15 p.m., when we reached the notch again, the upper part of the mountain was completely enveloped in swirling mists, although it was quite clear and warm at the camp. We celebrated by eating most of the remaining supplies, and staggered off to the sleeping bags as snow began to fall again outside.

Snow was still drifting down on the morning of the 2nd, but nevertheless we decided to return at once to Base Camp, as Brad wanted to go out to Fairbanks to take the aerial mapping pictures of the Hayes Range while there was still a chance for good weather. Two tremendous avalanches crashed down the face beside the abandoned camp as we hurried down the ridge. Hendricks, Ferris, and I were to explore the second highest mountain of the range, an unnamed 13,000 foot peak ten miles to the east of Mt. Hayes. The north and west sides presented formidable and repulsive precipices, so we decided to try the approaches up the glaciers to the east and southeast of the peak, intending if possible to traverse the Black Rapids Glacier basin to Rapids, on the Richardson Highway. For the next week we advanced our camp slowly up the Delta Creek Glacier, during the drizzles which punctuated the downpours. On the evening of the 8th of August it cleared sufficiently for us to reconnoiter a route through the great ice-fall which cascades in frozen waves 2000 feet from the upper snow fields of the E. Prong Glacier. The 9th dawned clear, the first good day in a week. We hurried through the lower icefall, but slowed up in the chaos of cavernous crevasses, towering ice-blocks and avalanche debris of the upper part. At last we could go no further with the heavy packs; Hendricks and I climbed out to the top over some shaky ice-bridges. Above, the glacier was badly broken into huge snow-blocks, and another ice-fall blocked the way beyond. Reluctantly we gave up the southeast side of the mountain and retraced our steps to the north side, to "Blitz Ridge," as we had named the route that we had seen from Mt. Hayes. Unfortunately Hendricks had to leave on the 11th to do some government work at Livengood, and with real regret we watched him cross the glacier as we took our loads up the base of the ridge. To him belongs the credit for making the climb possible for us.

The route followed a little hanging glacier on the northwest buttress of the mountain, gaining the ridge over a steep snow slope just beyond the first ice-fall in the glacier. Late in the afternoon we camped on a big serac, or ice-block, at 9700 feet, well sheltered from the wind. The 12th was a cloudless morning—a real Alaska miracle. We wasted little time in getting under way. The lower ridge ran out into a 60° face measuring by the aneroid 600 feet from the usual deep cleft, or bergschrund, at the bottom, to the upper ridge. The bergschrund offered no difficulties, but to our dismay the face above soon turned to ice at an angle of 65°. Cutting handholds and steps was very time-consuming, and our position became more exposed as we were forced by an overhanging ice-mass out over the 8000 foot north face. In about two hours we had made only 300 feet and were becoming discouraged with the prospects when the ice gave way to packed snow. A troublesome overhanging ice-wall was overcome and we were soon on the ridge above. The last obstacles were some rock towers corniced with several feet of powder snow, which had to be brushed awey carefully before holds could be found. Just as we were about to reach the summit, the noise of an airplane over Mt. Hayes attracted our attention. It was Washburn on his photographic flight. On the top we discovered that we had taken the only practical route, for a third ice-fall blocked the route above the two which had already frustrated our plans. Cliffs draped with icicles and frost feathers fell off on all sides except the northwest, whence we had come. Clouds began forming over the south peak, two miles away, and we hurried to descend. The snow had softened on the ridge, making progress very slow. One of the cornices suddenly broke off, carrying Ferris over the precipice with it. The rope held, and as he shakily regained the ridge the remains of the cornice crashed onto the glacier several thousand feet below. At the ice face we tied the rope to a tent peg jammed in a convenient crack and slid down 250 feet over the worst part. The tent was a welcome sight, and we wasted no time in cooking a side-bulging banquet. All excess food and the less valuable equipment were abandoned here, as we hoped to make it to the cache at the landing field in one day. Three days later we arrived at the field, bedraggled and crestfallen, after a thorough dousing in an icy glacier creek, an encounter with a bear at night, and a meager subsistence on bitter, watery arctic blueberries. On the 16th of August, as we flew out toward Fairbanks, Mt. Hayes was obscured by the clouds, but the 13,000 foot peak was still visible above the mists. We were sorry to leave them.

THE PATENT SYSTEM

By ALFRED W. KNIGHT
Western Precipitation Corporation

Our American patent system has become the subject of a violent controversy. Before Congressional Committees; in newspapers and periodicals, among organizations of engineers, scientists, industrialists, lawyers, and patent attorneys; and even in judicial decisions, the battle has been fought with steadily increasing intensity.

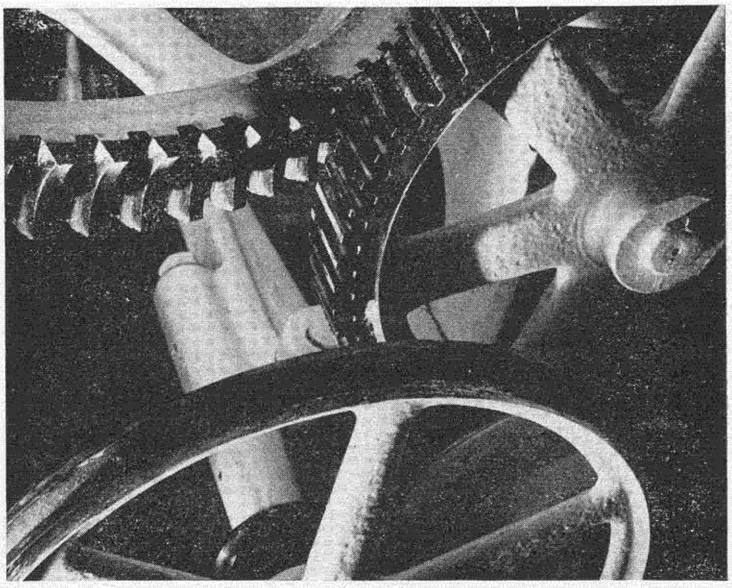
On the one hand, the cry is raised that patents are the cause of many—if not all—of our social and economic troubles; that many of the patents issued each week by the Patent Office should never have been granted, either because the subject-matter is not in fact new or because the improvements concerned are too trivial to warrant the granting of a seventeen-year monopoly; that litigation involving patents is fraught with excessive and inexcusable expense, delay, and uncertainty, particularly by reason of frequent conflicting decision by courts in the different circuits; that patents and agreements based thereon lead to curtailment of production, suppression of revolutionary improvements, and fixing of prices, all to the detriment of the general public welfare; that because of international patent cartels set up prior to the war, between American concerns and powerful foreign interests, we now find ourselves sadly lacking in certain vital materials that are sorely needed in our all-out war effort, and in the necessary facilities for production of such materials; and that in some instances the refusal of patent owners to grant licensees to others has seriously hampered the production of war materials for the government.

On the other hand, the dyed-in-the-wool defenders of the patent system in its present form ardently protest that it has been, and will continue to be, the only effective means of promoting technological and industrial advancement; that, on the whole, the proportion of patents improperly granted is relatively small and has but little harmful effect compared with the benefits of the system; that the expense, delays and conflicting decisions incident to patent litigation are not excessive in view of the importance of the issues to be decided; that there has been no actual suppression of important improvements nor any substantial curtailment of production because of patents or patent agreements; that if in occasional instances the public interest is adversely affected through abuse or misuse of patent rights the offending acts can be stopped and the responsible parties punished under existing statutes without requiring revision of the patent laws; that the international agreements under which American corporations acquired patent rights and technical information relating to inventions of foreign origin have, on the whole, been much more beneficial than harmful to our industrial progress and to our present ability to produce necessary war materials; and that any serious delays in the production of materials or equipment needed by the government have resulted not because of restraints imposed by patents but for other reasons.

The issues are—or should be—of interest to all persons engaged in the broad field of industry, and particularly to scientists and engineers whose chief concern is in the continuance of technological progress and the proper utilization of its products for the greatest ultimate benefit to the general public.

The views of most persons who have studied the subject and know the facts correspond more closely to what is believed to be the true situation, which lies somewhere between the two extreme positions indicated above. In other words, like most other institutions that are parts of the highly complex civilization in which we live, the patent system has many good features and some bad ones. There are probably few persons who seriously will deny that the incentive provided by patents has been an important factor in the creation and commercial development of new inventions with resultant benefits to the general public, or who actually believe that patents should be abolished if a system of private enterprise and individual initiative is to be maintained in this country. Similarly, few if any will contend that our present patent laws and procedure are perfect, or deny that they can and should be improved and modified in line with changing economic and social conditions and with a view to preventing or minimizing the use of patents in any manner that is against the public interest.

The writer's limited knowledge of the subject, as well as space limitations prudently imposed by the editor, preclude an attempt to fully discuss all aspects of the controversy in this article. It has been the subject of thousands of pages of printed testimony before Congressional committees and other investigating bodies, and many books and papers have been published presenting the views of persons on both sides of the fence, based on exhaustive studies of the problem or of certain of its specific elements. It will be the sole purpose here to comment generally on certain phases of the controversy, to review briefly some of the recent investigations dealing therewith, and to discuss some of the new legislation that has been passed in recent years, as well as additional changes that have been recommended or suggested.



Most of the arguments about the patent system that have come to the attention of the public in the last few years may be divided into two general classes: first, those having to do with the effects of patents on our normal peace-time economy and welfare and, second, those which are concerned only with their effects on our ability to build, maintain and operate an effective war machine. This distinction is important for a number of reasons.

Since long before the start of the present war, critics of the patent system have complained of what they contend are defects or "sore spots" in our present laws and procedure. These objections have been aimed chiefly at those factors that are concerned in the normal operation of the patent laws during times of peaceful industrial development. If these complaints are justified (and few will deny that at least some of them are), then the necessary legislation to cure such defects should, after careful study and preparation, be enacted as a permanent part of our patent law.

However, the approach and advent of this country's entry into the war have been accompanied by a marked increase in both the intensity and the scope of the attack against patents and patent monopolies. The direct result has been the addition of new complaints based on alleged hampering of the war effort because of patents. As a further result, however, these war-time objections have aroused increased public interest in the whole subject of alleged misuse or abuse of patent rights. In some of the proposed legislation introduced in the last session of Congress, and in the arguments advanced in support of such legislation, there was a lack of proper differentiation between emergency measures aimed at the removal of any existing patent obstacles to war production and permanent measures that would effect fundamental changes in the operation of the patent system in the post-war period. This has caused a great deal of confusion, not only in the minds of the public but even in the hearings before Congressional committees.

It probably would be unfair to say that there has been a deliberate or concerted attempt to capitalize upon this confusion by seeking enactment of laws disguised as emergency war measures but actually designed to produce permanent and fundamental changes in the patent system. However, it is quite possible that public opinion and action by Congress with respect to proposed drastic changes in the patent laws, wholly unrelated to the war situation, may be influenced unduly by some of the startling accusations that have been made (but not generally proven) as to the impeding of war production by patents.

It is *not* intended here to discuss particularly the patent situation as related to the war effort, for that is a highly debatable subject on which the writer is not sufficiently informed. It should be made clear, however, that for the most part the supporters of the patent system have been disposed not to argue that question. In general they have taken the position that if any additional emergency legislation is needed to remove any existing obstructions to war production, either because of patents or otherwise, such legislation should be speedily enacted. Their chief effort in this connection has been to keep all such legislation clearly distinct from measures dealing with long-range revision of the patent laws and definitely limited to the period of the war emergency. Only in this manner can proposed fundamental changes affecting the normal operation of the patent system be properly and fairly considered and acted upon.

Turning now to the essentially non-war aspects of the subject, it probably is unnecessary to go back more than about four years, to the time of the Temporary National Economic Committee hearings in Washington. For, although the controversy may be said to be as old as the patent system itself, a fair idea of the principal issues now under consideration and of some of the recent improvements that have been made in the patent laws can be obtained from a review of those hearings and of other later proceedings.

The Temporary National Economic Committee, or T.N.E.C., was established in 1938 by a joint resolution of Congress, as the result of a message by President Roosevelt in which he recommended a thorough investigation of "the concentration of economic power in American industry and the effect of that concentration upon the decline of competition." Among specific matters that the President said should be considered in such an investigation were revision of the patent laws and revision of the anti-trust laws.

The Committee consisted of three Senators, three members of the House of Representatives, and six representatives of various government department agencies. Senator O'Mahoney of Wyoming was chairman. Thurman Arnold was a member, representing the Department of Justice. During the first part of the hearings Leon Henderson acted as executive secretary.

The hearings, which covered a wide variety of subjects in addition to patents, began in December, 1938 and continued with some interruptions for about a year and a half.

The testimony regarding patents was presented principally by the Department of Justice, in an effort to show that patents have in some instances been used as weapons to secure complete domination of particular industries and thus limit production, suppress competition, and force the public to pay excessively high prices for the products of such industries. A large part of this testimony was concerned with the glass container industry as an example of the asserted abuse of patents through extremely tight control of production and prices under agreements involving practically all the important manufacturing concerns in that industry, and the automobile manufacturing industry as exemplifying the beneficial use of patents under an extremely free and open licensing policy.

A number of other witnesses testified as to the benefits of the patent system, while at the same time discussing certain of its defects and suggesting legislation designed to overcome some of these defects. One of the principal witnesses in this latter group was Commissioner of Patents Conway P. Coe, who specifically recommended the following changes in the patent laws:

1. Creation of a single court of patent appeals, to decide all appeals from the lower courts in patent cases.
2. Limitation of the term of a patent to twenty years from the date of filing the application, but not to exceed the present term of seventeen years from the date the patent is granted.

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AIR POWER AND THE WAR

By J. E. WALLACE STERLING

Professor of History

This article is being written on the anniversary of the first thousand-plane raid in history. On the night of May 30, 1942, more than one thousand bombers based on Britain soared into the sky and pointed their noses southeastward across the Channel. The target for the night was Cologne. Two thousand tons of explosive and incendiary bombs were unloaded over the target area in ninety minutes; forty-four planes were lost. Two nights later, June 1, Essen, the home of the Krupp armament works, was struck with comparable force; here thirty-five planes were lost. News of these raids warmed the cockles of many a heart in Britain and elsewhere, for at last the Germans were being paid back in their own coin, and with interest, for the Luftwaffe had never dropped as much as five hundred tons of bombs over Britain on any one raid; in fact, only twice had it dropped more than four hundred tons.

