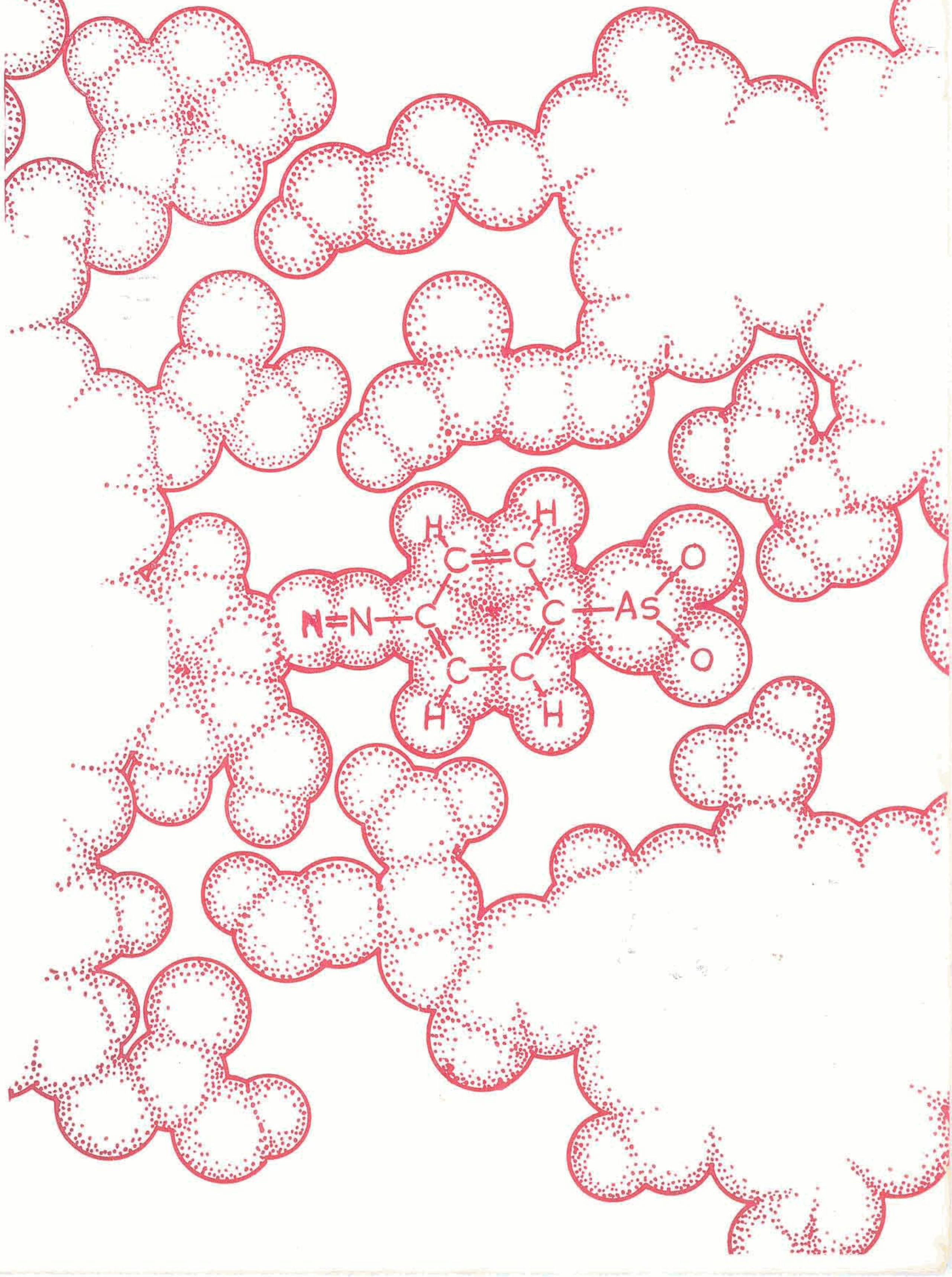
ALUMNI REVIEW

CALIFORNIA INSTITUTE OF TECHNOLOGY

Vol. 6 No. 1 September, 1942



ALUMNI REVIEW

ALUMNI ASSOCIATION, INC.

CALIFORNIA INSTITUTE OF TECHNOLOGY

VOL. 6, NO. 1 SEPTEMBER, 1942

PASADENA, CALIF.

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SEPTEMBER, 1942

EDITORIAL

Most of the alumni will be both surprised and amused by the change in editorship of the Review. Amused, because the present editor is completely lacking in editorial experience, which will be apparent as time goes on. However, this circumstance can be attributed to the war. If, however, the consolidation of the work associated with the publication of the Review with the work of the Alumni Office will assure its continuance, the appointment of your new editor will not have been in vain. Practically all work on the publication will be done by Miss Bertha Lee and Miss Charlotte Tompkins, in their spare time; they are effectively the editors. The editor extends to them his appreciation for their efforts in making publication possible.

The editorial group is interested in your criticisms and suggestions on the subject matter of articles and the general composition of the Review. With careful guidance of the editorial board it is hoped that the Review will continue with the high standards established during the past five years of publication.

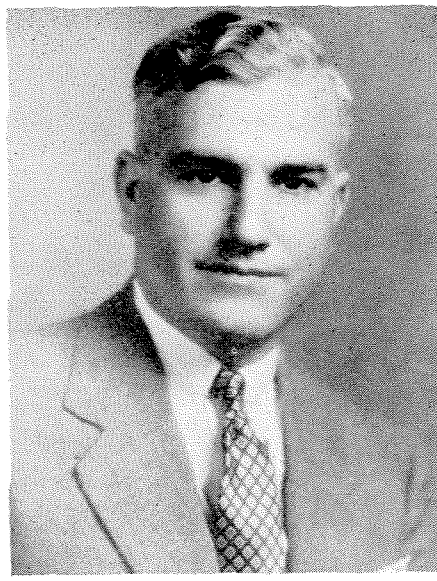
The articles appearing in this issue are timely and definitely related to war activities. One should give serious thought to Professor Fraser's article on the mineral situation; in some ways this situation is rather disturbing. An encouraging side of the picture is presented by Stanley Swingle in his article "The Chemists' War on Disease." The development of synthetic anti-serums seems to be promising. Many will be interested in the innerworkings of our communications system as it is related to civilian defense, described by Harry Farrar. Arthur Ellings' experiences in England are interesting as a check on the news we read in the papers. Your editor knows of no one who is more capable of presenting the world situation in as clear and interesting manner than Professor Sterling. It will pay every reader to study his article carefully.

The editorial board and staff wishes to express their appreciation to those who have so generously contributed to this issue of the Review.

COVER

Illustrated by the author of the article, "The Chemists' War on Disease", the cover is a diagrammatic representation of a possible configuration for the antibody complementary to the antigen, arsanilic acid coupled to albumin. Weak bonds may form where the atoms (represented as spheres) of the antibody are near atoms of the antigen. This drawing is about ninety million times natural size.

GREETINGS FROM THE BOARD OF DIRECTORS



ALBERT D. HALL

The year 1942-43 promises to be a period of rapid changes. Tech Alumni, because of their technical training and experience, are moving into key positions not only in civilian life but also on the firing line. A salute to the membership in these war undertakings, and greetings from the officers of the Association to all alumni.

We on the home front will this year dedicate our efforts to the maintenance of contacts with and between alumni whether they be near or far. Through the medium of the magazine we intend to let you know what many of your friends are doing and, if regulations permit, where they are located.

In addition to the magazine it is the present plan to continue all major association activities; insofar as these can be accomplished under current conditions. With the assistance of the membership we are confident that this can be achieved without sacrifice to the high standard of quality set by previous administrations. In the programing of these functions however, we solicit constructive suggestions in order that each event will be of maximum benefit.

An innovation this year will be the scheduling of some of our local get-togethers at noon in downtown Los Angeles. In line with the war effort such a move should conserve tires and free "all too busy" evenings. These noon meetings will be streamlined with snappy programs designed for quality appeal, favoring popular subject material. We believe that the freedom from formality possible at such a gathering will recommend itself and merit approval and support even in these strenuous times.

—ALBERT D. HALL
President.

CONTRIBUTORS

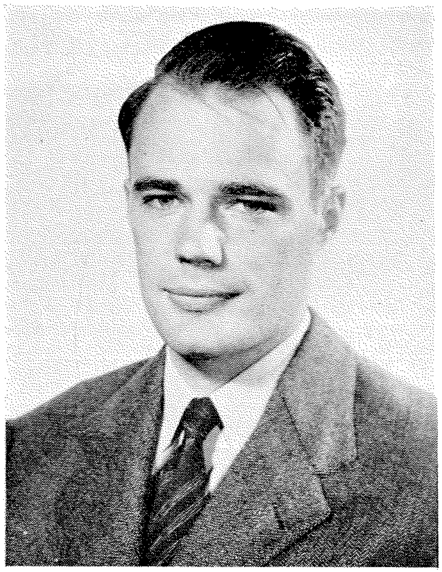
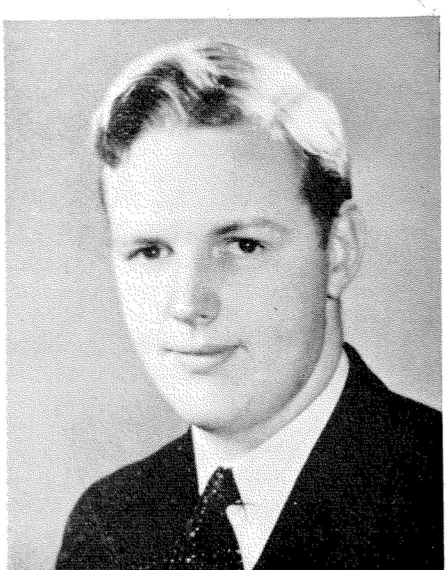


Photo by O. K. Harter

STANLEY M. SWINGLE

In 1939, Stanley M. Swingle received his B.S. degree from the Montana State College. He is now a teaching fellow at the California Institute of Technology, where he expects to receive his Ph.D. degree in June. During the past year Mr. Swingle has been working with Dr. Linus Pauling, doing research on structural chemistry and immunochemistry. His article, "The Chemists' War on Disease", in this issue of the Alumni Review gives a resume of the important work that they are doing.

Mr. Swingle was married last spring to Miss Elizabeth Carter, an instructor in bacteriology at the Montana State College.



ARTHUR C. ELLINGS

Arthur C. Ellings received his B.S. degree in Applied Chemistry from Caltech in 1938. For three years he was employed as laboratory assistant and junior chemist by the Shell Development Company at Emeryville, California. In November, 1941, he accepted a position with Basic Magnesium, Inc., at Las Vegas, Nevada, and was among the engineers sent by that firm to study a similar magnesium plant in England.

Mr. Ellings is married, and has two daughters, the youngest born while he was in England.

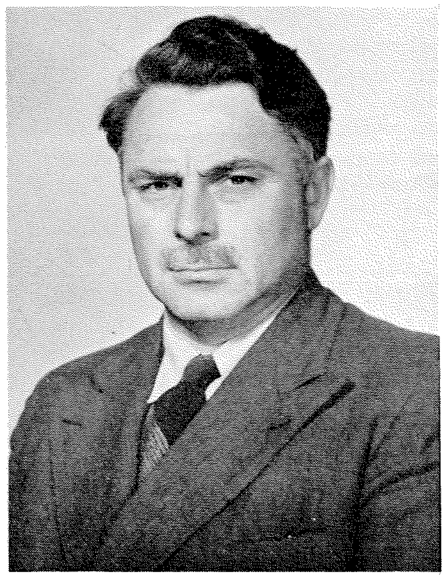


Photo by O. K. Harter

HORACE J. FRASER

Dr. Horace J. Fraser, who has been the Assistant Professor of Metalliferous Geology and Mineralogy at the California Institute of Technology since 1935, received his B.S. and M.S. degrees from the University of Manitoba. While there, he served as Lecturer in Geology, and later as a Travelling Fellow. Dr. Fraser received his M.A. and Ph.D. degrees at Harvard University, and also served as an instructor in Economic Geology and as a research associate at the Harvard Engineering School. From 1932 to 1935, he was a geologist with the International Nickel Company of Canada, Ltd.