But on the morrow of these thousand-plane raids, a word of caution came from high places in Britain. When Mr. Churchill announced the raid on Essen to the House of Commons, he said: "I do not wish it to be supposed that all our raids in the immediate future will be above the four-figure scale." He admitted, however, that these two great raids marked a new phase in the air offensive against Germany, which would be further developed when the United States air force was also in operation against Europe. "I may say, in fact," he concluded, "that as the year advances German cities, harbours, and centres of war production will be subjected to an ordeal the like of which has never been experienced by any country in continuity, severity, or magnitude."

Five months later, the Secretary of State for Air repeated Mr. Churchill's word of caution. He was reviewing the work of the R.A.F. for the first three quarters of 1942, and pointed out that there was a steadily increasing tonnage of bombs being dropped on Germany and German occupied Europe. This air offensive against the stronghold of the enemy had given great indirect aid to Russia, because "for the whole of 1942," the Secretary said, "we have held more than half the German fighter squadrons facing west and, in the Mediterranean area, south." Nevertheless, it was not true that Britain had all the bombers it needed. The force was as yet so limited that it was only by an exceptional feat of organization, which could be rarely repeated, that 1,000 bombers could be put into the air at one time. He, too, concluded on a note of hope, however, when he expressed confidence that in a few months such four-figure raids would be less important.

Time and events have proved the wisdom of the words of caution thus uttered, but likewise they have seen the partial materialization of the hopes expressed. The last two weeks of May, 1943, saw the heaviest bombardment of Germany since the war began. It is not inappropriate, therefore, to devote some consideration to the role of air power in this war.

Few, if any, weapons of modern warfare have been acclaimed as enthusiastically as the airplane. Machine gun, long range artillery, tank and submarine have each in turn greatly affected the nature of warfare and have wrought innovations in applied military science. But for none of these, with the possible exception of the submarine, have such extravagant claims been made as for the airplane. Among the most extravagant of these claims was that put forward by the brilliant Italian writer, General Douhet, in the years between the two world wars of this century. General Douhet advocated that an air force should be completely independent of the other armed services, and that it should be used to destroy an enemy's capacity to make war by bombing enemy factories and transport systems and by crushing the enemy's will to fight under a rain of terror from the skies. The use of air power to destroy the enemy's capacity to make war is referred to as strategic; it is contrasted with the use of air power to support ground troops, which is called tactical.

But the experience of the past decade has demonstrated that the strategic use of air power has not yet been developed to a point where it is complete in itself, where it alone can win wars. In Spain, during the civil war, civilian morale did not crack and crumble under bombing and strafing attack. It was said, however, that air power was not there used on a sufficiently large scale to produce the desired effect. But in Poland, in Holland and Belgium, and still more notably in Britain, the heaviest blows the Luftwaffe could strike did not stop the machinery of production or terrorize into helplessness the people who run the machines. Despite colossal damage inflicted by mass bombing, British morale remained good, even improved under fire. It was the German army, capitalizing on the work of the Luftwaffe, which overpowered Poland, Holland, Belgium and France,—something that proved impracticable in the case of Britain.

The experience of this war has taught several things about air power. The first is, that it cannot be effectively used as an independent force until that day shall have come when its bombers and fighters can be supplied by air transport. As long as air power must rely for gasoline, oil, bombs and other material on land and sea transport, it cannot escape its ties to the other armed services. The Japanese planes which dominated the skies over Malaya and Burma flew from bases which had been captured by ground troops; these in turn had been transported by the Japanese Navy. These planes flew with fuel and were serviced with materials and parts which had been similarly transported.

The dependence of air power on land and sea transport was seen likewise in North Africa. The supply line of the United Nations to Egypt was longer than that of the Axis, but it was less vulnerable. By great effort, therefore, it was possible for the Allies to assemble the supplies necessary to seize and hold that air supremacy which was such a vitally important factor in the eventual victory of the Eighth Army. The Axis supply

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ORDNANCE—THE BACKBONE OF WARFARE

By FREDERICK C. HOFF

To procure and supply the Army's weapons and ammunition —that in a broad term is the function of the Ordnance Department of the United States Army. With the high state of mechanization of modern warfare, the term "Ordnance" has come to include not only guns and ammunition, but also tanks and motorized combat equipment as well as a host of miscellaneous items.

To perform its tremendous tasks of design, procurement, testing, distribution and maintenance, the Ordnance Department, headed by a Chief of Ordnance, is divided into four major divisions, the Industrial Division, Field Division, Technical Division, and Military Training Division. The Industrial Division is concerned with procurement, acceptance, and testing of ordnance materiel. The Field Service Division is charged with the responsibility of distribution and maintenance of ordnance materiel. The Technical Division is connected with design and development. The Military Training Division is the branch which trains the thousands of enlisted men and officers required for maintaining equipment at the front, delivering ammunition to gun crews, handling bombs and other ammunition at airfields and performing other ordnance duties.

Through the years of peace it was the responsibility of the officers of the Ordnance Department to carry on a program of development of new ordnance materiel, devise better methods for ordnance manufacture and to set up a streamlined organization that could be expanded, in time of emergency, with a minimum of confusion. The peace time budget for these activities was indeed meager, but the success of ordnance production today is full proof of the resourceful planning of our peace time ordnance heads, such as Major General C. M. Wesson, former Chief of Ordnance.

For carrying on the program of development, there are our six manufacturing arsenals—Watertown, Watervliet, Springfield Armory, Rock Island, Frankford and Picatinny. Each works on one or more of the major phases of ordnance and on countless minor and associated details. Watertown and Waterveliet conduct various researches on the design and manufacture of guns and cannon. Springfield Armory developed the far-famed Garand rifle. Rock Island specializes in the development of tanks and gun recoil mechanisms, Frankford Arsenal makes studies on the manufacture of metal components for shells and bombs, and designs and develops methods for production of small arms ammunition. Picatinny Arsenal conducts researches on military explosives and their production; the manufacture of fuses, boosters and primers and the loading of high explosive shell and bombs and miscellaneous pyrotechnics. In addition to their researches, each arsenal manufactured enough items of their specialties to supply most of the peace time needs of the army.

Cooperating with all of our six manufacturing arsenals is the great proving ground at Aberdeen, Maryland. Here all ordnance materiel undergoes its test of acceptance. New weapons are tried and the proven designs in production are tested to see that they maintain their high standards of quality. With the increased volume of ordnance production, the Aberdeen Proving Ground has been augmented by a number of new proving grounds located near production centers.

A large amount of credit for the success of the war-time ordnance production program must go to the various Ordnance Districts located in the principal cities of our country. During peace-time these districts, working in cooperation with the prominent civilians most of whom made up the local Army Ordnance Association Chapters, made surveys of the potential ordnance production capacities of industrial concerns in their area. They supervised the performance of peace-time trial contracts. With war their volume of activities has been tremendously increased. They have now become the link between the Ordnance Department and the thousands of private industrial concerns engaged in the manufacture of ordnance materiel. Ordnance districts now supervise all ordnance contracts with private industries in their district, providing inspectors at each plant and supplying the Ordnance office with reports on the progress on the contracts.

Although many private industries have converted their vast facilities to the manufacture of many items of ordnance, there are certain phases of ordnance production to which private industries could not be converted. The principal activities falling in this category are the manufacture of military explosives and the "loading" or assembling of high explosive and armor-piercing bombs and shells. These facilities were far short of those necessary for producing ammunition in the quantities required by global warfare. As a first step towards expansion, additional loading facilities were provided at Savanna and Ogden. Both plants are 100% government operated and have established fine records for low cost and highly efficient production. The major program of expansion, however, came through the establishment of government owned but privately operated plants. A typical government owned-privately operated organization is the Ravenna Ordnance Plant in Ohio. It was one of the first major bomb and shell loading plants completed. The Ordnance Department contracted with the Atlas Powder Company to operate this plant. The next step was to let an engineering-architecture contract. In cooperation with the Atlas officials and the Ordnance Department, the engineer-architects drew up complete plans and specifications for the plant. These plans were then turned over to the Q.M.C. and later to the Corps of Engineers who, upon completion of construction, turned the plant over to the Ordnance Department and the operating contractor. The operating contractor hires and trains personnel for the entire plant.

The above procedure is typical of that used in establishing all the new loading plants, TNT plants, powder works, small arms plants and ammonia works as well as new tank arsenals, gun works, armor plants works and shell forging works that augment private industrial facilities turned over to ordnance production.

Naturally, with the increased ordnance manufacturing facilities, the job of the Field Service has also been increased. The result is the establishment of many new ordnance storage depots and increased facilities for handling and maintaining all types of ordnance materiel. Practically all Field Service activities have remained 100% under government operation. All storage depots are government operated and their personnel is made up entirely of civil service employees, and enlisted men and officers of the Ordnance Department. However, construction of new depots is by private contractors working under the supervision of the Corps of Engineers.

As previously mentioned, the military section of the Ordnance Department comes under Field Service and consequently ordnance schools and training centers are quite frequently operated in conjunction with Field Service establishments. For example, the Aberdeen Proving Ground Depot is also the center of the Officer's Candidate School for Ordnance.

To more clearly understand how these various divisions cooperate and are inter-related it will probably be well to follow the history of some one item of ordnance. Let us take, therefore, an imaginary type high explosive anti-aircraft shell. This shell will probably be of the complete, fixed round type, that is, it will consist of a high explosive projectile, assembled to a cartridge case in permanent fashion by crimping the cartridge to the body of the projectile near the base. A time fuse will be installed at the loading plant.

Let us first consider the principal elements of the shell:

1. *The fuse,* consisting of a multitude of small formed or machined parts, some die castings and some special ignition materials.
2. *The booster,* consisting of a number of small formed or machined parts and a charge of supersensitive explosive.
3. *The projectile,* consisting of a machined carbon steel body and a charge of TNT.
4. *The cartridge case* of brass or the new steel construction, filled with a propelling charge of smokeless powder and perhaps employing some type of cardboard distance wad to make possible the use of only a part of the potential powder capacity of the cartridge case.
5. *The primer,* consisting of some soft brass parts and a charge of fulminate of mercury or other ignition explosives.

The completed shell will probably be packed in a heavy cylindrical fibre container and three or four containers put in a wood box or crate for shipment.

The general design for this shell will have been made by Picatinny Arsenal and the Ordnance Department in Washington. Details of the design for the projectile body and the cartridge case will have been developed by Frankford Arsenal. Explosive details and details of the metal parts of fuse, booster and primer will have been worked out by Picatinny. The shell design will have to be approved by the gun experts at Watertown or Waterveliet for use in the anti-aircraft gun of the caliber and type they are developing.

After a number of trial rounds have been manufactured and loaded, they are sent to Aberdeen Proving Ground for test and final approval. If final approval is received, the shell may in time go into production.

Assuming that it does go into production, contracts will be let by the Ordnance Department Industrial Division for the various metal components which can be made by private industry. These components will be distributed to the various plants where fuse, booster, primer and final loading are to be done. Contract supervision and inspection of these parts will be handled by the Ordnance Districts.

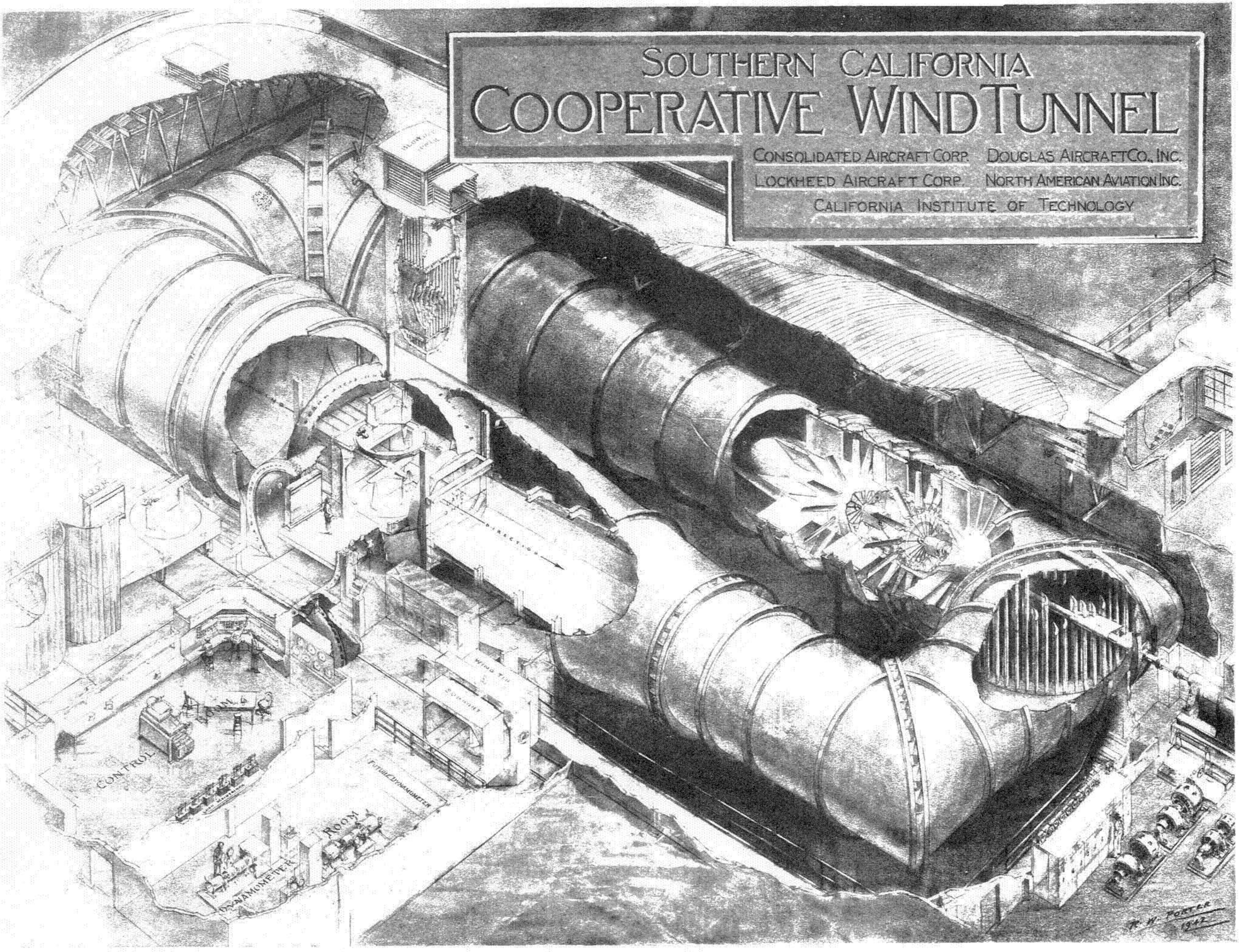
The shell loading plant is the receiving center for the fuse, the booster, the primer, the shell body, the cartridge case, bulk TNT and smokeles powder as well as the fibre packing container, the wood packing box and miscellaneous small items required for final assembly, marking and packaging. Shell bodies and cartridge cases are usually furnished on contracts with private industrial concerns. TNT and powder come from government owned ordnance works. The packing materials and miscellaneous items are furnished on contracts usually negotiated by the loading plant rather than the central ordnance office.