Photo by O. K. Harter

PROF. J. E. WALLACE STERLING

The Alumni Review again presents an article by Professor Sterling dealing with the latest aspects of the war, as of August 26. This feature has already proved to be exceedingly popular, and will undoubtedly be the highlight of the 1942-43 Review. In the December issue of the Review, Dr. Sterling will summarize the developments of the next few months.

Photo by O. K. Harter

HARRY K. FARRAR

The second in a series of articles on utilities in the war is presented in this issue of the Alumni Review; the activities of the telephone companies in the present emergency are discussed by Harry K. Farrar, Class of '27. Mr. Farrar joined the technical staff of the Bell Telephone Laboratories in New York in 1937, where he was a member of the Inspection Engineering Department until 1926, when he became a member of the Transmission Apparatus design staff. In 1941 Mr. Farrar became a member of the engineering department of the Southern California Telephone Company where he is now engaged in transmission engineering.

Two Tech Men Awarded Distinguished Flying Crosses

Heroic feats of a Caltech alumnus, flying for the Navy in the Pacific, were written into the national war record when Lieutenant Richard Blair Forward was awarded the Distinguished Flying Cross for heroism displayed in a battle of the lamented U.S.S. Lexington. Announcement of the honor was made in Washington by Secretary of the Navy Knox.

Lieutenant Forward received his B.S. degree in mechanical engineering in 1938. Shortly after his graduation, he entered the Navy Flying school at Pensacola, Florida, and upon receiving his "wings" was assigned to the Lexington. He was married in February, 1941, to Miss Ruth Angwin of Santa Barbara, and they are now living in Lanham, Maryland. Lieutentant Forward is with the Ordnance Department of the Navy in Washington, D. C.

Ensign Richard M. Rowell, who also received his B.S. degree in mechanical engineering in 1938, was awarded the Distinguished Flying Cross for heroism on the Lexington. He is listed as missing in action.

Make way

War's on the wires

Army, Navy and war industry *must* have quick communication.

It takes a lot of telephone calls to move a million men or make munitions — 12,000 calls, for example, to make a bomber.

As the war effort speeds up, the load on telephone wires grows. We can't build new lines to carry it because copper, nickel and rubber are shooting, not talking, materials right now.

But what we can do is make the most of what we have. You can help if you will not make any Long Distance calls unless they are really necessary. Even on these, please be as brief as you can.

The call you save today may speed a plane or tank to the fighting front.

WAR CALLS COME FIRST

BELL TELEPHONE SYSTEM

September, 1942

WESTERN WAR MINERALS

By PROF. HORACE J. FRASER

Dept. of Geology, California Institute of Technology

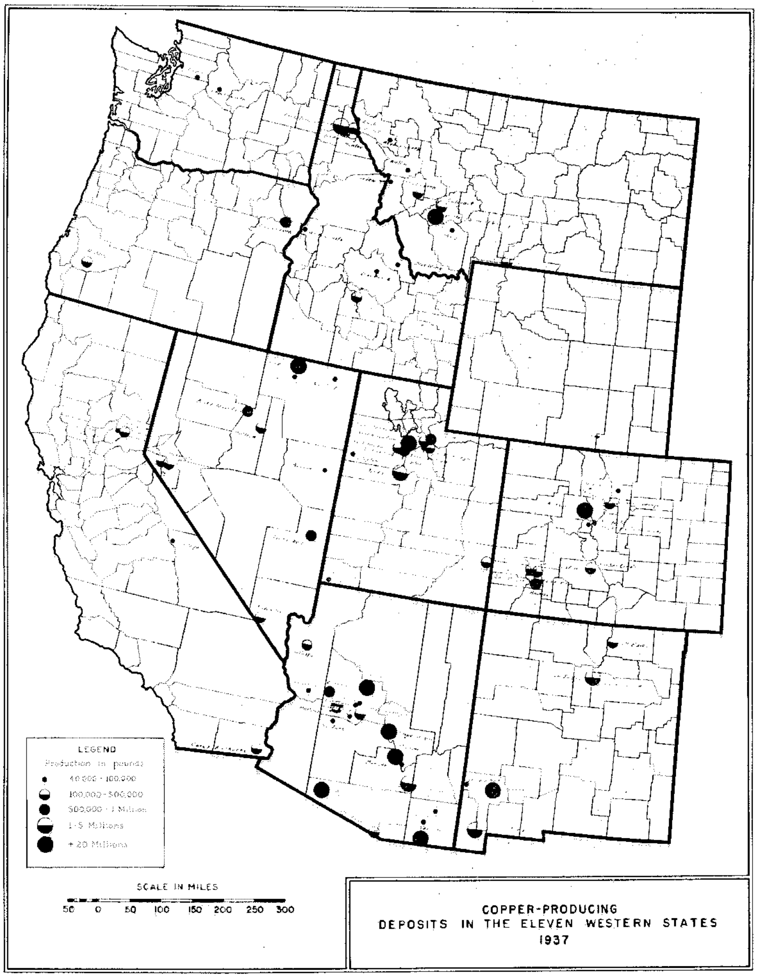
All of us are becoming increasingly conscious these days of the part many raw materials play in our daily lives. As the priorities system becomes more widespread, and more raw materials are totally withdrawn from civilian use and increasingly restricted in their military uses, there inevitably will be some very marked changes in both the technology, economics, and sources of our raw material supplies. Although the problem of supplying our essential needs is national, its effects will vary regionally. Its influence in the Southwest will be of particular interest because of the normal productivity of this area and the many rapid changes there taking place as a result of war activities. War stimulated industries leave their mark on peacetime industrial development. The tremendous expansion now going on around us will have many permanent effects, some of which are discussed in the following pages.

In 1940 the Army and Navy Munitions Board defined fourteen materials as strategic in the sense that dependence in war time must be placed in whole or in substantial part on sources outside the continental limits of the United States and strict conservation and distribution control measures must of necessity be enforced. This list of strategic materials included nine mineral products, namely antimony, chromium, manganese, mercury, mica, nickel, quartz crystals, tin and tungsten, together with five other materials: manila fiber, quinine, rubber, silk and cocoanut shell char. The same board also defined fifteen other materials as of critical importance, either because they had a lesser degree of essentiality or because they were obtainable in more adequate quantities from domestic sources. Some control over the use of critical materials was anticipated. These materials included five mineral products: aluminum, asbestos, iodine, platinum and vanadium, together with ten other materials: cork, graphite, hides, kapok, opium, optical glass, phenol, tanning materials, toluol and wood. Other mineral products regarded as essential to the national war effort and for which the supply was considered adequate if not abundant included bauxite, copper, 100-octane gasoline, industrial diamonds, iridium, zinc, fluorspar, lead, beryl, bismuth, cadmium, cobalt, rutile, zirconium, molybdenum and magnesium.

Since 1940 our foreign sources of supply and trade routes in many of these materials have been drastically altered. Great effort has been made to stimulate domestic production, particularly through governmental reconnaissance and wider dissemination of information concerning our resources, the drilling of many deposits of marginal or unknown value by the United States Bureau of Mines, and through Federal loans to finance development, exploration, and production of many mineral deposits. At the same time strenuous efforts have been made to control the price of various mineral products. For some metals, such as mercury, the price advance prior to its restriction reached a level such as to stimulate mining activity. In other cases the price restrictions were applied at levels such that additional production could be encouraged only through a bonus paid for new metal. In general, metal prices have not advanced in any degree comparable to the increased demand while at the same time labor, supplies and all the other costs of mining have increased tremendously. Thus we are demanding that our mining industry increase production and utilize lower grade, higher cost ores, while its costs and taxes are steadily increasing and its profits disappearing. This has resulted in many very real problems for the producing mineral companies.

WESTERN RESOURCES

From both an economic and a geological standpoint the Rocky Mountain and Western States must be regarded as a unit in the domestic mining picture. This block includes the states of Montana, Wyoming, Colorado and New Mexico along the eastern edge, with the central states of Arizona, Nevada, Utah and Idaho, and the western states of Washington, Oregon and California. These eleven western states together constitute the major domestic source for many essential metals. Virtually all of our domestically produced chromite, molybdenum, tungsten, vanadium and uranium is obtained from these states; about 90 per cent of our copper, mercury and silver, 60 per cent of the gold, about 50 per cent of the lead,



COPPER-PRODUCING DEPOSITS IN THE ELEVEN WESTERN STATES 1937 and 35 per cent of the zinc. Only iron is conspicuously low among metals produced by the western states. This is due not to a shortage of iron ore, but to the unfavorable locations and unsatisfactory quality of coke and coal necessary in the reduction of iron ore to pig iron and steel.

The importance of the western states as a source of metals is not the result of accidental development or exploration, but is the inevitable consequence of the geological character of the area. Most metals are obtained from deposits found only in relatively close association with igneous rocks and then only where structural conditions have been favorable for the accumulation of ore. In the western states, large areas have been subjected to intensive intrusions of igneous rocks at successive geologic periods and usually under conditions favorable to the development of a variety of mineral deposits. Since mineralization, the prevailing conditions such as climate, vegetation, weathering and erosion, have aided the exposure of metalliferous deposits. As a result the western states not only contain numerous deposits with a very diverse metal content, but these deposits are so situated with respect to the earth's surface that they can be found and exploited. It is most probable that the western states will continue to be the main domestic source for many metals in the future.

CURRENT DEMAND FOR MINERALS

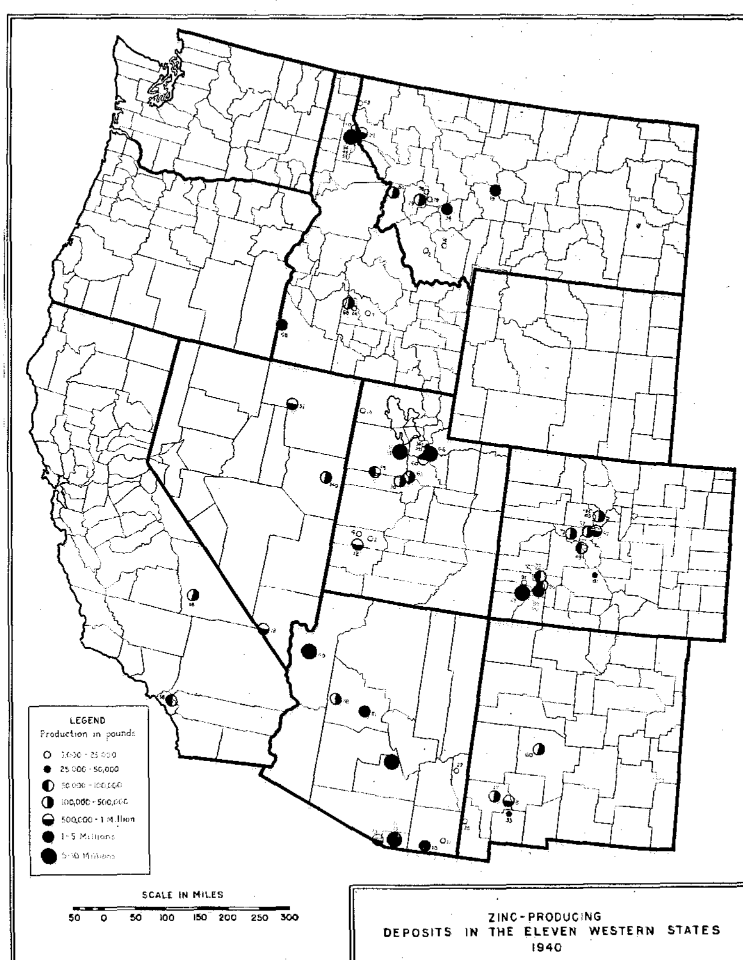
Let us briefly review the current situation with respect to strategic and critical mineral products insofar as it affects the western area. Production and consumption figures will be those of 1940, unless otherwise stated. Current figures although not generally available, do not materially change the 1940 picture for most metals.

The demand for aluminum has expanded tremendously since 1940 because of its consumption in aircraft of all types. Aluminum is produced exclusively from the mineral bauxite which forms by long continued weathering under tropical conditions of aluminum rich rocks. Commercial bauxite deposits in the United States are restricted to Arkansas, Georgia, Alabama, Tennessee and Mississippi. It is most probable that materials other than bauxite will soon be used as a source of aluminum. Then, some of the alunite or aluminous clay deposits of the west may be utilized. However, until such time as these processes may be perfected, any aluminum produced in our western refineries will be obtained from bauxite either mined domestically or imported from abroad, mainly from the Guianas. The existence of these western plants, situated near cheap power but far from sources of bauxite will unquestionably greatly stimulate efforts to utilize other available new materials.

Antimony is widely used in peacetime as a hardener in lead. We normally consume about 18,000 tons of primary antimony and produce less than 1,000 tons. Its wartime uses include hardening of lead for bullets and shrapnel, use of the sulphide in priming caps of shells and explosives, and also in shells to produce a white cloud of smoke marking the position of the exploding shell. Normally our supplies of antimony are imported from China and Mexico. With loss of the Chinese supply we have been forced to expand domestic production from the many small antimony deposits scattered throughout the western states. Moreover, we at last are recovering substantial amounts of by-product antimony from lead-silver ores, particularly those in the vicinity of Kellogg, Idaho. Domestic deposits containing only antimony probably cannot continue producing under ordinary economic conditions, but the by-production may well continue after this emergency period is over.

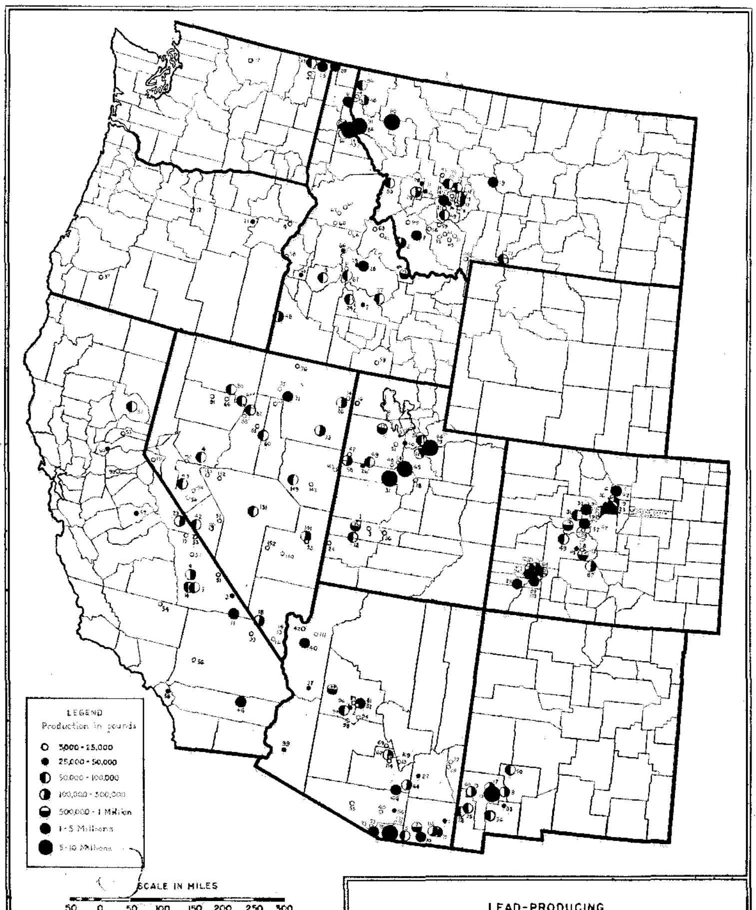
For the 25-year period prior to 1938 we consumed on the average 49 per cent of the world's production of chromite, and produced less than 1 per cent of our needs. We used about 45 per cent of this chromite as a ferro alloy to produce hard, tough and chemically resistant steels. Another 40 per cent went into refractories, particularly for furnace linings and 15 per cent was used in various chemical fields, such as dyeing, tanning, and chrome plating. Our known chromite reserves are almost entirely in the west, particularly in California, Oregon and Montana. The California and Oregon deposits were extensively worked during the last war; the Montana deposits are a comparatively recent discovery and are now undergoing extensive development. The survival of a chromite industry after this war will depend entirely on price, since it has been clearly established that our domestic deposits cannot compete with foreign deposits under prices prevailing up to the present. The development of the Montana district and the attempt to work chromite beach sands in Oregon are current results of our need for chromite.

Iodine is essential in medicine and photography and we normally consume about 500 tons. Most iodine is recovered as a by-product from refining Chilian nitrate ore, but our domestic



ZINC-PRODUCING DEPOSITS IN THE ELEVEN WESTERN STATES 1940 production of iodine is normally obtained (by two companies in southern California) from treatment of natural brines. During periods of emergency additional supplies of iodine can be recovered from kelp and other sea-weed.

Manganese is consumed almost entirely by the steel industry, where about twelve pounds of manganese are used in the production of each ton of iron. This is added mainly as a manganese-iron alloy rich in manganese. Ores used in the preparation of this alloy must contain a high manganese and a low iron content. The ratio of manganese to iron should be 8 to 1 or better. Recently we have been consuming 900,000 tons or more of such manganese ore and have been producing from 25,000 to 40,000 tons of high grade ore. Our supplies normally have come about one quarter from the Gold Coast, one quarter from Soviet Russia, one sixth each from Cuba and India, and the balance from various other countries, of which Brazil is the most important. Now we are calling for increased domestic production. The western states contain practically all our known high grade domestic deposits. They also contain large reserves of low-grade deposits and others are found in Dakota, Minnesota and elsewhere. Most domestic high-grade deposits are small and the standard grade of ore can be obtained only by selective mining. In order to stimulate present production, the Metals Reserve Corporation has dropped its specifications from 48 to 30 per cent manganese. Our low grade reserves have not been previously mined because no facilities were available for concentrating low-grade ores, but several plants are now being built with Federal funds and we probably can anticipate continued production from this source after the war, particularly if the industry is protected by increased tariffs or a higher price.



LEAD-PRODUCING DEPOSITS IN THE ELEVEN WESTERN STATES 1940

During peace times mercury has a wide range of uses in the drug and chemical field. In war times mercury fulminate becomes of great importance as a detonator in all types of explosives. We normally consume about 750 tons of mercury a year and produce about three quarters of our needs. California, Nevada and Oregon have supplied most of our domestic production and imports have been obtained mainly from Spain and Italy. The rapid increase in the price of mercury from less than $75 to more than $190 a flask during the period 1939-1940 resulted in a tremendous expansion in mercury mining and a consequent increase in production. Old mines and old dumps have been reworked and many new prospects developed. The maintenance of our current production is problematical and will depend on further price increases since our reserves are being rapidly depleted. During the last year and a half or more we have produced substantially in excess of our needs and have been able to supply our neighbors with much needed mercury.

The demand in mica is mainly for large flakes and sheets of quality usable for condensers and insulators. We have adequate supplies of ground and ordinary mica but our better grades were imported mostly from Madagascar and India. During recent years our imports of all types of mica have ranged between 5,000 and 11,000 tons. Considerable success has been met in the eastern states in producing from high grade pegmatites and granite, but in the western states there is little if any increased production.

Our consumption of nickel has averaged somewhat more than 50,000 tons a year during recent years. The distribution of this nickel is about 60 per cent in ferrous alloys, non-ferrous alloys 28 per cent, electro-deposition 10 per cent, and the balance in miscellaneous uses. Nickel, like chromite, imparts strength and resistance, (particularly to acids), to steels in which it is alloyed. It finds a very wide range of use in many types of military and industrial equipment. Our supply of primary nickel is obtained almost entirely from the Sudbury district in Canada. We have a few small scattered deposits, but none appear to be of more than minor commercial importance.

Platinum is on the critical minerals list largely because of its utility as a chemical utensil and the part it plays in many chemical reactions. In 1939 we used about 100,000 ounces, of which roughly one half was consumed by jewelry, one fifth in the chemical industry, somewhat more than a tenth in the dental and electrical industries and the balance in various other fields. The entire domestic primary production of platinum minerals comes from Alaska, California, Oregon and Montana. Ordinarily California is the leading producer from gold washing operations, but during the last two or three years there has been a very large production from the Good News Bay district in Alaska, where platinum is found as a placer deposit. This production is now declining and probably the deposit will soon be worked out. We normally produce less than 10 per cent of our consumption of new platinum but quantities adequate

(Continued on page 20)

THE CHEMISTS' WAR ON DISEASE

By STANLEY M. SWINGLE

Teaching Fellow, California Institute of Technology

For nearly a century and a half scientists have been studying ways of immunizing people against various diseases by artificial methods. Working mostly by trial and error they have devised reasonably safe vaccines and antisera for many diseases with a resulting spectacular decrease in mortality. The usual proceedure for vaccination is to inject the patient with the diseases-producing organisms which have first been killed or otherwise rendered harmless. Sometimes only bacterial products are injected. After vaccination the patient produces in his blood stream substances called antibodies which result in immunity. Serum from an immune person or animal (known as anti-serum) can be used to protect susceptible persons from the disease, e.g., diphtheria antiserum, or antitoxin, from the blood of horses previously injected with diphtheria toxin is in common use. Many puzzling problems still face these workers. In the case of many diseases the resulting immunity is only temporary, whereas for other diseases it lasts for many years. For many diseases there seem to be no effective vaccines. Often the most effective vaccines have a disagreeable effect on the patient.

In spite of the vast amount of research that has gone into developing practical vaccines and antisera, very little has been learned about the really fundamental principles of immunology, although it is apparent that such a knowledge would be of practical value in solving the problems just mentioned as well as being of purely scientific interest. Recently there has been a growing interest in making a direct attack on the problems of immunology in the chemistry department here at the Institute. Already there is a staff of several experienced immunologists and graduate students studying the problem from many angles.

Several investigators under the leadership of Professor Linus Pauling are attempting to discover the exact chemical composition and structure of antibodies, their methods of formation, and the details of the reactions by which they render invading organisms harmless. Such an application of ordinary physico-chemical principles to the processes occuring in living matter is in itself quite an advanced step. Chemists have traditionally confined their studies of reaction kinetics, molecular structure, etc., to relatively simple substances. It has generally been supposed that the reactions in living matter follow the same chemical principles which apply to reactions occuring in a test tube, but a detailed application of these principles to biological phenomena has generally proved impossibly difficult due to the complexity of living matter. Thus some of the simplest plant cells, organisms which have no apparent digestive system, can synthesize simple inorganic materials into organic compounds so complicated we have not yet succeeded in determining even their exact composition, let alone the processes by which they are formed.

Some of the members of the staff are trying to prepare antiboides synthetically in test tubes. It is their ultimate hope that in some cases we can produce antiserum synthetically which is superior to the natural product. Others of the group are studying the conditions under which an animal will produce natural antibodies to a given substance, with an eye to understanding why vaccines to some diseases prove ineffective or of only temporary protective power.