At the loading plant the shell body is usually painted with one or two coats of special enamel after being thoroughly degreased. Next the actual loading of the projectile with high explosive takes place. In a specially designed building, TNT is melted by carefully regulated steam grids and poured into the projectile. After solidification of the TNT the booster is inserted in the projectile at a nadjacent location. From a second section of the plant comes the loaded cartridge case. The case is fitted with a primer and an accurately weighed propelling charge of smokeless powder is inserted. Finally the two major elements of the complete round, the projectile and cartridge, are brought to a final assembly building and are assembled in a special assembly and crimping press. After the fuse is added, the complete round is marked, packaged and boxed. All loading plant operations are carefully watched by ordnance inspectors who accept completed shells.

From the time the shell leaves the loading plant until it is actually turned over to the gun crew for firing, it is the property of the Field Service, which determines whether it is to be placed in storage or immediately shipped to a fighting front. If stored, it will be subjected to frequent inspection to detect any deterioration. If sent to the front, it will be delivered to a gun battery by ordnance troops.

Rather complete records are kept on each lot of shells and before any lot is certified for use, representative samples are tested at a proving ground. Should any irregularities occur either at the proving ground or in the field, complete reports are made so that correction of any difficulties can be made.

A medium caliber shell is one of the simpler items from the thousands that make up ordnance materiel. Tracing the effort required to make this one shell ready for service gives a glimpse of the tremendous task which the Ordnance Department is facing in getting millions like it to the front. In addition, it supplies billions of rounds of small arms and tons of bombs, as well as the more complex items such as guns, tanks and motorized equipment. For the efficiency with which the Ordnance Department is fulfilling its part in the war program, all credit is due to our ordnance officers, enlisted men, Ordnance Department employees and those American industrialists who are cooperating to make mass production of ordnance practical.


SOUTHERN CALIFORNIA
COOPERATIVE WIND TUNNEL
CONSOLIDATED AIRCRAFT CORP. DOUGLAS AIRCRAFT CO., INC.
LOCKHEED AIRCRAFT CORP. NORTH AMERICAN AVIATION INC.
CALIFORNIA INSTITUTE OF TECHNOLOGY
DIRECTION
CONTROL
DYNAMOMETER ROOM
FUTURE DYNAMOMETER

World's Finest Privately-Owned Wind Tunnel At Halfway Mark

The most advanced, privately-owned wind tunnel in the world is at the half-way construction point.

The laboratory buildings for the $2,100,000 Southern California Cooperative Wind Tunnel are now completed and the construction of the steel tunnel itself is well under way.

Sometime in September, 1943, the tunnel will be ready to serve as the world's most advanced testing ground for the developments now making American airplane performance set new records in speed, altitude, armament, and maneuverability.

The tunnel, financed by Consolidated, Douglas, Lockheed and North American —Aircraft War Production Council members—is constructed and operated under the supervision of Dr. Clark B. Millikan, by the California Institute of Technology, though it is not located on the Institute grounds.

The Cal-Tech tunnel has an identical twin on the East Coast—at Buffalo, New York—being constructed under the supervision of Dr. Norton B. Moore, of Crutiss-Wright.

Design of both tunnels was in process for many months, under the general direction of Dr. Millikan and Dr. Moore. Collaborating were engineers of the four Southern California companies, Caltech and Curtiss-Wright.

Importance of the wind tunnel in the development of better aircraft lies in the fact that much of a new plane's flying data(probable top speed, landing speed, rate of climb, stability, controllability, number of required take-off feet) can be accurately determined in the wind tunnel before the proposed plane is built.

Aircraft manufacturers expect to build planes in the next few years that will have diving speeds exceeding 9/10 the speed of sound (approximately 741 miles per hour).

Airplanes of the future may be designed to dive at a rate of more than 700 miles an hour. The new tunnel will be equipped to test such speeds.

Most existing tunnels have a maximum testing speed for less than this, and only a few are capable of testing at speeds exceeding 500 miles an hour.

Aircraft engineers and designers point to difficulties already experienced at speeds well below the velocity of sound as indication that careful aerodynamic investigations should be made on every airplane model which is to be operated at these high speeds.

In the development of high performance military aircraft, problems requiring immediate wind tunnel testing almost always occur in the design phase and particularly during the flight test period when immediate access to a wind tunnel is of vital importance.

Wind tunnels operate on the principle of the Venturi tube, which was devised in 1800 by Giovanni Venturi, an Italian physicist, for measuring the flow of water through a pipe. Venturi discovered that the rate of flow of water through a pipe increased as the water passed through a narrower section of the pipe.

Substituting wind for water, air is moved by a huge propeller in a section of large diameter. From there it is blown into a much smaller section, the "throat." When the wind in the large section of the tunnel reaches the "throat" it gains in speed.

By placing an exact scale model of an airplane in the "tunnel," tests can be made which will show what the actual plane will do when it is in the air at similar speeds. Reactions of the model (placed on supports resting on highly sensitive balances) are measured mechanically, electrically or hydraulically. Readings are taken for every attitude of the model in the tunnel and the recorded information is immediately plotted on a graph. Engineers are then able to list accurate flying characteristics of the future airplane.

Existing wind tunnels in Southern California, all smaller than the Cal-Tech project, are owned by Lockheed, North American, Northrop and Vultee aircraft companies. As members of the Aircraft War Production Council, they have been making their tunnels available to the other member companies. When the new cooperative tunnel is completed, it also will be available to all the Council companies — Boeing, Consolidated Vultee, Douglas, Lockheed, North American, Northrop, Ryan and Vega.

Under the Council system of *industrial teamwork,* all member companies pool their facilities and research in the interests of producing more planes and still more planes—the best in the world—to speed victory for the United Nations.

Alumni Business and Professional Guide

PROTECTION OF CIVILIANS AGAINST GAS ATTACKS

(Continued from page 6)

done by Mr. F. R. Huddy in the yard at California Street and Broadway, under the supervision of Mr. L. S. Caswell.

It was attempted to render the driver's compartment and the first aid cabin gas-free under all circumstances. Mobile gas-free cabins of this type have several advantages. Inside these cabins the driver and a physician or first aider are not encumbered with masks or gas proof suits, and victims can be given aid on the spot. Also the men of the squad may change dress leisurely while the car is starting on its mission so that no time is lost in putting in the gas proof suit, shoes, masks, etc., before starting. The air is drawn into the interior by a whizz blower (marked W.B.) with a 200 watt motor and fan creating a pressure of 20 inches water lift. The air first passes through a thin felt filter and a large double cylinder activated charcoal canister kindly lent to us by Professor F. Went of the Institute. This is followed by a chemical muslin filter, which is kept wet by a solution of appropriate chemicals dissolved in water and some glycerin trickling through their orifices from eight five gallon tanks mounted on top. Finally, having surplus pressure left, we decided to install behind the whizz blower a tank air bubbling filter, not shown in the drawing. The power for the whizz blower and for the lamps in the first aid cabin and the rear platform is furnished by a small 500-watt motor generator set (M.G.), which is mounted on the rear platform. Two wet blanket doors form an airlock which closes the two cabins off against the rear platform. The surplus air pressure created in the two cabins by the whizz blower prevents any poison gas or carbon monoxide from the exhausts of the three gasoline engines from penetrating the two closed cabins in any dangerous amounts.

On the rear platform a *dual duster* (D.D.) is mounted. For the loan of this blower I am greatly indebted to the generosity of the Los Angeles office of the Food Machinery Corporation. Dual aluminum fans enclosed in aluminum blower cases are driven by a 1½ H.P. Cushman Husky Air-Cooled Engine. Powdered chemicals may be dumped into a 50-pound capacity hopper with independent feed control, and blown out with great force into the air through one or two semi-flexible hoses about three inches in diameter. While the truck is driving along, a dust cloud about fifteen yards high and a hundred yards in width may thus be generated. Very fine dry silt and powdered chemicals such as chloride of lime may be carried along in three hundred single friction top 5-pound cans (C). While one member of the crew is dumping the contents of these cans into the hopper, another member is handling the hose and generating the dust cloud. The neutralizing chemical cloud might under certain circumstances react all too violently with the poison gases, such as vesicants for instance. Decontamination truck No. 1 is therefore followed by truck No. II which carries some 450 feet of fire hose, to be attached to several already decontaminated hydrants. Powerful water jets then precipitate to the ground and wash down into the sewers the poison gases and the neutralizing agents. To speed up the neutralization of the poison gases, the fine silt dust is used. This dust, together with some additions of powdered detergents such as Dreft, acts to emulsify the whole precipitate into fine globules giving the chemicals and the water a maximum chance to oxydize, chlorinate or hydrolize the poison gases and thus render them ineffective. Dr. R. W. Hummer at our Institute was kind enough, at my suggestion, to carry out some experiments on the emulsification and destruction of mustard gas.

A third decontamination truck is being equipped by the senior gas officer, Mr. Ted V. Ackerman, with the officially recommended equipment of shovels, brushes, pails to mix slurry of chloride of lime, stirrup pumps, portable tanks with hand pumps, etc. This unit is designed to take care of the decontamination of local spots on the streets or in buildings, which cannot be reached with the blower on truck No. 1. Contaminated machinery in industrial establishments will be particularly difficult to decontaminate, since many of the poison gases are highly soluble in machine oils and greases. Special chemical decontamination agents which do not corrode any of the exposed metal parts will be needed. Unfortunately no good agents of this type are available to us. It is to be expected that the chemical warfare services will in an emergency release the non-corrosive agents developed by them.

A crew of fifteen men of the Pasadena Street Department is being trained in the operation of the equipment. In an emergency it is intended to call on the services of some of the students of the California Institute. The direction of operation of the chemical defense lies in the hands of the senior gas officer and his assistant at the main control center of the city. Associated with them is a group of four technical advisors from the Institute: Doctors F. W. Went, D. H. Campbell, A. L. LeRosen and the author of this article. On every yellow alert one member of this group is called directly by the senior gas officer to take up his station in the auxiliary control center. The remaining three members may be called upon to assist in the gas reconnaissance service or to go out with the decontamination fleet to direct operations in the field.

The decontamination fleet and the control officers keep also in touch with two groups of men which were organized at the California Institute. The first group, under the direction of Prof. Haagen-Smit, is a self-contained decontamination unit with all of the necessary equipment for local operations around the campus. The second group consists of about one dozen reconnaissance officers recruited among the faculty and the students at the Institute. These men have *gas identification kits* at their disposal, and on their reports as well as on the information to be obtained from the air wardens the whole gas defense service depends. Doctors Dan H. Campbell and A. L. LeRosen are responsible for the design and construction of a set of the identification kits used.

The individual equipment furnished by the government includes army training masks, steel helmets and a number of gas proof suits. To familiarize the men on our squads with the use of the gas masks, one or more practical tests were given to most of them in a room filled with tear gas (C.N.) to a concentration of 150 milligrams per cubic meter. The transit house on the roof of the Astrophysics Building proved to be very convenient for use as a gas chamber.

Several simple devices were developed to protect the gas masks from any possible damage. All of our men were advised to close up the canisters of their masks at both ends with double seals of cellophane and dental dam in order to prevent the activated charcoal from being saturated prematurely with gasoline fumes, steam and other easily absorbable vapors. Also there is danger that men operating stirrup pumps, fire hoses and other water spraying devices will get their canisters wet and thus render them useless. To prevent such accidents as far as possible, a light and partially stiffened muslin bag was developed, which protects the canisters from getting wet too quickly and which does not interfere with breathing.

So far the Office of Civilian Defense has not released any gas proof boots, socks or gloves. We therefore set out to develop some makeshifts. For shoes a type of *sandal* with wax-impregnated heavy wooden soles was made, modelled after the so-called *"Zoccoli"* worn in the Italian speaking parts of Switzerland. The wooden soles are fitted with hinges in the proper place, which sufficiently facilitate walking. I am indebted to Mr. Walden Shaw for the construction of forty pairs of these sandals, which were turned over to the Institute squads. The squads of the City were furnished similar sandals.

To take the place of impermeable socks a sort of *mukluk* was designed, which consists of five layers of cellophane being sewed between two layers of heavy muslin, the outer of which may be impregnated with some wax, oil or gelatine to be hardened subsequently. Unfortunately sewing of the cellophane presents considerable difficulties. Anybody who intends to ask any of his lady friends to fabricate such a pair of mukluks, therefore, had better be prepared for the worst. A large amount of excellent double thickness cellophane to be used for the mukluks was made available to us through the generosity of the Zellerbach Paper Co. of Los Angeles.