It is interesting to trace the steps by which immunology has evolved from Middle Age superstition to a modern branch of biology and chemistry. It was recognized many centuries ago that an attack of many infectious diseases conferred upon the patient immunity against further attack by that particular disease. Indeed there are records which show that attempts were made in ancient China and India to inoculate healthy individuals with the pus from smallpox pustules in the hope of producing a mild case of the disease which would result in continued immunity. These reports encouraged Jenner to devise a milder smallpox vaccination in 1798. At that time the bacterial cause of disease was still not recognized. However this imaginative and keenly observant English physician discovered that he could protect patients against smallpox by infecting them with mild cowpox.

People knew so little about disease then that practically no further progress in immunology was made until the work of Pasteur and his contemporaries nearly a century later. Pasteur not only extended Koch's proof of the bacterial cause of the

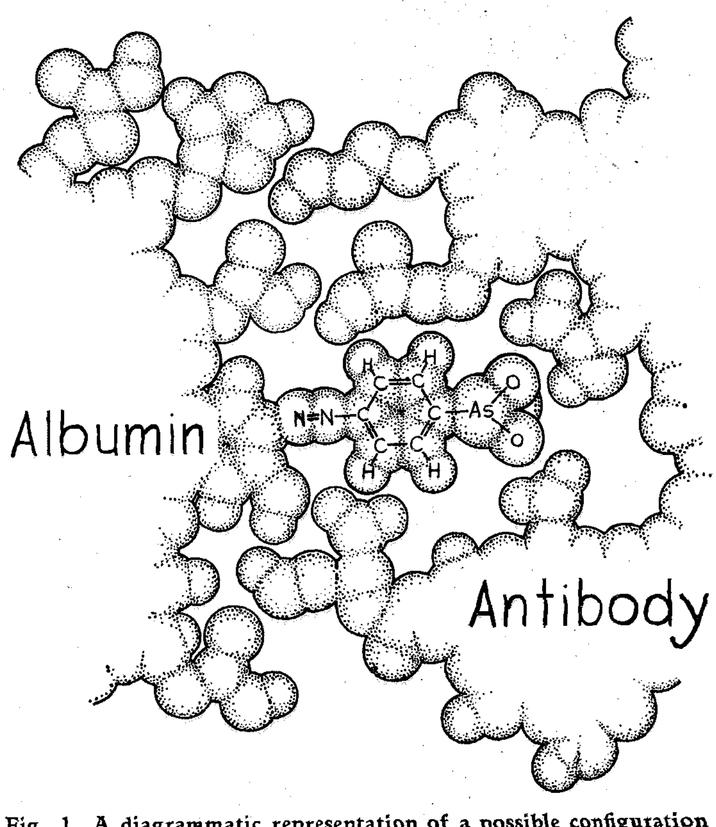


Fig. 1. A diagrammatic representation of a possible configuration for the antibody complementary to the antigen, arsanilic acid coupled to albumin. Weak bonds may form where the atoms (represented as spheres) of the antibody are near atoms of the antigen. About 35,000,000 times natural size.

disease anthrax in cattle to include many other diseases, but also discovered methods of treating virulent bacteria to render them harmless without destroying their effectiveness as vaccines. Until very recently further work in immunology has centered around isolating the organisms causing some disease and then finding a method of rendering them safe to use in vaccines.

The more imaginative investigators began studying immunology as a science in itself soon after Pasteur's time and discovered toward the beginning of the present century that the blood serum of immune individuals contains substances which give unique reactions in test tubes without the presence of living matter, i.e., *in vitro*. The first of these substances discovered were called agglutinins because they cause agglutination or clumping of the bacteria concerned. Then antiserum was found to contain precipitans which would precipitate the soluble material in bacteria. Later opsonins, antitoxins, and lysins with their own special effects were found. We now believe all these substances to be of essentially the same type and use the term antibody to designate the substance an animal produces in its serum when some foreign substance called an antigen, such as bacterial cells or a protein, is introduced. Furthermore, it is assumed that the process by which an individual fights off invading bacteria is essentially the same as the immunochemical reactions observed *in vitro*.

The next advance was quite recent work which shows that in many respects antibodies are not "bodies" comparable to cells at all, but are special proteins almost indistinguishable from serum globulin, one of the proteins normally present in blood.

The remarkable characteristic of antibodies is their high specificity. For example if hen egg albumin is the antigen injected into a rabbit, the resulting antibody in the rabbit's serum will combine best with hen egg albumin, to a lesser extent with related albumins, and not at all with serum albumin.

If either antigen or antibody is in large excess when the two are mixed they do not form a precipitate. This calls to mind similar observations in inorganic chemistry. For example, if silver ions and cyanide ions are mixed in sufficient concentration and in suitable proportions a precipitate forms. If the cyanide is in excess a complex forms and no precipitate appears. This type of reaction is not comomnly found among organic substances however.

Very few theories of the nature and formation of antibodies have been postulated. The first was Ehrlich's classical theory that antibodies are a normal component of the cell wall which aid in metabolism and which are released into the blood stream when an antigen is injected. Ehrlich did not present a detailed picture of antibodies and only intimated in a general way that thier specific reaction was due to their having a structure complementary to that of the antigen. Landsteiner and others experimented with hundreds of different artificial antigens and found that animals can produce antibodies highly specific for an infinite variety of antigens never found in nature. This demonstrated that antibodies could not be present in the animal before the antigen is introduced.

Two years ago Dr. Pauling proposed a theory of antibody structure and formation based on modern principles of structural chemistry, a field in which he is a recognized authority. The theory of the nature of the linkage between antibody and antigen when the two combine to form a precipitate had to fulfill certain unusual requirements. First, the bonding does not involve particularly active chemical groupings on the reactants as there are none available. Furthermore, the bonding is reversible and the antibody and the antigen can in some cases be separated from the precipitate in their original form. In these two respects the bonds are like certain highly nonspecific and relatively weak bonds involved in adsorption, crystallization, etc. These bear the names polar bonds, hydrogen bonds, and Van der Waals forces. Landsteiner has shown that even antibodies to optically active isomers, compounds identical except that one is a mirror image of the other, are so specific that the cross reaction of one with the opposite isomer is relatively weak. The unique feature of Pauling's theory is a detailed explanation of this high specificity in terms of ordinary chemical bonds. The antibody to a particular antigen is postulated as having a structure complementary to the antigen in two respects. First, to a certain extent its shape is such that it roughly fits the contour of the antigen. Furthermore, several sites on the antibody where hydrogen bonds, etc., can form are opposite corresponding sites on the antigen. Fig. 1 shows in very diagrammatic form a possible structure of a portion of an antibody complementary to arsanilic acid coupled to egg albumin. The antibody must have at least two such complementary regions in order to form the framework of molecules that makes up the final preciptates as shown in Fig. 2. Soluble

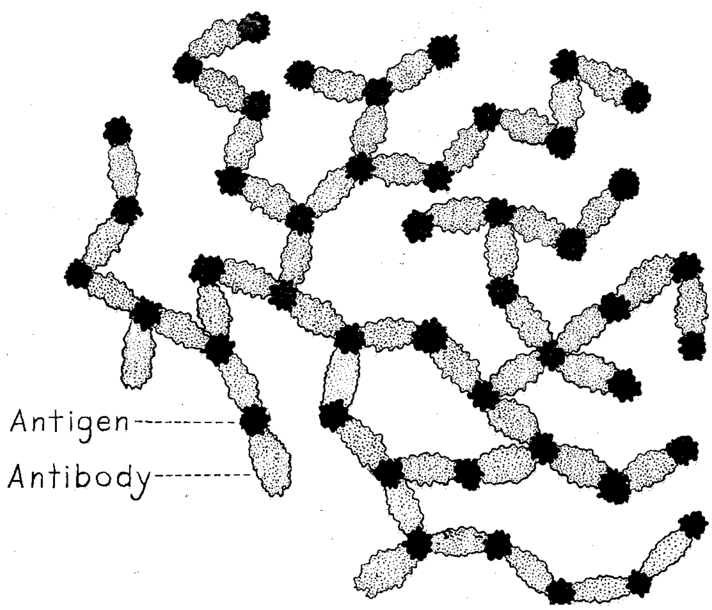


Fig. 2. The precpiitate of antigen and antibody consisting of a framework of antigen molecules joined by antibody molecules having two complementary regions. About 1,000,000 times natural size. (After Pauling)

complexes are formed when all the complementary regions on all the antibody or all the antigen molecules (depending on which material is in excess) are occupied before the framework forms. Agglutination of cells is essentially the same except that we are dealing with much larger particles, Fig. 3.

Several interesting phenomena of immunochemistry are explained by this theory. Fig. 4 illustrates typical examples of some of these. Consider the antigen *p*-nitro-aniline coupled to egg albumin. The complementary antibody obtained from rabbits injected with this compound will react with *p*-nitro-aniline coupled to egg albumin or any other protein or to benzene ring. Likewise it will react to a lesser degree with *p*-toluidine coupled to any protein because this molecule is structurally very much like *p*-nitro-aniline. Furthermore it will react with egg albumin alone. However this reaction with egg albumin will not occur if any large molecule which gets in the way is coupled to it. Also uncoupled *p*-nitro-aniline, if present in the solution in sufficient concentration, will inhibit any of these reactions by occupying the complementary sites of the antibody.

Experiments of the type just mentioned may prove useful in structural chemistry for comparing the structure of a known with an unknown compound. Thus if the antibody to the unknown compound also reacts with the known, we can assume that they both contain similar chemical groupings. This method is particularly adaptable to complicated compounds of biological origin which cannot be studied by election diffraction, x-rays, or spectroscopy due to their complexity. As our knowledge of immuno-reactions increases, especially in regard to the quantitative studies now in progress, and as we learn more about preparing satisfactory antigens of known structure, we believe that immunochemical reactions will be of primary importance to the structural chemist. Even many years before this, biologists have frequently used immunological reactions to show the similarity in structure of proteins from various species of animals and thus show that the species are probably related.

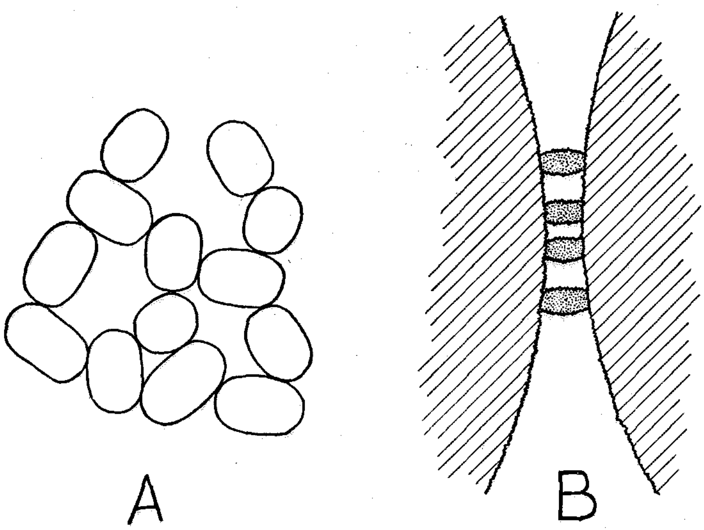


Fig. 3. (A) Diagram representing agglutinated cells. About 10,000 times natural size. (B) Diagram of the region of contact of two cells, showing four antibody molecules joining the cells. (after Pauling)

Pauling's theory also goes into a possible process for the formation of antibodies based on current theories of protein structure. Normal globulin, the protein most closely related to antibodies in most animals, is thought to be a long polypeptide chain of about 1,000 or 1,500 amino acids. This chain is folded back and forth on itself to make a compact, slightly elliptical molecule, the folds of the chain being held together by the weak bonds mentioned above. There are about 12,000