So far, official gas masks have been issued only to a relatively few men. On a large scale gas attack it would be imperative to have many more gas masks available immediately. Also, if gases, fires and perhaps phosphorous sprays had to be fought simultaneously, the official rubber face mask might prove to be a truly hot affair. For these reasons we experimented with a complete hood of multiple muslin and cheese cloth, kept as wet as possible with water, glycerin and some surface tension-lowering detergents. The hoods are provided with horizontal channels into which various chemicals such as sodium bicarbonate, urotroprine, sodium sulfite, chloramine-T, etc., can be inserted; the chemicals to be chosen appropriately, depending on the gases to be neutralized. These hoods, which we call *scram masks,* are equipped with exhaust valves of various designs and are considerably more convenient and effective than the wet towels occasionally recommended for emergency protection. With Drs. F. Went and R. W. Dodson, the author tested these scram masks on numerous occasions against tear gases, phosgene, chlorpicrin, mustard gas and smokes. It was found that the scram mask may well be used to decisive advantage to scram out of gas infested areas as long as nothing better is available. For suitable models of scram masks and mukluks made after his designs, the author is indebted to Mrs. Winchester Jones, Miss A. Stryke and Mrs. M. L. Cross. Subsequently Mrs. F. B. Badgley and Mrs. B. Gutenberg organized a circle of ladies who made about two hundred scram masks available to the Health Department of the City of Pasadena, which provided most of the needed materials. A considerable number of persons also produced similar masks for their own private use. On breathing in through the scram mask the outside air passes through the films of liquid lamellae which are suspended between the threads of the various layers of cloth. A difference in pressure of only a few inches of water column is necessary to make the air pass. This transfusion of gases through thin liquid films, as well as the various physical and chemical processes which accompany it, present some rather interesting scientific and technical problems which justify a more detailed study.

The problem also was studied of making large buildings gas tight by filtering the air at the intakes and by creating a positive pressue of about one half of an inch water head in the interior of the buildings. With all of the windows closed the doors could then be used freely for entrance and exit without danger of poison gas entering. An air intake of this kind was installed for the control center of the City of Pasadena. The air intakes must be located as high as possible. The most suitable building to be rendered gas tight on the campus is the biology building, but no practical action has as yet been taken. The protection of factory buildings and the machinery which they contain presents some of the most interesting problems of gas defense, and it is to be hoped that adequate studies in this direction are being made. Even if we never should be forced to make practical use of the results of such studies, they might be of value to our friends overseas who are more likely to be exposed to enemy gas attacks.

In conclusion we wish to express our gratitude to the great number of persons who have cooperated in our efforts. Lack of space makes it impossible to mention them individually. I wish, however, to express my most sincere thanks to Mr. Charles Arthur, Director of the Health Department of Pasadena, who most clearly recognized his responsibility in working for the protection of the civil population; without his untiring assistance and support our efforts would have been futile. The effective cooperation of the senior gas officer, Mr. Ted V. Ackerman, as well as that of many of my colleagues at the Institute likewise is highly appreciated.

POST WAR AIRCRAFT MANUFACTURING

(Continued from page 9)

Military airplanes will probably continue to occupy a prominent place in our industry, especially among those who have the most flexible design and manufacturing facilities. World and national political factors will largely govern here.

Commercial cargo and passenger transportation will provide a large demand, especially for the bigger airplanes, but this field will be dominated by those companies with the highest degree of engineering skill. Airline operators will greatly expand their potential volume of traffic, especially as design changes permit further declines in operating costs. However, in the field of bulk cargo there will be plenty of business for the railroads and our ships—at least as far as we can see ahead. New merchandising methods may develop, as air transportation makes it possible to reduce the need for carrying large inventories of the higher cost goods. But cost of transportation will still be a governing factor, even though the small town merchant may have the goods of the world within a few hours reach. The general level of prosperity in this country, following the war, will be the big question mark. Also our world-wide tariff policy. The means of trading with all the peoples of the earth and easy access to them will certainly be at our disposal through the use of the airplane. Will our political leaders see the light?

However, let me emphasize the fact that none of this can come true for us if we lose the war. That is why post-war planning seems to me to be decidedly secondary at this time. Our engineers are developing many things for war which can be used in peace. Let's not take our minds from the big task at hand today. The development of the airplane is *evolutionary* rather than *revolutionary*. *If we* make the world a safe place to live in—post-war aviation will follow as a matter of course and on an unprecedented scale. The war has accelerated its development—let's not throw away these benefits by dissipating our energies in fighting with our Allies for future air commerce now while our enemies strive to drive us from the skies.

THE PATENT SYSTEM

(Continued from page 16)

3. Abolishing of appeals within the Patent Office in interference proceedings between rival applicants claiming the same invention, and prompt issuance of the patent to the winning party based on the final decision in the Patent Office.
4. Abolishing of "renewal" applications so that, after an application has once been allowed, the patent must be issued within a definite period.
5. Reduction of the period of permissible public use or publication of an invention, before filing application for a patent, from two years to one year.
6. A similar reduction in the period during which, after issuance of a patent to one inventor, another person may present claims to the same invention for the purpose of contesting priority of invention through an interference with the patentee.
7. Giving the Commissioner of Patents authority to require an applicant for patent to respond to a Patent Office action in less than the usual six months period, under proper circumstances.

Of these seven recommendations, the first was aimed at reducing delays and expense in patent litigation and avoiding conflicts between the decisions of appellate courts in different ones of the ten judicial circuits, while all of the others were for the general purpose of preventing unnecessary delays in the issuance of a patent after the invention is made or, if issuance of the patent is unduly delayed, at least limiting the period for which the patent may remain in force after the invention has gone into use.

All of these recommendations were endorsed by the T.N.E.C. in its report following the hearings. Bills based thereon were introduced in the 76th Congress and, with the exception of the first two, all of these were enacted into laws in August, 1939. In time, it can be expected that these changes will prove to be of considerable benefit to the public. As for the other two proposals, the single court of patent appeals and the limitation of the patent to twenty years from the filing date, serious arguments have developed regarding the necessity, advantages, and practicability thereof. These two measures, however, are still being seriously studied and may receive further consideration in the present Congress.

The Department of Justice also recommended to the T.N.E.C. a number of changes of much more drastic nature, which it contended were needed in order to prevent abuse of the patent privilege. If enacted into law, these measures would greatly limit the manner in which the owner of a patent may exercise his control over the patented invention. The specific recommendations of the Department of Justice, briefly stated, were:

1. To make it unlawful to grant a license under a patent, containing any restriction as to amount of production, selling price, purpose or manner of use of the patented article, or geographical area, or any unnecessary restriction tending to lessen competition or create a monopoly.
2. To make it unlawful to impose any such restriction in connection with the sale or lease of a patented article.
3. To require that all assignments and agreements relating to patents or to the sale of patented articles be in writing, and a copy thereof be promptly filed with the Federal Trade Commission.
4. To prohibit bringing suit for patent infringement against a licensee or the purchaser or lessee of an article, unless judgment for infringement has previously been secured against the person granting the license or selling or leasing such article.
5. To provide that any person violating either of the first two prohibitions mentioned above shall forfeit his patent or his interest therein.

All of these recommendations were approved by the T.N.E.C. and, in its final report in March, 1941, it made the following additional recommendation:

> To require that any future patent shall be available for use by anyone who is willing to pay a fair price for such privilege.

This last proposal is a very broad "compulsory licensing" provision such as has frequently been proposed, but in this case the obtaining of the license would not even be conditional upon failure of the patentee or his existing licensees to adequately meet the demand for the patented article. Such a proposal would appear to place the small manufacturer or individual inventor at the mercy of a ruthless powerful competitor.

Thus far, no laws have been passed for putting into effect any of the Department of Justice recommendations or the last mentioned provision with respect to compulsory licensing. However, bills incorporating most of these provisions were introduced in Congress last year, and similar measures will probably be considered during the 78th Congress now in session.

The hearings before the Senate Patents Committee, from April 13 to August 21, 1942, received a great deal of publicity because of the sensational nature of some of the charges made regarding alleged monopolistic patent practices and international cartels. The stated purpose of these hearings was to consider Senate Bill 2303, which purported to be an emergency measure providing "for the use of patents in the interest of national defense or the prosecution of the war." The main provisions of that bill would authorize the President, during time of war, to grant licenses under patents upon such terms as he might prescribe, for the manufacture, use or sale of any article or product declared by him to be in the interest of national defense or the prosecution of the war; would prohibit injunctions under patents with respect to any such manufacture, use or sale; and would further authorize the President during any time of war or national emergency to "acquire" patents in the interest of national defense, either by purchase or by a "declaration of taking," in which latter event the owner of the patent could recover "fair compensation" from the United States in the Court of Claims.

While this bill was in some respects an emergency proposal rather than a permanent reform measure, it was not so worded as to positively limit its effects to the duration of the war. Shortly after the start of the hearings there was introduced into the record another measure, Senate Bill 2491, which was aimed squarely at permanent revision of the patent laws along the lines of the Department of Justice-T.N.E.C. recommendations. Thus, S. 2491 provided for:

Compulsory licensing of patents under certain conditions;

Prohibiting licenses containing restrictions as to quantity, price, use or territory;

Prohibiting sale or licensing of patents under conditions which tend to lessen competition or create a monopoly, unless necessary to the "progress of science or the useful arts;"

Declaring patents null and void if either of the last two provisions is violated;

Compulsory filing of copies of all assignments, license agreements, etc., with the Federal Trade Commission; and

Prohibiting infringement suits against a seller, user or contributory infringer, unless a decree has first been obtained against the manufacturer, supplier or primary infringer.

It is noteworthy that in the lengthy hearings before the Senate Patents Committee on these two bills, there was almost no discussion or testimony directly related to either of the bills. The testimony was presented principally by representatives of the Department of Justice and other government agencies, charging violation of the anti-trust laws and attacking certain foreign cartel agreements declared to be injurious to the best interests of this country. The testimony was almost wholly one-sided, and afforded little or no basis for judging as to whether the charges were well founded or whether there was any real need for the proposed legislation or any other drastic changes in the patent laws.

Numerous other proposals for revision of the patent system have been made. These, as well as the specific proposals mentioned above, have been and are receiving very earnest consideration by individuals and organizations interested in patents and in the improvement of the system. In general, there are sound arguments both for and against most of the suggested changes. Great care should be exercised in attempting to modify a set of laws that have played such an important part in our industrial and scientific progress, lest we either destroy completely the beneficial effects of patents or introduce other objections or inequities perhaps more serious than any now existing under the present laws.

In December, 1941 the President issued an executive order establishing a National Patent Planning Commission for the purpose of conducting a comprehensive survey of the American patent system and of its benefits and defects. This commission was directed to consider, among other things, how any existing obstructions in the laws can be eliminated and "what methods and plans might be developed to promote inventions and discoveries which will increase commerce, provide employment, and fully utilize expanded defense industrial facilities during normal times."

The President appointed a group of very able and experienced men to constitute the commission. Charles F. Kettering, Director of Research for General Motors, is the chairman. The other members are Owen D. Young, Chairman of the Board of General Electric; Chester C. Davis, President of the Federal Reserve Bank, St. Louis; Edward F. McGrady, former Assistant Secretary of Labor and now expert consultant to the Under Secretary of War, and Francis P. Gaines, President of Washington and Lee University. In addition, Dr. Andrey A. Potter, Dean of Engineering at Purdue University, and Commissioner of Patents Conway P. Coe have been appointed as Executive Director and Executive Secretary, respectively.

These men are believed to be eminently fitted for the task assigned to them. They are now engaged in studying the various proposals mentioned above, as well as other suggested changes. In this connection, they have requested and received the wholehearted cooperation of interested individuals and organizations including representatives of industry and of technical and professional associations. Indications are that they will submit a report to the President in the near future, with at least tentative recommendations based on the results of their investigations.

The problem is truly an enormous one, and suggested remedies should not be put into effect without full consideration and an opportunity for presentation of all the facts and the arguments for and against the proposed changes. These arguments are so numerous and involved that it is impossible to discuss them in this paper. The important thing is that there are bona fide arguments to be advanced on both sides, and these should be fully heard and carefully weighed.

If additional legislation, strictly of an "emergency" nature, is needed at this time to expedite the production and utilization of materials and equipment for winning the war, let us see that it is speedily enacted. But, when it comes to permanent legislation affecting the use of inventions and patents under normal conditions, let us not act too hastily or drastically. Certainly, no such long-range revision of the patent laws should be undertaken until the National Patent Planning Commission, established by the President for this very purpose and composed of men of unquestioned ability and integrity, has had an opportunity to complete its studies and submit its recommendations.

SOIL MECHANICS

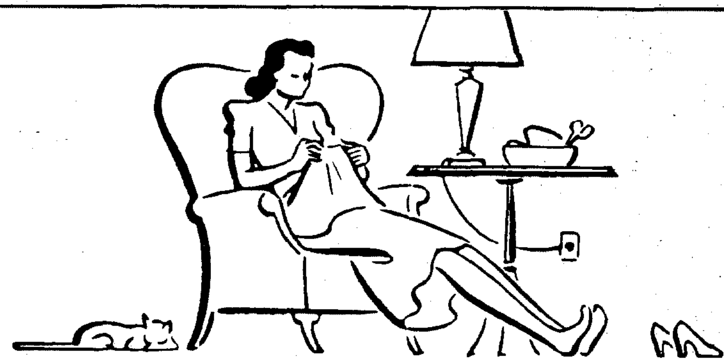
(Continued from page 12)

The calculation of safe pile loads from laboratory tests of disturbed samples has taken a great deal of the "guess" out of pile driving. This method is now replacing the former method of driving test piles and estimating the bearing capacity by a dynamic formula based on the penetration per blow of the pile driving hammer. This latter method has been found to be very unreliable and frequently calls for unnecessarily long piles. At the plant of the California Shipbuilding Corporation, 54,000 piles were driven to a predetermined length calculated from field investigations and laboratory analysis. It is estimated that at least $250,000 was saved by this procedure. At an aviation gasoline plant near Houston, Texas, calculations indicated a safe bearing value of 20 tons on a 35 ft. pile with a factor of safety of 2. When the piles were driven, the usual dynamic formula indicated an allowable value of only 4 to 8 tons. The piles were tested by loading them for several days with 30 tons. Upon removel of the load, the permanent settlement was found to be less than 1/16 inch.

The problem of safe slopes for earth fills and cuts in such structures as highways, dams, levees, canals and ship channels, has been solved in a very satisfactory manner. The construction of firm, dense fills of known characteristics is now accomplished by a standard procedure, developed in California and carrying the name of Mr. R. R. Proctor of the Los Angeles Department of Water and Power.

Research into the basic principles of soil mechanics is proceeding at an unprecedented pace in spite of war conditions. In fact, war problems have intensified the necessity for such work in connection with the construction of airports, harbor facilities and war production plants. Studies in the field of the colodial chemistry of clay are leading to new conceptions regarding the behavior of soil containing such clay. Based on this work, new processes for the stabilization of highways and airports are being developed, and a better understanding of the action of clay under load is assured. Studies of the pressure developed in the water confined within the pores of the soil, in dams and in laboratory test specimens, is producing some illuminating information which will undoubtedly have an effect on design and construction procedure as well as laboratory test methods.

An understanding of the fundamentals of soil mechanics is an asset to any Engineer. It is part of the stock in trade of a Civil or Structural Engineer, and provides him with an interesting and illuminating field of study and experimentation.



AIR POWER AND THE WAR

(Continued from page 17)

line, on the other hand, was under constant, effective attack by Allied airpower, surface ships and submarines. Axis sea transports moving across the Mediterranean lost heavily, and although air transport was pressed increasingly into service to make good some of the sea losses, the result was inadequate. The effectiveness of Marshal Rommel's air power in Egypt and Libya was seriously impaired by lack of supplies, and the work of the Eighth Army was made proportionately easier. The same pattern of circumstances reappeared in the battle of Tunisia.

But perhaps the most telling example of the dependence of air power on the other armed services to date in this war is seen in the difficulty of getting aid to China. In the absence of lines of supply along the ground or over the sea, air transport has risen nobly to the task which confronts it, but, even so, the bases from which it operates are themselves supplied in large measure and in substantial part protected by land and sea forces. Time, the genius of aeronautical engineers, and the energies of production may one day combine to make obsolete for war purposes the freight train, the truck and the freighter; but that day is not yet, and until it dawns the use of air power in war as an independent force seems hardly possible. Even after that day has dawned, such a use of air power may not be desirable in terms of optimum efficiency.

Another lesson suggested by the experiences of this war is that strategic bombing has not yet proved sufficiently decisive to justify a completely independent air force, because such bombing has yet to demonstrate its capacity singlehandedly to knock an enemy out of the war. But given the overwhelming air superiority which the United Nations have concentrated against Italy, and the rising crescendo of air attack on Germany and Western Europe, developments of the not distant future may provide a stronger case for those who advocate that wars may be won by strategical bombing alone.

However that may be, the war has already demonstrated beyond doubt or cavil the effectiveness with which air power can be used tactically in close cooperation with ground forces. The early German team of Stuka dive-bomber and tank taught a sound lesson in this respect, a lesson which the Allies in Russia and Africa have learned well and improved upon. And the improvement of the lesson lies in the fact that the Allies in Africa combined strategical use of bombing with the tactical use of bombing as never before. Weeks of bombing of enemy supply lines and depots were followed by intensive bombing and strafing of enemy reserve and reinforcement areas close behind the front just previous to the assault upon land positions; then, during the assault, came low level attacks on fixed land positions while the harrying of enemy reserve areas continued. Finally, once the fixed positions had been broken through, there was relentless pressure during the pursuit, a pressure which was designed to transform retreat into rout.

The war has also provided basis for comment about the use of air power in relation to seaborne invasion. The record of war indicates that for seaborne invasion to be successful, it must employ the assistance of an air force capable of overcoming and eventually nullifying the air force of the enemy. The seaborne invasions of this war that have succeeded have enjoyed just such assistance in greater or lesser degree: the German invasion of Crete, the Japanese invasion of the Netherlands East Indies, the United States invasion of the Solomons and of Attu, the Allied raid on Dieppe. The evacuation of Dunkirk might be added to this list, because the same principle of air support was here in operation, although for an opposite purpose. Where seaborne invasion has failed, it is to be noted that the invader did not have the mastery of the air. This was the case in the Allied invasion of Norway, in the spring of 1940, and in the German attempt to invade Britain the following autumn; it has been true also of Japanese attempts to extend their conquests in the southwestern Pacific in the face of the air power under General MacArthur.

If air power has been an important factor in the success or failure of these several operations, then upon what does superior air power depend? Obviously, it depends upon having a great number of not inferior planes in the air. A layman is in a poor position to evaluate the qualitative features of one airplane against another; about all he has to go by is the reported ratio of losses between the contesting powers, and from this evidence he gets the firm impression that the air power of the United Nations enjoys a general qualitative advantage over the air power of the Axis. But a layman who has learned simple arithmetic can comprehend the quantitative aspects of air power: the number of planes available for operations in a given area, the distance that must be flown from base to target, and the speed with which servicing and refitting may be done at the bases in order to keep the maximum number of planes in the air. The slower the service of supply and the longer the distance from base to target, the greater the number of planes that will be required to achieve a given air strength against a given enemy area or position. To date, *terra firma* has provided the best of air bases and the greatest number. Bigger, faster, and more planes can operate from land than from carrier decks. To a layman, this simple combination of facts seems sufficient explanation of the advantages which land based planes enjoy over those otherwise based. Likewise, it goes far to explain why the control of land bases within reasonable operational distance of enemy shores is a desirable if not an indispensable prerequisite for seaborne invasion. The difficulty of carrying the war to Japan proper is due partly to the fact that the United Nations lack such bases in the Far East and partly to the fact that they do not yet control the seas there. That it is possible for the Allies to carry the war to the European end of the Axis is due largely to the fact that they have such bases and do control the seas around Europe. To the north of that continent there is Britain, from which big bombers may range far over enemy territory and from which fighters have already operated to cover invasion forces, as in the Dieppe raid. To the south are the bases in Africa and Malta, from which Italy may be bombed heavily, but from which it would be difficult to provide air cover for an invading force. It is generally expected, therefore, that the islands of Pantellaria, Sicily and Sardinia will be the next, limited Allied objectives in the Mediterranean, because they are close enough to African bases to be reached by fighter aircraft, and because these islands in Allied hands would provide bases from which an invasion of Italy might be covered.

Meanwhile, the bombing of Europe continues with ever-increasing intensity. To meet these bombing attacks the Germans have been obliged to increase the number of their interceptor planes in Central and Western Europe. During the first half of March, 1943, spokesmen of the British Air Ministry estimated this number to be twice as great as the number remaining on the Russian front. This means two things: that air raids in the West contributed to Russian successes during the past winter, and that if the Germans mount an offensive against Russia this year, that offensive will probably lack the air support to which German ground troops have been accustomed. For great as the Luftwaffe has been in the past, it has never during the course of the entire war mustered superiority on more than one front at a time. In the past three or four months, it has not enjoyed superiority on any front, including the home front. In short, it is now confronted with the situation that bedeviled the R.A.F. two and three years ago; there is not enough to go round. The Luftwaffe can only pay Peter on the Russian front by robbing Paul in the West.

Allied bombing of Europe has also played a part in the anti-submarine campaign. Heavy bombers have tried to knock out some factories, such as those at Nuremberg, which make engines used in submarines; they have struck hard at the yards outside Bremen and at Wilhelmshaven where submarines are built and repaired. One of the biggest raids of the war was made on March 18 by Flying Fortresses and Liberators against the submarine yards at Vegesack, some 15 miles northwest of Bremen. Then there is the bombing of the submarine bases, particularly those at Brest, Lorient and St. Nazaire. There is much dispute as to how effective these raids have been against the strongly protected pens in which the submarines are refitted at these bases, but surely the raids would not have been kept up as they have been if they were not producing results.

But it is not only the submarine bases themselves that are under attack. The main railway junctions on the lines leading to the bases are favorite and frequent objects of attack by fast, low flying light bombers. The yards at Tours and Le Mans, on two separate lines running to St. Nazaire, as well as the yards at Rennes and St. Brieuc and the viaduct at St. Morlaix on the way to Brest are among those hit hardest. Presumably the object of disrupting railway traffic to the submarine bases would be to cause delays in the refitting process, which would keep the submarine away from the sea lanes as long as possible.

More recently there has been a notable emphasis on the bombing of German industry. The list of industrial objectives is long. It includes such centers as the Rennault works outside Paris, the steel and armament works of the Ruhr, the Cockerill engineering and armament works near Liége in Belgium, the power station and railway workshops at Trier near the German-Luxemburg frontier, the Erla plane works near Antwerp, the Skoda armament works at Pilsen in Bohemia, the Fockewulf plant at Bremen, and more recently, the Moehne and Eder dams in the Ruhr. In fact, the last two weeks of May, 1943, saw a greater concentration on one industrial area than has yet occurred in the war. This concentration was against the Ruhr. There, within a radius of fifty miles or so from Essen, Allied bombers delivered in that fortnight blows against Duisburg, Dortmund, Duesseldorf, Wuppertal and the two dams already mentioned. It is true that there has been an appreciable relocation of German war industry further east and south, but the heart of Germany heavy industry remains in the Rhineland and Westphalia, in a zone 250-400 miles distant from London and within easy reach of Allied medium and heavy bombers. Estimates as to the damage done to German production for war vary, but in the past five months they have all varied in an upward direction, until as May, 1943, comes to a close, it is being said, without official confirmation, that German war production has fallen as much as twenty per cent, largely due to bombing, and that if it falls off as much as forty per cent, Germany will be unable to carry on effectively even defensive warfare. These estimates are encouraging; but for the moment they should be accepted with sober reserve.

Able and informed men have argued that German industry is a less vulnerable spot in Germany's war armor than is German transportation. Be that as it may, the pattern of Allied bombing suggests that it is designed to strike blows not only at Germany's vital organs, that is her war industries, but also at her circulatory system, that is, her railways and rolling stock, her canals and aqueducts, and her coastal shipping. Against this shipping, which moves cargoes from the Bay of Biscay and from Norwegian waters through Belgium, Dutch and Danish ports, Allied air power is constantly on the offensive. It lays mines, destroys docks and shipping at such places as Flushing, Rotterdam and Hamburg. Every week from spring through fall, German controlled canal and river traffic is the object of one or more attacks, and well it might be, for in peace time rivers and canals moved about one-third as much of German cargoes as did German railways. Barges themselves are blown up or important inland ports like Duisburg are bombed. Last, but by no means least, there are the attacks on railway transport. Railway shops and locomotive works at Tours, Nantes, Trier and elsewhere have been hit hard. Railway junctions and marshalling yards in the Low Countries, northeastern France and western Germany, as well as those in western France already mentioned, have been more frequently attacked in the past four months than any other type of objective. Then there are almost daily attacks on railway traffic. Cannon-bearing fighter planes and fast bombers are usually over northern France and Belgium several times a day; their favorite target seems to be railway locomotives, whose boilers, under 200 to 300 pounds pressure per square inch, carry their own explosive charge of steam, a charge released by shells from the attacking planes. It is a poor day's work when two or three locomotives are not attacked, and it is not uncommon for airmen to register scores of six or eight in twenty-four hours. With Germany now confronted with attack from all sides of Europe, there is a high premium placed upon the efficiency of her transport system, yet the most important part of that system is under constant and heavy attack from Allied air power.

Italy is even more vulnerable to Allied bombing than is Germany. Except in the valley of the Po in northern Italy, her main railway lines follow the sea coast and are within the range of big navy guns as well as planes. Italian transportation and industry relies heavily upon hydroelectric power, and these power installations are fairly vulnerable to air attack. It may well be that the strategic use of bombing will be so effective against Italy as to make actual invasion little more than a nominal operation. If this turns out to be the case, it would indeed be justice,—for Italy would then fall as first victim to that theory of air warfare so ardently propounded by the Italian Douhet.

Nor is the present bombing of Germany, without appropriate and ironic justice. For it was in the air that the Germans regarded themselves as so superior to their foes. But the Luftwaffe was organized on the assumption of quick victory. And when quick victory eluded it, it was unable to sustain the great attritional cost of prolonged war. As Allied air power climbs steadily upward, German air power has passed its peak,—certainly in quantity and probably in quality as well. The resulting altered balance of power in the air is the handwriting on the wall for Germany: the Luftwaffe has been weighed in the balances and found wanting, and the kingdom of its creators will soon fall before invaders. Could it be that those great Aryans, Hitler and Goering, failed to study such a minor prophet as Daniel?

. . . . . . OF INTEREST

Sixth Annual Alumni Seminar

In spite of the increasing demands of the war on the alumni, Frank Wiegand, '27, and his 1943 Seminar Committee presented an exceedingly interesting program for the Sixth Annual Seminar on Sunday, April 11.

Following the chapel program at 9:30 the alumni met to hear Dr. Linus Pauling review the developments which led to the establishment of the department of immunochemistry, Dr. Daniel Campbell, Professor of Immunochemistry, then explained the work of this department.

Professor William H. Pickering explained and demonstrated a number of micro-wave phenomena. The similarity of micro-waves to light waves in being conducted readily through hollow tubes, and their dissimilarity from light waves in being transmitted almost as readily through solid wood rods was effectively demonstrated.

Immediately following the luncheon, which was held at the Athenaeum, Dr. Edwin F. Gay reviewed the nation's economic history. He compared the effect of this war upon the nation's economy as compared to the effect of World War I. Dr. Gay continued with an analysis of the philosophy of the Beveridge plan, but declared that free enterprise is the only real future hope for our economic welfare.

Dr. J. E. Wallace Sterling was the speaker at the next meeting, and gave an analysis of the present war situation. Dr. Millikan concluded the Seminar with a talk reviewing the basis upon which the Institute was founded.

It will be of interest to alumni groups unable to attend the Seminar that the talks of Dr. Pauling, Dr. Campbell, and Dr. Gay were recorded by Dale Barcus, '24 and Clarence Kiech, '26. The records are 10-inch, 33 r.p.m., lateral. Included in the recordings are greetings from several alumni who are introduced by Ward Foster, '27. The records may be obtained by addressing the Alumni Association office at the Institute.