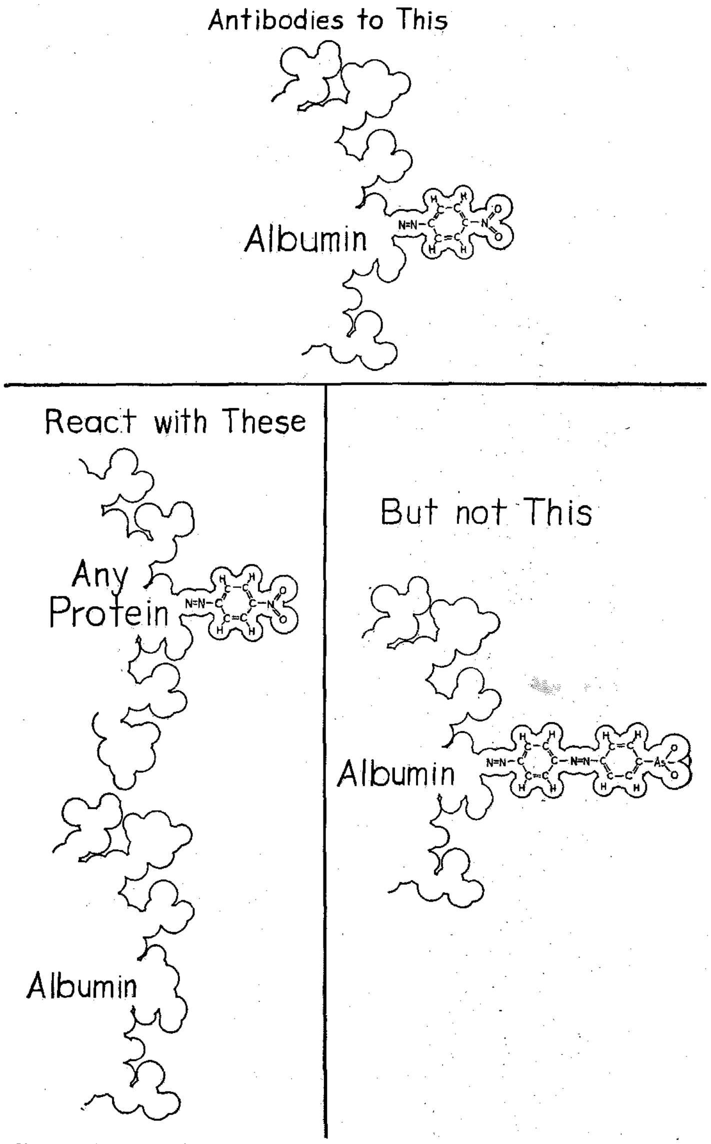


Fig. 4. Illustration of typical immunochemical reactions.

atoms of various elements in the entire molecule and the order of 400 on the surface of one end. Antibodies, according to the new theory, contain exactly the same polypeptide chain as normal globulin and differ only in the pattern of the folding. If an antigen particle is present during the folding process it pulls the chain around it by forming bonds to suitable groupings of the chain with the result that the globulin folds into the specialized complementary configuration of an antibody.

It occurred to Dr. Pauling that it might be possible to make antibodies synthetically if the process by which they are formed naturally is indeed the one mentioned above. Experiments to this end have been encouraging almost from the outset. All the methods tried have in common some means of unfolding the normal globulin chain and refolding it in the presence of the antigen. Experiments on denaturation have already shown that this can be accomplished by mild heating, treatment with alkali, or by spreading the protein on a liquid surface. All these methods have been tried for producing synthetic antibodies. The most successful procedure developed so far is to heat together a solution of normal globulin and the desired antigen, holding the temperature at 57° C. for several days.

(Continued on page 20)

ENGLAND: 1942

By ARTHUR C. ELLINGS, '38, *Basic Magnesium, Inc.*

Early Sunday morning, December 7, 1941, our group boarded a train at Las Vegas for England. A few hours later we heard of the attack on Pearl Harbor. With that as a starter, we almost expected to be caught in an invasion of England, but, for the five months we were there, little German activity took place in any part of Britain.

The trip over was made on a troop transport, while the return trip was made by freighter. James Van Horn, '38, Lt. U. S. Signal Corps, was in an adjoining cabin on the way over. Of the two the freighter was the most enjoyable, except from the standpoint of time. As a troop ship, the ex-liner was carrying many times its normal capacity. The black-out was complete and almost foolproof. The glow of a cigarette has been seen for a distance of two miles at sea. The portholes were all boarded shut, and a double set of doors was used for leaving and entering the lighted section. Even ventilators that could emit light were closed up. This meant the ship was stuffy inside. We were required to carry our life belts with us at all times. There were few objections about this, but many jokes. By the end of the trip they had many names such as "parachute" and "Mae West."

Every day we had lifeboat drill. This meant standing in the cold wind for quite some time. Few were prepared for such cold weather, and the variety and combinations of clothing that appeared on deck were remarkable. One of the favorite discussions during this period was how long one could live in the cold water.

We were given very little news on board of the outside world, and absolutely no news as to our position. Hence, each day a new crop of rumors, usually quoting the captain, started the rounds of the ship. The Australians on board had spent so much time under similar circumstances that they had them named "D R R's" (Daily Routine Rumors). For the first part of the trip we had a very strong escort, so the rumor was that a large German battleship was in the vicinity. The sailors on board were afraid of airplanes, the airmen of submarines, and the civilians of the number of places available in the lifeboats. The news bulletins covered the world situations with such statements as, "Prime Minister Churchill is the guest of President Roosevelt at the White House."

On the trip back we had access to the ship's radio for direct news broadcasts and much more freedom of movement.

We amused ourselves by trying to keep track of our position at sea. Why on our way to England we spent hours going west, we are likely never to know. We returned with a better understanding why there is a shipping shortage. The time consumed in waiting for a convoy to form, in zig-zagging, and in keeping back with the slowest boat greatly reduces the effectiveness of each ship.

On neither trip did we have any known contact with the enemy. One of our escorts would now and then dart off, then reappear. On the return trip one of our escorts detected a whale and caused considerable excitement for a few minutes. On the one occasion that depth charges were dropped, the captain of our ship explained them as an attempt to hurry up the ships that were lagging behind. It did. We soon learned that in a large convoy, the man at the helm of the ship next to you is almost as dangerous as the enemy.

Our first sight of the British Isles was the barrage balloons at Liverpool. We immediately started to count these small specks on the horizon. From that day on, I was never able to count the same number twice. There are just too many of them, and yet more could be used. Their habits were also another mystery. Their pattern was far from regular. One could never predict if they would be up or down. The only consistent quality is that they usually all go up and come down together. They make a pretty picture during a clear sunset, and make a spectacular sight when on fire. They evidently accomplish their purpose in keeping the enemy planes at a respectable height.

I was surprised rather than shocked at the damage that we were soon to see. Surprised that so much had been left standing. I do not wish to underestimate the damage that was done, but to call attention to the tremendous task it is to destroy a large city by bombing alone. In particular, London struck me that way. London is so large that the damage looks relatively small. In a smaller city such as Coventry, the damage stands out much more.

England had not had a raid of any consequence for almost eight months. Most of the damage had been cleaned up, and many buildings had been rebuilt. The British were leading a changed life, but it was not one that will lead to defeat. It would have been a different matter if an invading army had followed the raids immediately. We soon saw evidences of the make-shift defenses thrown up after Dunkirk. It is the consensus of British opinion that the Germans might have successfully invaded Britain after Dunkirk. As in America, there is a variety of opinion why the Germans did not invade.

It did not take us long to decide we would just as soon miss the experience of an air raid. The Germans were kind enough to oblige by only causing a few alarms. We were to hear many stories about the raids, all of which agreed on two points. The raids are terrifying, but if each individual does his part, their damage can be greatly reduced.

The latest blitz technique used by the Germans was to drop thousands of incendiaries and then to drop the high explosives into the fires started—stoking them, as the British say. The result was that the poorly manned areas received the greatest damage. Most incendiaries are relatively easy to extinguish if attacked immediately. However, that takes a lot of fire-fighters and fire-watchers. They must also work while the explosives are coming down.

There is considerable difference of opinion among towns as to which received the severest blitz. Many of those who had near misses are rather proud of the holes in their back yards. Most are rather proud of their air raid shelters. There are many types and all have saved lives. Some have even built theirs into the house as a secret room which is entered through sliding panels. Tragic mistakes have been made as to what constitutes a satisfactory shelter. A basement is not a satisfactory shelter as its ceiling will not support the possible load above it, or one which can be flooded or filled with gas.

I had not realized before the problems arising with a large raid that are acute after the raid has stopped. One has to assume that the regular water, gas, electric, sewerage, communication, and transportation systems are out of commission, and the hospital hit. This is not always the case, but it is for what one has to prepare. Although, putting out the fires is the first task, sanitation and its related problems are just as important. Surprise was expressed at the successful prevention of sickness and disease. Coventry was thankful for the paper cups sent by America. They helped in the distribution of sterilized water. It is the individual himself who must take care of these problems. He must keep his own house from burning down, look after his own health, and keep at his job. When the British learned that it was safer to keep production going (more guns, etc.) than to go to shelters, the effectiveness of the air raid was greatly reduced.

It is with a great deal of justified pride that a plant manager will tell of fighting off a raid without the loss of production. If the plant uses such materials as liquid chlorine and is located in the middle of a city, the problems are many. Most plants have their own systems of air raid warning and control. Work is carried on as long and as rapidly as possible.

If the plant is in an outlying district away from the regular defenses, the plant staff has the added problem of controlling aircraft defenses, manned by home guard units composed of men from the plant. Three German bombers had made a direct attack on one such plant visited. The anti-aircraft fire was so accurate that it brought down one of the planes and drove off the other two. The crew of the crippled plane bailed out and were captured. It was with great amusement that we were told of the fear shown by the young Germans when women from a nearby village came out to meet them with meat cleavers.

Apart from enemy action, the problem of keeping British industry running is not an easy one. A very delicate balance must be maintained between the importation of food, necessary industrial and military materials, and the shipping space available. A change in a war front does, of course, change the ease or difficulty with which some raw materials can be obtained. A ship returning from India can bring back the much beloved tea. Wood was such a scarce material, in some places concrete forms were being built with brick, in others the dirt sides of excavations served as one side of the form. The latter also requires a prayer for a dry spell as well as a great deal of optimism. The encouraging part was that most of the tricks used to conserve imported materials worked.

The factors of safety which the engineer so loves to use has been more than justified during British wartime experiences. Machines are running well above their rated capacity since the invasion of Poland and show no signs of weakness. Whatever the political effect of Munich, some industries imported tremendous stocks of materials. The number of German-built factories and machines in Britain, which were obtained just before the war, is something that puzzles those who consider Hitler's pre-war intentions. Coventry still remembers the German engineers who were there just before the war broke out.

The black-out was an interesting experience, but after a few months rather tiresome. It is hard to describe how black a city can be. The only lights visible are the occasional flash of an electric street car (tram), the green and red slits of the signal lights (robots), and that of flashlights and cigarettes. The regulations require that the flashlight beam be no larger than 3/4 of an inch in diameter and the lens, no matter how small, must be covered so as to give a diffused light. A light should never be pointed upward, and a match should be covered with the hands while lighting it. Care is taken that no cracks, no matter how small, occur around windows. It is claimed such a crack gives a searchlight effect and can be seen for miles. To show a light during a raid is almost fatal. If the Germans do not drop something on the offender, the home-guard would be likely to send a few bullets. Phosphorescent buttons or paving strips were not to be seen. Even the specially constructed blackout street lights were not used.

One soon recognized buildings by their silhouettes. I have been lost in a town in daylight, in which I could find my way about in the blackout. The blackout does not dampen the spirit of those who go out. There is a considerable amount of singing. One must be very careful in moving about during a blackout, especially of moving vehicles. A driver does not have much chance of seeing a pedestrian. After my first night in the good-humored crowd at Liverpool, I decided that the spirit of Britain had not been broken.

Travel, in general, is rather hard, and is discouraged as much as possible. Busses stop running at 10:00 P.M. Except in London, taxis are hard to find at any time. The trains are always crowded with military personnel on leave. It was with great surprise that I awakened one night to find a soldier in full equipment asleep on my shoulder. Diners and sleepers can be found only on the more important runs. The ten-ton capacity freight cars (goods vans) were always a source of amusement to us. The old canal system has been utilized to some extent. The boats are about six feet wide and thirty feet long. In some places one branch of the canal will pass on a bridge over another branch. In another place the small canal passes over a large ship canal on a draw bridge.

The American tourist would find most of his favorite spots untouched by war. Most of them are very quiet, and many closed to the public for the duration. Some, of course, have been damaged or destroyed.

One gets the best idea of the rationing, by looking at it from the standpoint that, if there is no shortage, war industries are not being given all the materials possible. No one is going hungry, but no one is getting all of what he would by choice like to eat. It is lack of variety in the meals that one misses most. The food sent over from America has been much appreciated. Much interest was displayed in boneless cuts of meat.

(Continued on page 22)

UTILITIES IN THE WAR: COMMUNICATIONS

By HARRY K. FARRAR, '27
Southern California Telephone Company

When our broadcasting stations on last December 7th interrupted their regular programs to transmit the startling news of the bombing of Pearl Harbor, many telephone people immediately went to emergency posts believing that the demand for telephone service would instantly soar, which it did. In three important Southern California offices, the number of toll calls handled on the 7th was over 75 per cent greater than on the Sunday just preceding, and the news of Pearl Harbor was not received until mid-afternoon.

The present emergency began to affect telephone organizations long before the Pearl Harbor attack, however. The orders placed in the United States by nations later to become our allies, in addition to development work requested by our own National Defense Research Council, had shifted a large portion of telephone research and manufacturing to development and production of defense communication equipment. Soon it became necessary, while carrying on an increasingly active development program, to develop substitutes for materials, shortages of which arose or became imminent, and later it became imperative to find substitutes for the substitutes.

In the operating telephone companies, one early effect of the impending war was upturn in requests for service resulting from the increased pace of aircraft and other industries manufacturing war materials for ourselves and other nations. In short, the telephone companies and related research, development, and manufacturing organizations were considerably affected before December 7th, but after our declaration of war the acceleration of all these activities made the former effect seem insignificant.

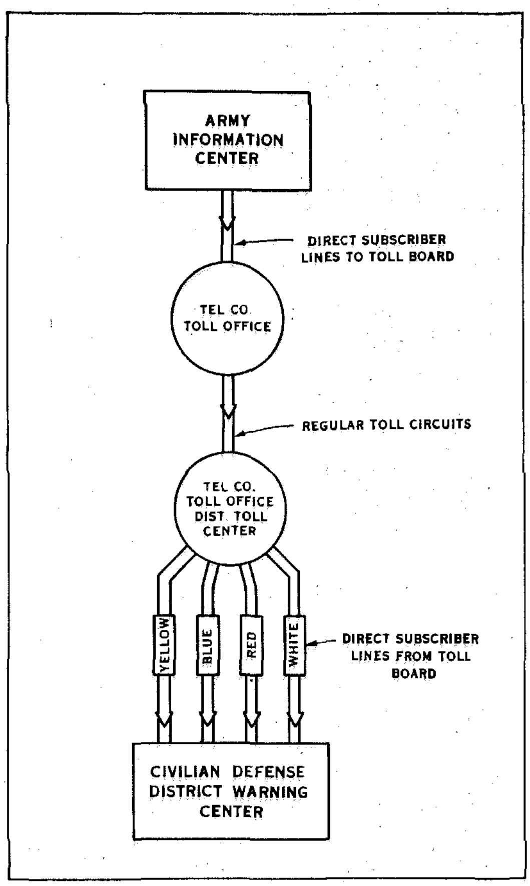
Applications for new telephone service continued at a high level and shortages of copper and other strategic materials became so great that it soon became necessary to conserve the supply and direct the distribution of telephone materials to insure deliveries for war and essential civilian requirements. The War Production Board, therefore, on March 2, 1942, issued conservation order LY50. The effects of the shortages have by now been felt by many people. For example, a number of telephone users have changed from individual line service to party-line service in order to permit applicants essential to the war effort to obtain telephone service.

The telephone companies have provided large quantities of facilities for military and civilian defense purposes, in addition to the continued attempt to meet essential demands for telephone service. One of the most interesting uses of telephone facilities is in the aircraft warning network. In 1938 and 1940, thanks to the foresight of our military leaders, extensive war games were held and early versions of aircraft warning systems were given practical tests. These suggested refinements and improvements made possible the high efficiency of the present network, the most extensive system of intelligence ever devised for military use. Today, upon the ground observer system depends in large part the efficacy of the fighter commands which, day and night, are guarding our shores.

THE AIRCRAFT WARNING NETWORK

Land area of continental United States comprises 2,977,128 square miles. Much of it has been ruled off, on small sectional maps into units one mile square. In each unit has been placed a symbol indicating the presence or absence of a telephone in that area. Telephones of the Coast Guard, Forestry Service, and similar agencies have been indicated. The telephone companies, Bell and independent, did that job, and turned the maps over to the Air Corps' four Fighter Commands.

That was the start of the present ground observer network. On these maps, starting with an indicated telephone, Air Force officers laid circular templates scaled to an eight-mile diameter, and drew overlapping circles. At some point within each of these circles an observation post was carefully selected and a trustworthy citizen appointed chief observer. To obtain this enormous organization, aid of the Office of Civilian Defense, State Defense Councils, and the American Legion was enlisted. Each



AIR-RAID WARNING CHANNELS

This diagram shows how both the Army Information Center and the Civilian Defense District Warning Center are directly connected to long-distance switchboards.

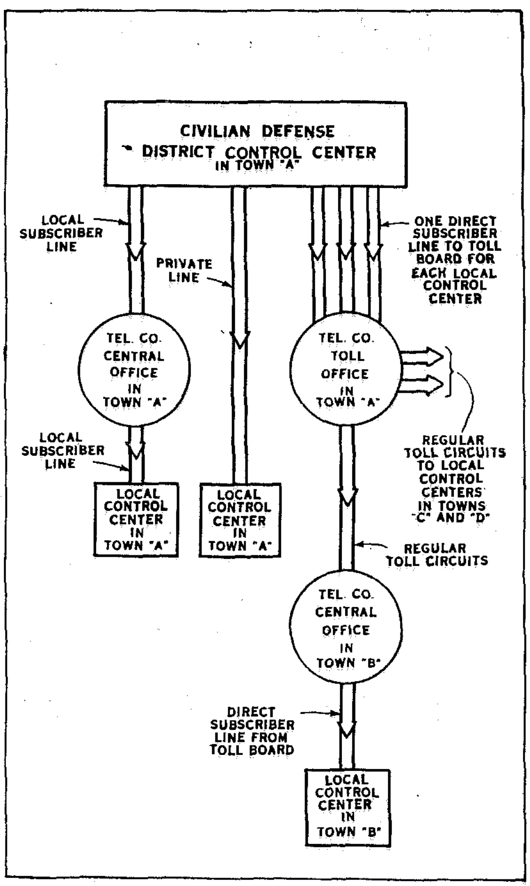
chief observer appointed his deputy observer, and obtained enough volunteer observers to insure constant coverage of the post—24 hours a day, seven days a week.

So, day and night, those observation posts which have been activated by the Army are manned by these patriotic civilian volunteers. Each of these thousands of posts has its code name; each observer has his instructions—or hers, for many women are among the watchers.

An observer at an authorized observation post, seeing or hearing an airplane, or several, goes to the telephone, says to the operator "Army Flash," gives the telephone number of his post—and initiates a train of events which are astounding both in their complexity and in the speed with which they are executed.

The telephone operator, receiving the "Army Flash" call (and screening out any such call from an unauthorized telephone), connects the observer, either directly or through her toll center, over regular commercial circuits to the regional Fighter Command filter board terminating at a point on the filter board corresponding with the observer's own location.

The filter board, near a city selected because of its tactical location and its telephone facilities, is a very large map of the area it covers, so mounted that it becomes in effect a table. It is marked off into squares designated by code names and numbers. These codes correspond with those of the observation posts in the area. Around the map sit the plotters, all civilians, all volunteers. To them come the calls from observation posts,



DISTRIBUTION OF THE WARNINGS

In this diagram, channels from a District Control Center to the Control Centers of several neighboring communities are represented.

each call routed directly to the plotter nearest the mapped location of the post.

Receiving a signal light and an "alert" tone at her position, indicating a "flash" call, a plotter, equipped with a telephone operator's set, answers "Army, go ahead please,' and receives the report from the observer at his post.

The observer reports only non-technical facts, as instructed by the Army: Number of planes seen or heard; whether single-, bi-, or multi-motored; apparent altitude; distance from the observation post; and direction of flight.

The plotter adjusts a marker to represent the information just given her, and places it on the map at the proper coordinate location of the reporting observation post, pointing in the reported direction of flght. This is accomplished in a matter of seconds, and the plotter is then ready at once to receive a call from another observation post.

This operation, it must be understood, takes place many times in rapid succession as one observation post after another reports—since the speed of planes is great and observers are located only a few miles apart. It takes but a moment for the markers on the map to make a definite line. Also, reports of a flight from successive observation posts corroborate each other, and thus of themselves rule out an occasional discrepancy on any one report.

The markers, having so swiftly become a line, are now as swiftly evaluated by a "filterer," who places on a small stand nearby cards describing the observed flight, and replaces the markers with arrows indicating direction. To show the speed of the flight, the color of the arrows is alternated at regularly timed intervals.

The information about each airplane flight in a filter area, having been thus evaluated or "filtered," is now ready to be transmitted instantly over private telephone lines to an Army information center.

The heart of the aircraft warning system is the information center. It is here that decisions are made, action is initiated.

Here is the operations board for the particular defense region. Like the filter board, but larger, it includes all the filter areas of the region. Here, too, plotters place their symbols; but now they are duplicates of the evaluated information received moment by moment from tellers at each filter board in the region.

In the same room are the seaward board, on which all flights approaching from the sea are plotted; and the status board, on which are shown the availability, position, and condition of pursuit squadrons in the region.

On a balcony overlooking these three boards sit the men who decide, and the men who help them. Contact among them, even between those who sit side by side, is by telephone.

First comes identification of the flight, from location and direction, if it can be identified. On the balcony, with this responsibility, are representatives — liaison officers — of the Army ,the Navy, the Civil Aeronautics Administration, and the Federal Communications Commission.

On the balcony is the Controller. He is, or acts for, the Commanding Officer of the region. It is he who orders into the air, from the most logical field in the region, pursuit of sufficient strength to effect interception of an enemy flight.

THE TELEPHONE'S PART

Although little has been said in detail about the use of the telephone in the system described, it must be evident that every operation, from the reports of airplanes seen by civilian observers to the ordering of pursuit into the air, is keyed to and carried out by telephone. And even the pursuit flight is controlled by Army radio telephone sets connected by telephone circuits to information centers.

Fundamental to all is the use of existing commercial telephone lines, both of the Bell System and of independent telephone companies, made possible because the United States is served, as is no other country, by a network of telephone lines not only interconnecting cities and towns and hamlets but reaching out into almost every countryside. "Flash" calls from observation posts, using regular commercial telephone lines, get absolute right of way, of course. Where certain telephone and teletypewriter circuits may be required for the use of the Air Forces exclusively, these are provided in most cases from available lines. Even the intricate and vitally important intercommunicating systems by which coordination is attained at filter and information centers is put together out of standard parts, with a minimum of special equipment. The use of standard equipment—although specially arranged—expedites installation, and minimizes maintenance problems which might result from the use of specially designed facilities.