Dr. Morgan Given Science Citation

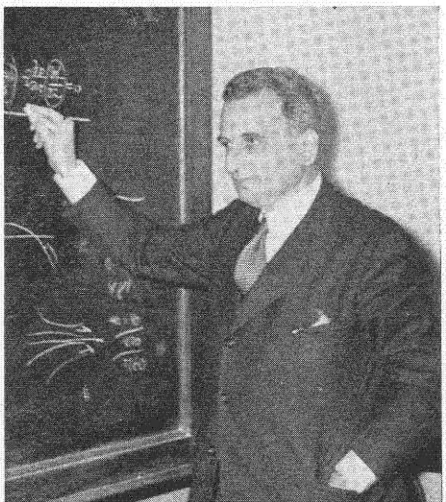
Dr. T. H. Morgan was one of nine American scientists to receive a Copernicus citation recently. The awards were given for eminence in varied fields of achievement in pure and applied science in commemoration of the 400th anniversary of the Polish astronomer.

Frederick W. Hinrichs III Victim of Air Crash

Lt. (j.g.) Frederic W. Hinrichs, III, son of Dean Hinrichs, and a former student of Caltech, was killed on March 31 in the crash of a Navy transport plane near Flemington, New Jersey. When Lt. Hinrichs received his commission as ensign in the Naval Reserve in January, 1942, he was the president of Folghum and Co., paint dealers in Los Angeles. While in the Navy he served as a flight test and line officer and was an instructor in the training school at Pensacola, Florida. Recently he had been transferred to a base in Rhode Island.

Professor Von Karmen Honored

On March 22 the regents of the University of California conferred the degree of doctor of laws upon Theodore Von Karman, Professor of Aeronautics and Director of the Guggenheim Laboratory. The citation recognized his achievements as follows: "Internationally educated and internationally distinguished pioneer in aerodynamic development; enthusiastic apostle of science, skillful in the application of mathematics to the problems of engineering, highly successful in the union of high scholarship and industrial practice in the field of aeronautics."



THEODORE VON KARMEN

Death Takes President of Caltech Board

Mr. Allan C. Balch, president of the California Institute of Technology board of trustees and member of the executive council, died April 30 at his Los Angeles home at the age of 79.

Born in Valley Falls, N. Y., on March 13, 1864, he graduated from Cornell in the ME-EE course in 1889 and in the same year began his professional engineering career in Seattle. Two years later he married Janet Jacks of Monterey, California, with whom he had become acquainted when they were both in attendance at Cornell, and for five years thereafter he operated in the light and power field at Portland, Oregon. In 1896 the Balchs moved to Los Angeles and, having no children of their own, for 47 years gave themselves with extraordinary devotion and rare understanding to the development and service of the rapidly growing Southern California community.

Immediately after his arrival in Southern California, Mr. Balch joined a firm in connection with the development of the San Gabriel Light and Power Company, and later in the organization of both the Southern California Gas Company and the San Joaquin Light and Power Company. After the sale of these utilities to eastern interests in about 1927, Mr. and Mrs. Balch gave their experience, wisdom, and resources unstintingly to the upbuilding of the educational and cultural activities of the Southland.

Mr. Balch joined the board of trustees of the California Institute of Technology in 1925, and since 1925 has been president of the board. He assisted powerfully in the creation of the Kerckhoff Biological Laboratories. In 1929 and 1930 Mr. and Mrs. Balch founded the Balch Graduate School of the Geological Sciences at the Institute, and built the Athenaeum, the center of the social life of the Associates of the Institute and of the staffs of the Huntington Library, the California Institute, and the Mount Wilson Observatory. He was also a member of the observatory council, which has the responsibility for the building of the 200-inch telescope.

Dr. Robert A. Millikan stated that, "Rarely has any man given himself more untiringly, more wisely, and more effectively to the upbuilding of any community anywhere than has Allan Christopher Balch done during the last half century to the upbuilding of Southern California, which he and Mrs. Balch have loved intensely and in whose future they have unwavering confidence. In his death California loses one of its wisest and greatest leaders and benefactors."

San Francisco

The fourth annual Sports Day and Supper was held at "Cactus Rock", the Oakland home of the Howard G. Vespers, on May 22. Despite gasoline and food rationing, an attendance of 43 alumni and their wives gathered for an enjoyable day.

The usual soft-ball game was played between the 4-H's, a team composed of older grads, and the 4-F's, or younger grads. The 4-H's were the winners by a large score.

After an excellent supper served on the patio, motion pictures were shown of events leading up to Pearl Harbor and a sports film in technicolor on Skiing in various locations throughout the west. President Don Morrell acted as commentator and projector attendant during the showing of these pictures. Howard Vesper showed some fine colored pictures of his vacation in Yosemite Valley and also several shots of the alumni taken at Bob Bowan's swimming pool last summer.

The following officers were elected for the coming year:

E. Howard Fisher, '27 .... President
Alex J. Hazzard, '30 .... Vice-President
M. A. Baldwin, '27 Secretary Treasurer

Bob Bowman invited the group to his home at Concord for the second annual swimming party some time in August.

At the last dinner meeting of the San Francisco Chapter on April 7, 1943, at the El Jardin restaurant in San Francisco, a group of twenty-two Tech men welcomed a new member, Lt. Dean Carberry, who is assigned to the San Francisco Naval Officers' Procurement Department. As speaker of the evening, Lt. Carberry gave an instructive talk accompanied by the showing of an official Navy film entitled, "Sea Bees." In the Pacific areas it clearly showed the hardships and obstacles which must be surmounted by the technical men in the building and maintenance of Navy advance bases.

Discussion followed, during which Major Robert Bungay, '30, related his experiences while on a trip through Alaska recently. This was an interesting contribution to the general discussion.

The dinner meeting was arranged and presided over by the President of the San Francisco Chapter, Don Morrell, and was enjoyed by all present.

The San Francisco Chapter is still carrying on with its Monday luncheons at the Palace Hotel Fraternity Club dining room.

A great number of trunks and boxes belonging to alumni are in the trunk room of the student houses, and must be claimed immediately as the Navy is taking over this space.

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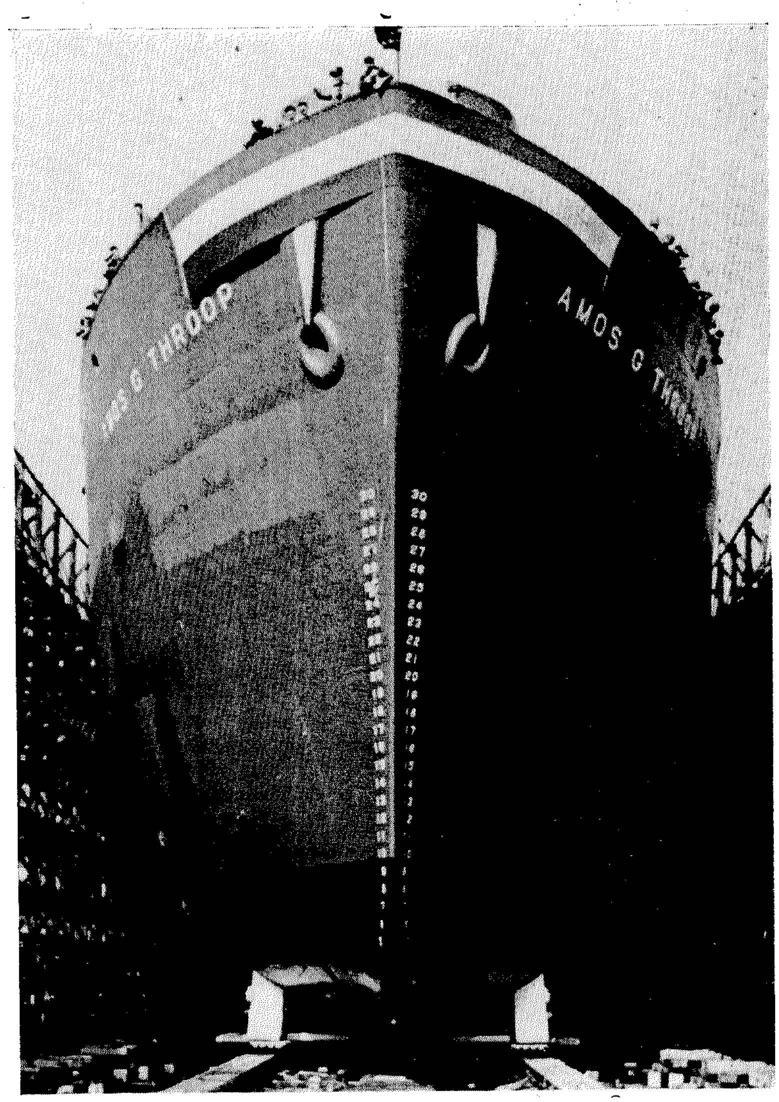
Please inform the Alumni Office at Caltech of the addition of the zone number in your address.

Commemorating

CALTECH'S FOUNDER



November 28, 1942—with Miss Inga Howard as Maid of Honor, Mrs. Robert Millikan swung the champagne bottle that sent the S.S. Amos G. Throop down the ways. Named for the founder of the California Institute of Technology, she was a fine addition to America's growing "Victory Fleet".

Courtesy of California Shipbuilding Corporation

NEWS OF CLASSES

1918

General Carlyle H. Ridenour was promoted in June from Colonel to Brigadier General for "conspicuous leadership during the recent Tunisian campaign." During the last war General Ridenur enlisted as a private; he later became a second lieutenant and was an Air Corps instructor at March Field. Deciding to make the Army a career, he joined the regular Army Air Service. Since the present war he has risen from lieutenant colonel.

Dr. William R. Hainsworth, vice-president in charge of engineering and research at Servel, Inc., Evansville, Indiana, has been named chairman of the Industrial Research Institute, an organization of representatives from various types of industrial firms for the purpose of cooperative study of their common problems.

Lt. Col. K. J. Harrison is with the U.S. Army Engineers at Phoenix, Arizona.

1919

C. J. Bjerke recently moved to Pasadena to live, although he is still connected with the Rainbow Oil Company of Wyoming.

1920

William C. Renshaw is now on active duty with the Navy, holds the rank of Lieutenant Commander, and is now stationed at San Francisco.

Charles R. Root, who was formerly an executive with the Fuller Paint Company, has been commissioned a Lieutenant in the Army Engineers and is now on duty at Fort Belvoir, Virginia.

1921

R. E. Hambrook was recently named Vice-President and General Manager of the Pacific Telephone and Telegraph Company for the Northern California and Nevada areas.

Major Smith Lee has traveled 11,000 miles between various Army camps, and was recently assigned to Camp Callan near San Diego.

Dr. A. J. Stamm of the Forest Products Laboratory at Madison, Wisconsin, is extremely busy, particularly in new lines of development and experimentation.

1922

Raymond W. Ager is an associate professor in electrical engineering at Cornell University where he is in charge of the new high voltage laboratory. He has also been doing some research work for the Navy.

Howard Vesper is Chief Engineer in charge of lubrication problems for the Standard Oil Company of California, with his office in San Francisco.

1923
20-YEAR ANNIVERSARY

Fellow Classmates of the class of 1923:

Herewith is a report on some of the activities in which we have been and are engaged, covering the past twenty years. Out of our class of 54 some 38 have replied to the questionaire and the data is presented herewith. Sixteen members were present at the banquet and were unable to give more data on the missing members, so it is now up to you readers of this column to write to the Editor with all corrections and additions. Later news will be welcomed in the next issue. With thanks to all who have and will help to complete our record of achievment, I am,

Sincerely yours,
Loren Blakeley
Class Secretary

C. Donald Adams is Chief Mechanical Engineer with the Riverside Cement Company in Riverside, California. He has a 17-year-old daughter.

J. R. Alcock is still with the American Cyanamid and Chemical Corporation in Covina, California, where he supervises the building and handles correspondence and orders for mining machines and reagent feeders used on critical metal ore concentration. He has two daughters, 11 and 14 years old.

M. B. Alcorn is an engineer for the Southern California Telephone Company.

Willard E. Baier is manager of the Research Dept. of California Fruit Growers Exchange. The war has brought him more of the same work he has been engaged in, including problems of concentrating fruit juice for export. He has a son aged 13 and a daughter aged 11.

W. L. Bangham is a building supervising engineer employed by the M. W. Kellogg Co. in the building of the Shell Chemical Company's plant which is part of the synthetic rubber program. Before the war he was engaged in civil engineering on the Federal Housing Project. He has three sons, 17, 15, and 11, and one daughter, 3.

Harold A. Barnett is a civil engineer with offices at 35 S. Raymond Avenue in Pasadena.

Loren E. Blakeley is now one of the Regional Waterworks Advisers with the California State Health Department, Bureau of Sanitary Engineering, on a civilian defense program surveying status and preparations for wartime operations. Before the war he was engineer for the Santa Ana Valley Irrigation Company and engaged in waterworks engineering and irrigation supply for 15,000 acres, mostly citrus, in Orange County. He has a son aged 7 and a daughter aged 12.

Arthur G. Duncan has been engaged in civil engineering work with the U.S.E.D. for some time and is now Associate Engineer in the San Bernardino office. He has three sons aged 19, 5, and 1, and a daughter aged 15.

Harold S. Endicott is assistant engineer at General Electric in Pittsfield, Massachusetts, engaged in work on high frequency dielectrics. Has twin sons 18 years old.

Capt. Bernard G. Evans is now with the Marine Aviation Detachment, Naval Air Technical Training Center, Jacksonville, Florida, in an administrative capacity. He has a 15-year-old son.

Charles E. Fitch is an Associate Patent Examiner for the U.S. Patent Office, and lives in Richmond, Virginia. He has two sons, 14 and 15 years old.

L. Dean Fowler has been engaged with the Industrial Division of General Electric Company in Los Angeles, and is now with the Oakland Works and District Headquarters at San Francisco. He has three daughters aged 5, 14, and 18.

Alva C. Hall is a Lieutenant in the U.S.N.R.

R. J. Hammond is Plant Staó Assistant in the office of General Plant Manager of the Southern California Telephone Co. in Los Angeles. His duties are in general staff supervision of all technical work involving interference and protection, and the war has given him more of the same sort of work. He has one 11-year-old son.