A large part of the defense network is used by civilian defense organizations, picking up where the Army leaves off. The Army telephones warnings to the warning district centers which are the points of contact between Army and civilian groups. From there on the operations are directed by civilians. The size of warning districts varies but is illustrated by Massachusetts, where nine districts have been established.

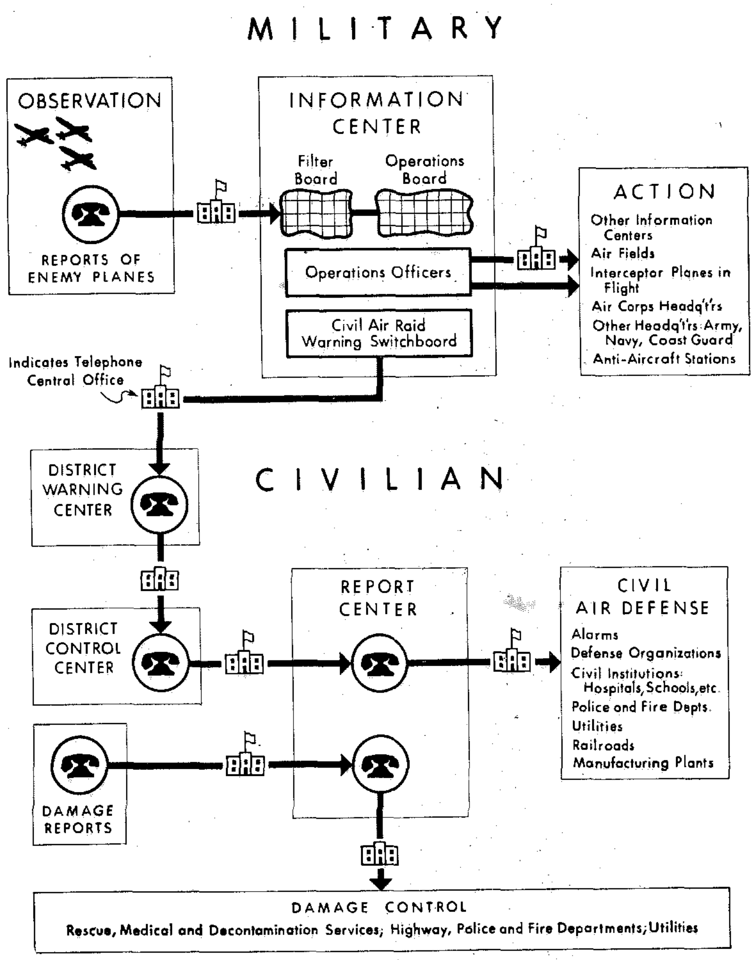
A blackout can be ordered for a region regardless of the degree of warning in effect. This is likewise true of silencing radio broadcasts.

It should be pointed out that these warnings are the subject of continuing study and tests, and may therefore be changed from time to time as experience and circumstances warrant.

The Army arranges to have each Warning Center provided with a special telephone which has four keys. Each key is associated with a line to the long-distance central office, and with a lamp signal. There is a combination of line-and-key-and-lamp for each of the four degrees of warning; the key and lamp are of the same color as the warning they represent.

For example, when the Army sends a yellow warning to a Warning Center, a bell rings and the yellow lamp lights. The Warning Center attendant depresses the yellow key and, using the telephone hand set acknowledges the warning with "Bridgeport Warning District, yellow." Generally the warnings disseminate from the Warning Center by message telephone service to the Control Centers of individual communities. However, there may be variations to this method of routing warnings; e. g., warnings are sometimes relayed through a District Control Center which has been established to coordinate the activities of several neighboring communities. Also, police and other teletypewriter networks are sometimes used for warning dissemination.

AIR DEFENSE COMMUNICATIONS



"TELEPHONE LINES AND AIR DEFENSE"

Only the upper portion of this diagram represents military activity. The lower part shows how the telephone serves Civilian Defense as well.

CIVILIAN PARTICIPATION

This background brings us to the last link of the warning chain, which is forged largely by the individual community. Based on a study of the steps required to prepare for an attack and the time involved, lists are developed of individuals and groups to receive the yellow and blue warnings. Such lists include three groups: (1) Key people in the civilian defense organization, e. g., personnel required to operate the Control Center, and heads of such essential services as fire, police, medical, repair, utilities, etc.; (2) schools, hospitals, and other such institutions where special steps have to be taken to protect large groups of people located on the premises; and (3) Large war plants in those cases where the steps necessary to prepare for a raid require an appreciable amount of time. The exact composition of warning lists must, of course, be determined individually by each community, based on a careful review of its requirements.

Only a limited number of these advance warnings can be transmitted over regular message telephone service. Excessive use of the telephone at such critical times would congest the telephone system, and thus some calls most important to civilian defense might not get through. To avoid congestion of the telephone system, civilian defense officials and telephone people in each community jointly develop the warning lists, giving due consideration to the capacity of the telephone facilities to handle warning calls. Particularly dangerous at such a time are the so-called "chain calls" of excessive length, whereby a small group is called from the Central Control and they in turn call a larger group, and so on. To show how such calls "snowball," if an attempt were made to reach about 1,000 people in ten minutes, there would be a wave of over 500 calls during the last minute and over 120 operators would be required in a manual central office to complete them within the deadline.

PATROLLING AND REPORTING INCIDENTS

Wardens are the sentinels of civilian defense. Their functions are similar to those of police patrolmen or guards and watchmen in private business. They are mustered when such patrolling agencies require reinforcement. They start patrolling their posts when the red (or public siren) warning is given, and (1) warn the inhabitants of impending danger, (2) prepare their area for an attack, e.g., effect blackout, clear streets of traffic, and help the public to take cover, (3) spot and report damage and casualties to the Control Center, and (4) render such other assistance as they can.

To reach the Control Center, wardens ask for or dial the telephone number assigned to the Control Center incoming lines. When the Control Center answers, they give a terse but adequate report covering the incident.

The Control Center is the nerve center of civilian defense. It is usually established in a centrally located public building which affords adequate space and good protection. Larger cities may require several Control Centers which are coordinated by a Main Control Center.

The Control Center force is composed of two groups. The first is a group primarily responsible for recording the incoming warden incident reports. They are stationed in a message room. The second is the staff organization, which analyzes each incident and notifies the various emergency services in cases where their help is needed. They are located in a staff room. The Control Center forces are all summoned for duty as promptly as possible following the receipt of a yellow warning. However, as mentioned previously, many Control Centers, particularly in the zones of possible military operations, are manned by skeleton forces continuously.

The facilities used for receiving warden incident reports are another example of efficient planning. In a typical Control Center, the telephone set and signal provided at the incoming telephone positions in the message room were selected so as to meet adequately the needs without requiring elaborate special equipment. Desk stand telephones with head sets, giving the telephonists free use of both hands, are used. The signal of an incoming call is obtained from a regular bell box, minus the cover and bells, which is mounted before the telephonist. When there is call on the line the clapper, which has been painted a bright color, vibrates to announce the call.

DISPATCHING EMERGENCY UNITS

The Control Center staff is supervised by a chief and has the following members: A medical officer, chief air raid warden, representatives of the fire and police departments, the community's gas, power, communications and transportation companies. In small cities many of these jobs may be combined. As mentioned previously, the staff is assembled on receipt of the initial warning. Its function is to analyze incident reports and notify the emergency services involved.

As each member of the staff arrives at the staff room, he places a call to the dispatching point of the service he represents, using the telephone at his position. When it answers, he orders "Stand by for action." A private line connection for continuous, exclusive use between a staff man and his dispatching point may sometimes be required. More often, however, regular individual message telephone lines at staff positions prove adequate, since a connection with the dispatching point,

THE CONTROL ROOM OF A CONTROL CENTER
This is the main message center of the community. It is here that the orders are swiftly issued to meet the situations which are revealed by the wardens' reports.

once it has been established via the central office, can be maintained continuously if required throughout the period of emergency.

Soon after the staff men reach their posts and establish contact with their dispatching points, incident reports start coming into the message room. Immediately after a telephonist completes recording an incident, she sends the report by messenger to the staff room. The chief reads the report aloud. Each member of the staff passes by telephone to his service dispatching point such details as affect it.

From a communications standpoint, the Control Center is the main message center of the community. Communications must be engineered so that incident reports can be translated into action at top speed.

From the Control Center goes information covering incidents which enables the emergency services to make the most effective use of their organization and equipment during the period of emergency. It permits them to go only to those incidents where their help is really needed. It also gives them a good picture of the type and amount of work they will have to do. For orders and other communications between their main dispatching points and various emergency units of the several emergency services, adequate telephone arrangements are usually available.

(Continued on page 22)

THE SECOND FRONT AND A GLOBAL WAR

By J. E. WALLACE STERLING

Associate Professor of History, California Institute of Technology

Two years ago General Sir Archibald Wavell delivered at Trinity College, Cambridge University, the Lee Knowles Lectures. His subject was *Generals and Generalship.* In his first lecture on "The Good General" he sought to "explain the qualities necessary for a general and the conditions in which he has to exercise his calling." He sought evidence in history and found what seemed to him "the real root of the matter" in a statement "attributed to a wise man named Socrates." This statement read as follows:

> The general must know how to get his men their rations and every other kind of stores needed for war. He must have imagination to originate plans, practical sense and energy to carry them through. He must be observant, untiring, shrewd; kindly and cruel; simple and crafty; a watchman and a robber; lavish and miserly; generous and stingy; rash and conservative. All these and many other qualities, natural and acquired, he must have. He should also, as a matter of course, know his tactics; for a disorderly mob is no more an army than a heap of building material is a house.

General Wavell was most attracted to this definition by the fact that it began with the matter of administration, which is to his mind "the real crux of generalship," and placed tactics, the handling of troops in battle, at the end. He goes on to say that it does not take a trained and experienced military scientist to devise strategy; an intelligent amateur can do it. But the carrying out of that strategy requires an expert, one who knows the function and performance of the weapons at his disposal and how to get to the scene of battle "fustest with the mostest."

This brief article is being written on the morrow of the Commando raid on Dieppe, when speculation on the imminence of a second front seems to dominate all conversations about the war. Few pause to define "second front;" indeed, such definition is hardly necessary, for there is tacit agreement that "second front" means the invasion of the continent of Europe by land forces in great strength, supported adequately by sea and from the air. Inevitably there is speculation also as to where such an invasion would strike; and again there is widespread acceptance of the view that the blow will fall somewhere in northwestern Europe. The Dieppe operation would seem to rule out any other possibility, since such success as it enjoyed was to a significant degree due to the "umbrella" of superior air strength with which the United Nations were able to cover the operational area. This air strength necessarily included fast fighter planes land-based on Britain. It is permissible to doubt that any initial invasion attempt made at a point beyond the range of these vital fighter planes would be practicable.

So long as Russia remains a real fighting force, the logic of such a second front is simple and sound. It does not take a four-star general to appreciate the advantages that would accrue to the United Nations from catching the enemy between two fires. But the appreciation of these advantages does not always carry with it a corresponding appreciation of the technical difficulties involved in preparing and launching such an invasion, and in successfully sustaining it so as to avoid another Gallipoli or Dunkirk. These difficulties would be great even if the war were confined to Europe alone; they are increased many times by the global nature of the struggle and its inherent problem of strategic priorities.