D. G. Harries, Jr. is employed in engineering and general administration work in the Pacific Tel. and Tel. Co. in San Francisco. He has a seven-year-old son.

George I. Hickey is with the Edison Company in Los Angeles, and is engaged in valuation cost work. He has an 11-year-old son.

D. G. Kendall is Field Engineer with the Square D Company in Los Angeles, and has two sons, 11 and 19.

George C. Kuffel is a micropaleontologist and lives at Long Beach, California. He has a 15-year-old son.

Howard B. Lewis is a consulting engineer and partner in the firm of Lewis-Larson Co. in Los Angeles. As usual he is full of new ideas to keep the wheels of industry rolling, and reports having sons, aged 19, 15, and 6 and daughter aged 0.

Donald H. Loughridge is a professor of physics at the University of Washington in Seattle, and is also engaged in war research. He has two sons, aged 15 and 20, and a daughter, 23.

Forest L. Lynn is more busily engaged than ever in teaching Electricity and Radio at the Institute of Electricity and Radio in Bakersfield, California. He has two sons, aged 13 and 6.

H. Todd Nies was engaged in patent work before the war, but is now in personnel work with Contractors, Pacific Naval Air Bases, Hueneme, California, as Manager, Employees Services.

John R. North is Assistant Chief Electrical Engineer with the Commonwealth and Southern Corp., Jackson, Michigan. He has 12 year old twins, a boy and a girl, and a 14 year old boy.

C. R. "Clancy" Owens has been with the General Electric Company since his graduation from Tech, and is the Pacific District Welding Specialist. He lives in Oakland, and has one son, 18, and two daughters 16 and 6.

J. H. Puls is the chief engineer in the production department, Pacific Coast Division of the Texas Company. He has a 9-year-old son and a 12-year-old daughter.

G. N. Ramseyer is still with the General Petroleum Corp. in Los Angeles, where he is Assistant Manager in the Operating Department.

Hubert A. Reeves was with General Petroleum Corp. in Geophysics Department for eight years following graduation from Tech. For the past twelve years he has been associated with his father in the publishing business and business manager of Western Plumbing and Heating. However, he has continued with research and consultation work to some extent. He has two sons, aged 13 and 15.

F. Fred Roberts is engaged in subdivision development and home building in

Tucson, Arizona. He has two sons, 14 and 16 years old.

L. P. Roth is President of Refrigeration Service, Inc., in Los Angeles.

R. J. Schonborn is an electrical engineer with Los Angeles City Bureau of Light and Power. Bob still reports no wife, no children.

Richard Seares was engaged in petroleum products transport and distribution before the war, and now has the added duties of strategic metals mining and transport. He is the development engineer for Signal Oil Co. in Los Angeles. Mr. Seares has a 9-year-old son and a 6-year-old daughter.

Elmer L. Smith is assistant engineer with the Municipal Water Dept. in Pasadena, and has an 18-year-old son.

Laurance G. South is contractor's manager with the William C. Crowell Company, a general contractor engaged in war housing. He has three daughters, 6, 12, and 14.

Charles C. Storms passed away several years ago, leaving his wife and two sons.

Perry Walker is an Engineer in the Plant Staff of Southern California Telephone Co. in Los Angeles. He has one son, aged 12.

L. A. Walling is Assistant Branch Manager of Sprinklered Risk Dept., Board of Fire Underwriters of Pacific. He has also been doing part time advisory work on army projects during construction. He has two sons, 11 and 14.

John P. Walter is Chief Engineer with Wintroath Pumps, Inc., and is engaged in deep well turbine manufacturing. He has one daughter, a year old.

Hubert Woods is Chief Chemical Engineer at the Riverside Cement Co., and has two sons aged 9 and 13 and a daughter 17.

Robert E. Woods is a geophysicist with the General Petroleum Co., and lives in Altadena, California. He has a 9-year-old son and a 17-year-old daughter.

1924

Loys Griswold is now living in Phoenix, Arizona, where he has been appointed Manager of the Phoenix branch of General Electric.

Major Edward D. Lownes is in charge of the construction of port embarkation in Seattle, fortifications of the Washington coast and Prince Rupert and Edward Islands, B.C.

Paul Stoker is attending the General Ordnance School, Navy Yard, Washington, D.C.

Lt. Col. William Lawrence Hall is now the commanding officer of a Coast Artillery Anti-Aircraft Battalion which has been assigned to protect one of the Southland's defense plants. He was recently promoted from Major and given this new assignment. Before entering the Army, Col. Hall was statistician for the Los Angeles City Engineer. His family lives in Pasadena, where Lawrence, his eldest son, is a freshman at Caltech and has enlisted in the Naval Reserve.

Fred Groat is with the Pan American Union in Washington, D.C.

1925

Oscar S. Larabee is a Lt. Col. in the Corps of Engineers, stationed in the Washington office of Air Engineer Headquarters of the Army Air Force.

Edward Cornelison has been the Civilian Training Administrator at the Sacramento Air Depot, and is now reported to be at Patterson Field, Ohio, on a similar job.

Tracy Atherton is now a 1st Lt. in the U.S.M.C.R. (A.V.S.) and has been stationed in the east.

Mick O'Haver is still with the Southern California Gas Co., and has been given a recent promotion, at present being the Divisional Sales Supervisor with headquarters in San Bernardino.

1926

J. Edward Kinsey is an instructor at U.S.C. in the evenings, teaching Safety Engineering.

Stewart Seymour is a Major in the Automatic Weapons Battalion of the Anti-aircraft Artillery. He is stationed at Riverside, California.

Frank H. Streit is on leave from his job as Senior Electric Engineer with the Hawaiian Electric Company, Honolulu, and is visiting in Southern California.

John E. Michelmore is Division Engineer with the Southern California Gas Company, Glendale office.

Charlie Bidwell and **George Moore, '27** are still with the Bell Telephone Laboratories in New York.

1927

Alan Capon is with the City of Burbank, working on the engineering staff of their steam power plant.

George R. Kaye is with the Union Oil Company in Seattle handling fuel oil and asphalt distribution.

Dave Shuster is with Bethlehem Shipbuilding at Quincy, Massachusetts.

Gleb A. Spassky is employed by the U.S. Engineer Dept., Pan American Highway, San Jose, Costa Rica. For the past three months he has been engaged in culvert and bridge location in the field, road drainage design, and has acted as coordinator between Bridge and Road Design Sections.

Wayne Rodgers is a Major in the Army Engineers and is in charge of the Maps Supply Division at the Pentagon Building, Washington, D.C.

Thurman S. Peterson is a Civil Service employee of the U.S. Navy, on duty in Seattle for the duration.

1928

Elbert Miller is chief engineer at the Fleetwings Aircraft Co. in Trenton, New Jersey.

John G. Gilbert is with the Texas Company.

Ralph Cutler is Chief Engineer of the Los Angeles Division of Western Pipe and Steel Company.

Alex Clark is engaged in oil exploration work in Alberta, Canada.

Frank Noel is Assistant Highway Engineer with the California Division of Highways, Los Angeles. He passed the November, 1942, examination for Licensed Civil Engineer, State of California.

Bill Mohr was promoted to a Lieutenant Colonel in the Corps of Engineers and is now on duty at the Desert Training Center in California.

Les Scott was promoted to a Major in the Corps of Engineers and commands a battalion in the Second Army.

1929

Thomas H. Evans is in the Army, and is working at the Pentagon Building, Washington, D.C.

George Weismann is now located at the Naval Air Base at Alameda, California, where he is a Lieutenant (j.g.) occupying the official capacity of an executive officer. His wife and family are with him.

Frederick R. Cline has been working on Pan American Highway, San Jose, Costa Rica, as Assistant Chief Engineer.

Al Cramer is still with the James Graham Mfg. Co., and that company's principal work is the rehabilitation of damaged naval aircraft for the U.S. Naval Air Base at Alameda. The company also holds contracts for a large quantity of OCD Stirrup Pumps. After being alone for seven months, he now has his wife and family located with him in Palo Alto.

Walt Grimes is now on duty with the Army Engineers in Australia and is a Lieutenant Colonel.

1930

Roland Hawes is with the National Technical Laboratories in South Pasadena.

1931

Thomas Robert White participated in the Tokio raid.

Lt. (j.g.) R. F. Labory, U.S.N.R., attended the training school for Naval officers at Ft. Schuyler in New York, and at present is with the Bureau of Ordnance at the Navy Department in Washington, D.C.

Herb Ingham, Rea Axline and **George Lufkin,** '29, are the Metallizing Engineering Company of New York. Rea is President, Herb Vice President and Chief Engineer, and George is Vice President and Treasurer.

George Liedholm is with Shell Development Company in New York City, and lives in Scarsdale, New York.

Larry Ferguson expects to finish his training at Penn State College where he is an Ensign in the U.S.N.R., and hopes to see duty in the Pacific.

DeWolfe Murdock is living at Ventura, California, and is employed by the contractors, P.N.A.B. at Port Hueneme Naval Advance Base Depot. He spent a year and a half at Midway Island, and saw the bombing of Pearl Harbor.

Walter Dickey is now a lieutenant in the Navy, and was at Midway during the battle.

1932

John V. Chambers has left the staff of Lybrand, Ross Bros. and Montgomery to accept a position as Assistant Administrative Manager of Marinship Corporation. However, the alumni is still represented in L.R.B. and M. by **Howard W. Finney,** '32, who remains on the Los Angeles staff of the firm.

Phil Schoeller spent three years in Hawaii as project engineer, and was at Pearl Harbor during the attack. He is now with the Bechtel Company in San Francisco.

Robert B. Freeman is the Assistant Plant Metallurgist at the Columbia Steel Co., Pittsburg, California.

1933

J. Stanley Johnson and Mrs. Johnson are the parents of a second son, Donald Pitkin, who was born March 29 in Pasadena.

Samuel Y. Johnson is a Lieutenant (j.g.) with the U.S.N.R.

Arnold P. Wilking, a Lieutenant (j.g.), is with the Inspector of Naval Material at Houston, Texas.

Dana E. Washburn has been on active duty with the U.S. Navy since September, 1941, and is now at Pearl Harbor.

Al Libby is the father of a son, Michael, born May 22, 1943.

Captain Robert G. Macdonald, has been in the Southwest Pacific for 18 months with the Engineer Corps.

Cedric Stirling is now a Lieutenant Commander and completed a course in aeronautical engineering in June from Caltech.

1934

William S. Everett, a Lieutenant (j.g.), U.S.N.R., is a Navy material inspector in San Francisco.

Nick Ugrin is a Lieutenant (j.g.) in the U.S.N.R.

Glen Woodward is an Ensign with the U.S.N.R. indoctrination at Quonset Point, Rhode Island.

Donald Rooke, a Lieutenant (j.g.) with the U.S.N.R., is with a Sea Bees Construction Unit in the South Pacific area.

1934

Dr. R. S. Crutchfield has devised a new type of survey of public opinion which is now being tested through several leading universities throughout the country. The survey is designed, not to "poll" the people of the United States, but to give them an opportunity to express their opinions and hopes about the war and the future.

James Radford is now a Lieutenant Commander is the U.S.N.R. and is at Washington, D.C.

Ray Kidd has been attending the Ft. Schuyler Naval Training School.

James N. Gregory is engaged in oil exploration in Alberta, Canada, as exploitation engineer.

Ernest R. Howard and Mrs. Howard are the parents of a daughter, Carol Jean, who was born April 26.

Willis Donahue is employed by the General Petroleum Corp. in the San Joaquin Division in connection with the conservation, production, and consumption of natural gas. He also keeps meters repaired and looks after miscellaneous compression equipment.

G. P. Brockman is a Lieutenant (j.g.) and is serving as an aviation volunteer specialist somewhere in the Pacific.

1935

Herbert S. Ribner is an assistant physicist with the National Advisory Committee for Aeronautics at Langley Field, Virginia, doing theoretical work on aircraft stability and control.

Carl R. Estep is working at present as an instructor for the Signal Corps and is teaching radio theory and laboratory.

John Ritter is now serving overseas as a Lieutenant with the Navy Sea Bees. He is the father of a baby girl born April 5.

Adrian Gordon, visited Tech recently. Since his last visit he has seen a good deal of the globe, having been in military meteorology in England, Gibraltar, and Bermuda, climaxed by a year as RAF Second Leader in Iceland.

1936

Paul Jones is with the U.S. Army Engineers.

Walfred Swanson is with the U.S. Army Engineers as assistant to the Division Engineer, Pacific Division, and is located in Salt Lake City.

Charles Best is in the Air Corps and is stationed at Kearns, Utah.

Glen R. Carley is employed by the Naval Aircraft Factory, Philadelphia Navy Yard, and is in charge of the Instrument Development Section Laboratory with a Civil Service rating of Associate Physicist.

G. Russel Nance, who is now in the army, writes, "This un-named spot is a mere pile of coral in the middle of the Pacific—the typical hypothetical desert island that seafarers get stranded upon in fiction. We have some of the best food available, and all for the meagre sum of $21 per month. I have charge of one of the shops, and really have my hands full. When I get back, I'll be able to act as a specialist in aeronautical engineering for the company."

Frank Davis, who has been doing engineering flight testing for Vultee for several years, has recently been put in charge of aerodynamics and flight testing at the Vultee Field Division of Consolidated Vultee Aircraft Corp. He learned to fly at Pensacola with the Navy.

Al Creal followed up the Reserve Commission that he received while at Tech, and is now hunting Japs somewhere in the Pacific. He is a Major in the Marine Corps.

Charles B. Jordan is now employed at the Industrial Laboratory, Mare Island Navy Yard.

Leo J. Milan is employed by the Douglas Aircraft Co. Inc., at Long Beach.

1937

Richard T. Brice, now a Major, recently finished a nine weeks course at the Command and General Staff School, Fort Leavenworth, Kansas.

Richard Goodell is still employed by the Brown Geophysical Co. in Houston, and is at present working on an N.D.R.C. job at the University of Texas.

Mr. and Mrs. Gordon Bussard are the parents of a son, Gordon, born April 15 at Martinsville, Virginia.

J. Ridgely Leggett, an Ensign in the U.S.N.R., has terminated his work with the Hughes Aircraft Co., and in February finished his indoctrinal training at Fort Schuyler, New York. At present he is at Bowdoin College, and later will finish his special training at M.I.T.

Bill Elconin is with the Signal Corps at Ft. Monmouth, New Jersey.

Charles C. Woolsey is now working at Caltech as a research assistant.

1938

Leroy Bruce Kelly, an Ensign in the U.S.N.R., was married at Hartford, Connecticut, on May 1 to Miss Betty Beale of Pasadena.

George B. Holmes, Jr., who has been with Douglas for the past two years, was transferred in February to that company's plant in Oklahoma City to act as Supervisor of the Analysis and Reports Department of the Comptrollers Division.

Charles Heath, Jr., is now teaching in the Mechanical Engineering Department of Rutgers University.

Roger H. Cowie is an instructor of physics at the Oklahoma A. & M. College. He is the father of a son born last November.

William T. Cardwell, Jr. is the father of a son, William T. Cardwell, III, born in March.

Gardner P. Wilson is a member of Western Electric Company's Radio Division and is employed as an electronics or Radar Engineer. He is in charge of a group of 10 engineers doing liaison work between the Bell Telephone Laboratories and the Western Electric Field Engineering Force. He lives in Summit, N.J.

1939

Frank McCreery, Jr. is now the Chief Engineer for Rohr Aircraft Corp., San Diego.

Lt. Charles F. Carstarphen was married on May 22 to Miss Susan Wilcox at Portland, Oregon.

W. D. Merrick is now in the chemical engineering department at the Institute after having spent several months in the British Isles.

Carl Paul announced the arrival of Carlton Hutton Paul III on Tuesday, March 23, at St. Francis Hospital, Peoria, Illinois.

1940

Robert Gewe is employed by the P. J. Walker Company, contractors for the Aluminum Company of America in Torrance, and other firms.

Jules Mayer and Miss Helen Doris Hoover were married March 27 in Los Angeles.

Walter R. Larson is a Captain in the Air Corps at Bainbridge, Georgia.

Dumont Staatz was married last October to Miss Marion Baker of Pontiac, Michigan, and he is now a senior medical student at the University of Michigan where he expects to graduate in October.

Robert Brumfield and Miss Marian Johnson have announced their engagement, and plan to be married in August. Bob will receive his doctor's degree in June.

Harold S. Mickley is attending the Massachusetts Institute of Technology.

Lt. C. S. Palmer, Jr. graduated in March from the Army Air Forces Technical School at Yale University.

Major P. M. Honnell is with the Department of Chemistry and Electricity at the U.S. Military Academy at West Point.

John Billheimer and Miss Elizabeth Spencer were married on March 27 and are living in Minneapolis where they both are taking graduate work at the State University. John also holds a position as efficiency expert with a powder concern.

1941

John W. Gillings is now at Ft. Monmouth, New Jersey, after having spent several months in England doing electronics work for the army.

James W. Whittlesey has moved from Hollywood to 3504 NE U.S. Grant Place, Portland, Oregon.

Grant W. Ewald has been transferred from the West Virginia Ordnance Works to the Delaware Works of General Chemical Company in Wilmington, Delaware.

Capt. Frank Casserly of the Marines has recently returned from England, and spent a few days in Pasadena during June. He is stationed on the east coast.

Frank Skalecky and **Bill Menard**, '42, joined together in the U.S.N.R., attended the same intelligence school at Washington, and since that time have spent their "leisure" on a south sea island.

William Schubert, a Lieutenant (j.g.) has been attending the U.S. Naval Engineering Experiment Station at Annapolis.

1942

Harry (Sam) Madley and Miss Lois Norman of San Marino, were married on April 17, and are now in the east where Sam is an Ensign with the U.S.N.R. at Fort Schuyler, N.Y.

Al Landau is an instructor in light anti-aircraft fire control at the Aberdeen Proving Grounds. He holds the rank of Technical Corporal.

Dave Berman is the father of a son, Jerald Dennis, born February 12. Dave is with the Goodyear Tire and Rubber Co. in Los Angeles.

Gordon K. Woods and Miss Leona Jakobsen were married on April 25 at Palo Alto, and they are now living in Berkeley. Gordon is employed by the Kaiser Co. in Richmond.

Chang-nee Tsu and Miss Doris Chao were married in Pasadena on June 5. Both were born in Shanghai and received their early schooling in China, but they met in Pasadena. Mr. Tsu is an aerodynamicist with an aircraft company.

Kenneth Schureman, Ensign (CEC) U.S.N.R., was put on active duty immediately after his graduation from Tech. After a short training at Norfolk, Virginia, he was sent to the Navy Yard Annex at Bayonne where he worked for the Offices in Charge of Construction of the Supply Depot and Dry Dock. He is now attached to the Public Works Department.

Eric H. Schauer is a design engineer for Central Metal Products, Los Angeles.

Warren Gillette has been attending the Midshipmen Training School in Manhattan.

Paul Allen is now located at the Office of Inspector of Naval Material for the Los Angeles District. He was married on February 7 to Miss Nancy Momson of Fresno.

Frank W. Wood was graduated on May 31 with the Maintenance Engineers Class from the Technical School, Army Air Forces Training Command at Yale University, and now holds the rank of Lieutenant.

LETTERS TO THE EDITOR

Donald S. Clark, Editor
Alumni Review
California Institute of Technology
Pasadena, California

Dear Don:

The article "Commercial Broadcasting" by Beverly Fredendall in the March issue of the Alumni Review contains implications of wire line frequency range limitations which do not exist on lines leased from the Bell System by the broadcasting companies.

The chart on page 7 shows "Good broadcast studio and transmitter," 16 to 16,000 cycles; "Wire circuit to local transmitter," 16 to 8200 cycles; and "Transcontinental wire circuit," 80 to 5200 cycles. This incorrectly implies that limitations imposed by wire circuits prevent reception by broadcast listeners of the full frequency range of which broadcast equipment is capable. This implication is repeated in the text on page 19.

As a matter of fact nation-wide wire circuits covering the range 50 to 8000 cycles are available on order and, for limited distances, channels capable of transmitting frequencies from 20 to 20,000 cycles are available. Furthermore, wire lines with higher frequency limits have been used on several occasions, as for example those used for transmitting television frequencies up to about 3 megacycles. In short, wire circuits are available or in normal times would be made available to cover any frequency range ordered by the broadcasting companies.

Although some readers may not realize it, I am sure that Bev does not intend to imply that technical considerations limit the frequency band width which wire lines transmit. On page 19, following the statements of limitation of frequencies transmitted by wire, Bev points out that the upper frequency limit is restricted by several other factors, chiefly by the need to prevent inter-channel interference, and by radio receiver circuits and loudspeakers. To the careful reader it will be obvious that these other limitations make it largely unavailing to transmit wide frequency bands on many transcontinental circuits. However, the casual reader or the person looking at the chart but not reading the text very likely would be given the incorrect impression that wire line transmission prevents full enjoyment of broadcast transmission. Actually wire lines are available and in use whose capabilities exceed that of the "Good broadcast plant" referred to by Bev on page 19.

I am sure I am expressing the thoughts of all members of the Alumni Association in saying that we appreciate Bev's providing this article and I am confident that Bev will welcome the thoughts expressed here as endeavoring to remove any misapprehensions which may have resulted from lack of emphasis on the actual limitations upon transmitted frequency band width.

Yours very truly,

H. K. Farrar,

Transmission Engineering Dept.,
So. Calif. Tel. Co.

Donald S. Clark
Editor, Alumni Review
California Institute of Technology
Pasadena, California

Dear Don:

I am in substantial agreement with the basic thought expressed by H. K. Farrar of the Southern California Telephone Company regarding the article "Commercial Broadcasting." In this article it was not my intention to imply inability of the telephone companies to provide wire circuits having a greater frequency range than that in use today and correctly pictured on the published chart, but rather to give an explanation of current practice as used in network operation at the present time in terms everyone could understand.

In a similar manner the picturization of the limited frequency range of the present day radio sets as shown in the same chart was not an indication of the inability of engineers to design radios of greater frequency range. Proof of this ability is evidenced by present day television receivers. It was an attempt, however, to show the average radio set as it exists today.

Perhaps more emphasis should have been placed upon the basic reason for the limited frequency range of present day radio sets and in turn upon the economic use of a comparable frequency range wire circuit. The primary reason for the limited high frequency range is due to the crowded condition of the present broadcast band where adjacent channels are only 10,000 cycles apart. Being only 10,000 cycles apart means that under certain conditions, usually associated with long distance reception, when the listener attempts to tune in a "desired" station and finds that on an adjacent channel there is an "undesired" station, that the program of one crosses over into and causes interference with the other. For example, a 4,000 cycle tone on one channel would be received as a (10,000—4,000) 6,000 cycle tone on the other. Similarly a 7,000 cycle tone on one channel would become (10,000—7,000) 3,000 cycles on the other. This form of inter-channel interference results in the inversion of sound, with respect to 10,000 cycles (the channel separation), as the program crosses from one channel to an adjacent one. Since this inverted sound is unintelligible it is popularly called "monkey chatter."

The entire subject is too technical for full treatment here, but in short, inter-channel interference is reduced by limiting the upper frequency range of radios used for long distance reception applying under present broadcast conditions.

Very truly yours,

Beverly F. Fredendall

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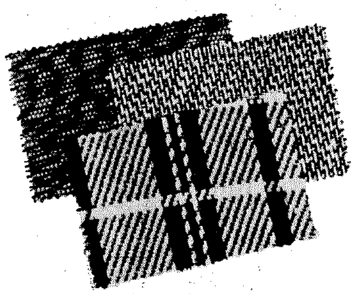

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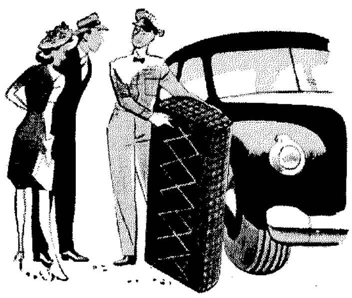

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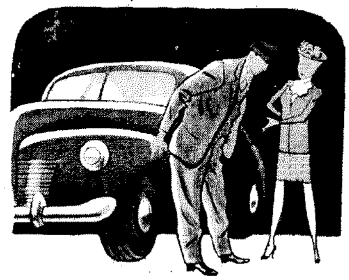

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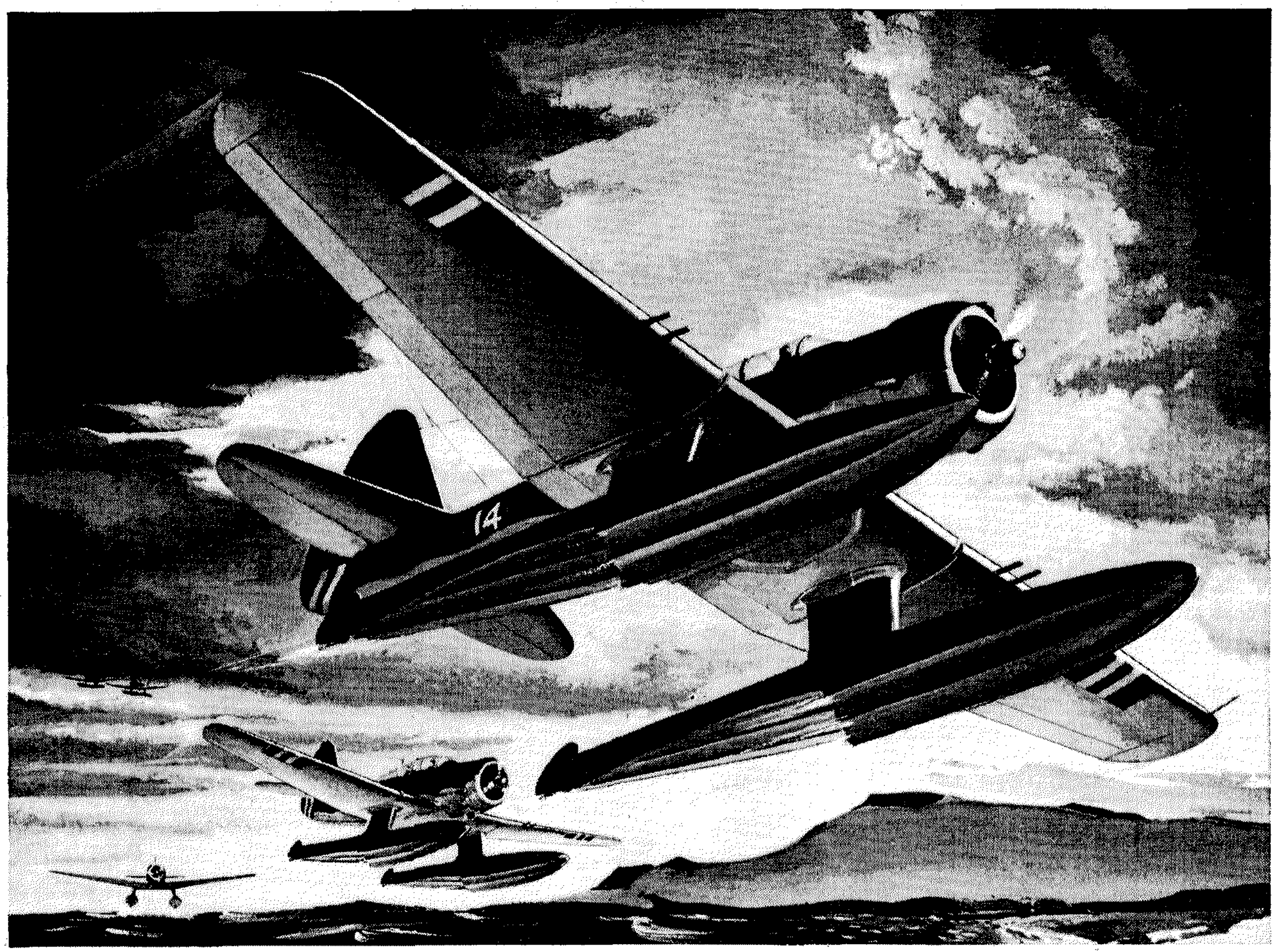

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