The Russo-German pact of August, 1939, marked the failure of British and French diplomatic efforts to line up the Soviet Union against the Axis powers. That failure made impossible for the time being the establishment of an effective eastern front against Germany, because gallant Poland was beyond the reach of allied aid and alone was no match for German brains and brawn. Almost two years were to pass before Germany's unprovoked (Hitler to the contrary notwithstanding) attack on Russia created a front in Eastern Europe. By that time, however, France had been knocked out of the war and Britain driven from the continent, so that the new Russian front stood alone: there was no second front in Europe. Nevertheless, the potential advantage to the anti-axis powers of Russian belligerency had to be seized. Accordingly, on July 12, 1941, a scant three weeks after Germany had attacked Russia, Great Britain and the Soviet Union signed in Moscow a treaty binding themselves to "render each other assistance and support of all kinds in the present war against Hitlerite Germany," and "neither [to] negotiate nor [to] conclude an armistice or treaty of peace except by mutual agreement." Six weeks later, on August 25, this pledge of military cooperation was implemented in the field by the combined Russian-British invasion of Iran. Meanwhile, arrangements had been made for not only Britain but also the United States to send all possible aid to Russia in the form of equipment and supplies.

Few persons in the West expected Russia to withstand for long the carefully prepared sledge-hammer blows of the Reichswehr. Few but the Russians themselves had much faith in their capacity to prevent the speedy liquidation of this new eastern front. But once the western powers and populace awoke to a proper appreciation of Russia's resistance, there began a steadily growing public demand that steps be taken to establish a second land front in Europe as a means of providing the best sort of aid for Russia and of achieving ultimate victory over Germany. The history of the demand for such a second front merits attention.

Early in October, 1941, after three and a half months of campaigning in Russia, the German armies launched a tremendous offensive against Moscow. This drive was to be, in Hitler's phrase, "the last, great decisive battle of the year." As the invaders smashed their way toward their objective, the Russian army paper, *Red Star,* called on the British to relieve German pressure on the Red armies by making a diversion on a second front. This summons was echoed in the rising cry of the British public and press, especially of British labor, for "action" of some kind. By the end of the month, the "action" called for was an invasion of Western Europe while so much of German might was occupied in the East. A demand for such action was made in the House of Commons and drew from the Government the reply that Britain was in no position to risk an invasion of the continent at a moment when it might be forced to take the initiative on other fronts.

For the moment, the only offensive action Britain could contrive on the continent as aid to Russia was the bombing of industrial centers, military installations and transportation facilities in enemy territory. But British strength in heavy bombers was not sufficient to do vitally serious damage, and the reason is not far to seek. With a late and rather slow start in building up her air power, Britain had been obliged first to concentrate on production of fighter planes for the defense of the United Kingdom itself. Consequently, when the Russo-German war broke out she was unprepared for intensive bombing of Nazi Europe on a large scale and therefore could count on her air force to give little more than token aid to Russia by attacking Germany.

On November 6, 1941, the German armies were sixty-five miles from Moscow. And on that day Joseph Stalin, speaking in Moscow on the twenty-fourth anniversary of the Bolshevik Revolution, referred to the urgent desirability of a second front in the following words: "There can be no doubt that the appearance of a second front on the continent of Europe — and undoubtedly this will appear in the near future — will essentially relieve the position of our armies to the detriment of the Germany army." Although no such front was established, relief was brought to Russia by General Auchinleck's North African army which attacked the enemy in force on November 18. This offensive in Libya is reported to have caused the German command to withdraw as much as half of its fighter-plane strength and some other units from the Russian front in order to meet the threat in North Africa. It is hard to resist the conclusion that this withdrawal contributed somewhat to the success of the spirited Russian counter-offensive which recaptured Rostov on November 29 and spread to most of the front by December 6. Presumably, also, it was this offensive which the government spokesman had in mind when, late in October, he replied to the demand for a British invasion of Europe.

While Russian and British armies continued their separate advances during winter months, Japan entered the war and went rapidly from one victory to another. With the capture of Singapore on February 15 and the subsequent conquest of the Netherlands East Indies, the Japanese cleared the way for eventual major offensives on Australia and India, providing they retained the power to carry out such designs. Their successes induced understandable apprehension in Asia and the Southwestern Pacific. From China and Australia came pleas and demands for assistance, immediately and in volume.

Given the German reverses in Russia and Libya, and the astonishing, even humiliating, Japanese successes in the Far East, it would not have ben surprising if talk of a second front in Western Europe had died down. But such was not the case. Throughout the successive Allied disasters in and around Southeastern Asia, official spokesmen of the United Nations repeatedly affirmed the intention of attacking Nazi Europe in the west.

From conferences held in Moscow and Washington at the turn of the year and resulting in the official formation of the United Nations, there came reports and announcements which revealed that the new war in in the Pacific had not taken precedence over the old war in Europe. In January, Secretary of the Navy Knox and First Lord of the Admiralty A. V. Alexander both indicated that Hitler should be considered the principal enemy and that priority should be accorded to the war against Germany. These particular utterances, coming as they did when Japan seemed irresistible, had an unfortunate effect on China, the Dutch East Indies, Australia and New Zealand. Some adjustments in the rating of strategic priorities were made out of consideration for these Far Eastern powers, but there does not appear to have been any fundamental alteration of the official opinion that Germany was the prime enemy and should be the object of primary action. Certainly, the much publicized arrival of American troops in Northern Ireland on January 26, 1942, seemed to indicate that despite the turn of events in the Pacific, steps were continuing to establish in Europe the second front that had been demanded.

Through February and March, while Japan was still unchecked, still more official pronouncements served to keep very much alive hopes of a second front in Europe. On the anniversary of the Red Army, February 23, Stalin made two pleas for allied aid. He urged once more the opening of a second front in Europe without waiting until the last button was sewn on the uniform of the last soldier. This plea was reiterated by Ambassador Litvinov in New York on March 16 and by Ambassador Maisky in London on March 25, but it was only partially answered by the increased intensity of R.A.F. bombings on such objectives as the Renault works, Rostock, Luebeck, Cologne, Essen, etc. Stalin also asked for an increase in Allied supplies sent to Russia. This second plea did not fall on deaf ears. On March 26 President Roosevelt responded by directing that barriers to the shipment of supplies to Russia be removed. Three days later Lord Beaverbrook, British Lend-Lease Coordinator in the United States, declared that "If the Russian armies were scattered beyond the Urals, all our hopes would be scattered too." He urged that all possible supplies be sent to this "most critical battlefront in the history of civilization."

The first half of April brought bad news for the United Nations. On the ninth Bataan fell; on the tenth the Working Committe of the Indian Congress Party unanimously rejected the British proposals and on the next day Sir Stafford Cripps informed the press in Delhi that the British Government's offer to India had been withdrawn; on the fourteenth Pierre Laval returned to the Petain cabinet. The developments in the Far East suggested that Japan, with the thorn of Bataan removed from her side, might now strike in some other direction, and the stalemate in Delhi further suggested that Japan might find it advantageous to fish in India's troubled waters for great economic and strategic gains. In Europe, the return of M. Laval was read in the context of intensive Nazi preparations in Russia, the Balkans and the Mediterranean: the bombing of Malta and the raiding of Alexandria, reported concentrations of German men and equipment in Greece, Crete, and Bulgaria. These activities indicated that the expected Nazi push to the Caucasus and the Near East was dreadfully imminent, and, observed in relationship to events in Asia, justified some apprehension of a meeting between Japan and Germany in the Indian Ocean and the Middle East. Clearly there was need for some decisive action by the United Nations if these possibilities were to be obviated. Russia's armies could be depended on to give excellent account of themselves. But what could their allies do? Once again they were confronted with the problems of strategic priorities: How much of what to send where?

Excluding Russia, there were three great bases which might serve as bulwarks against enemy advances or springboards for allied attack: Australia, the Near and Middle East, and Britain; these three, and the greatest of these was Britain, — greatest because it was in itself a source of supply, because it was closest to the great North American arsenal, and because, while bristling with defensive strength, it stood most adjacent to important enemy territory. Decisions at the turn of the year had indicated that Germany held priority over Japan as Enemy No. 1. Emphasis on coming to grips with Germany in Europe did not at all mean that the United Nations, particularly Britain and the United States, would let the Far and Middle East go by default, as subsequent events have shown. Accordingly, while they nourished China's resistance and built up strength in the South Pacific and in the Near and Middle East, they increased supplies to Russia and proceeded to make such preparations in the British Isles that not only the people of the United Nations but also the enemy command expected an invasion of Western Europe. Events and official statements tended to confirm this expectation.

On April 8, Mr. Harry Hopkins and General Marshall, Chief of Staff of the United States Army, arrived in London. In the days that followed, Mr. Hopkins was particularly busy with the problems of production and transport; General Marshall was in discussion with the British and other service chiefs. These activities gave rise to much speculation. Those who interpreted the visit as of special significance for the preparation of a second front in Europe chose to find confirmation in the remarks of General Marshall to United States forces in Northern Ireland. He said that a constant flow of United States troops would continue to reach the British Isles; that this would include air units which would be stationed all over the United Kingdom. A whole army corps, known as "Task Troops," had been trained in amphibious warfare, and would carry out raids, not necessarily only in Europe, such as those of the Commandos. The time for action, he said, was near. In this latter remark he was supported by Lord Beaverbrook in Washington who once more publicly urged Britain to establish a second front in the west so as to divide German armies.

The urgency of some action became increasingly clear during the month of May and has not been diminished by the course of the war since then. Early in that month, with a reported million and a half fresh troops concentrated in Southwestern Russia, the Germans launched their spring offensive. Their first major move was in the Crimea on May 8. This was countered by a Russian attack in the Kharkov area on May 12. But while the struggle about Kharkov swayed indecisively back and forth, the Germans increased the pressure and pace of their advance in the South. Once more there was sharp demand in Britain for a second front. In its eagerness for action the public failed, apparently, to reflect on the implications inherent in the Prime Minister's statement that the British expeditionary force which had attacked Madagascar on May 5 had been three months in preparation. What preparation would be necessary for a successful invasion of Europe the man in the street could not say, but to him the war was going badly. Russia was the only member of the United Nations who had a real fighting army in the field and the Churchill government was roundly criticised for its "defensive psychology". So sharp was this rise in public indignation and impatience that Sir Stafford Cripps saw fit to speak to the point at Bristol in the third week of May. "The whole country," he said, "feels that the long period of defensive operations is nearing its end and that the time is at hand when we must prepare ourselves to take the offensive." Later in the week, on May 20, he told the House of Commons that it was the War Cabinet's opinion that no price was too high to pay for the continued support "of the gallant Russians, even if it meant endangering part of our own territory, since it was protecting the vital heart of our resistance in Great Britain itself." He said that the heavy pounding of German industry was, in the Cabinet's view, the best way in which Britain could give assistance to Russia until such time as she would be able "to make a carefully planned attack on the continent of Europe which we intend to do."

The arrival in London during the following week of more ranking United States officers and the presence among them of Lieutenant General Henry H. Arnold, Chief of the Army Air Force, Rear Admiral John H. Towers, Chief of the Navy Bureau of Areonautics, and Lieutenant General Brehon B. Somervell, Chief of the Army's Service of Supply, — the arrival of these men seemed to constitute a significant earnest of the intentions to invade expressed by Sir Stafford, as also did General Marshall's statement to the graduating class at West Point: "Today we find American soldiers throughout the Pacific, in Burma, China, and India. They have flown over

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A letter from Pearl Harbor

A sailor at Pearl Harbor wrote us the letter below after reading a Southern Pacific advertisement, headlined "The Victory Trains come first," which appeared in Pacific Coast and Hawaiian newspapers. The letter was inspiring to us. We think its fine spirit will please you, too.

Mr. A. T. Mercier, President
Southern Pacific Company
San Francisco, California

Dear Mr. Mercier:

This place sounded like the Rose Bowl this afternoon when we saw your advertisement in the Honolulu papers. You see, people don't often forget the things they've grown up with, and a lot of us over here, from Klamath to Nacogdoches, have grown up with the Southern Pacific. So, when we saw your advertisement, it seemed as though a bit of the mainland had been brought over. But, since you're not over here, I suppose you'll find this a bit hard to understand.

This must sound like a very sentimental letter, but most of us in the Navy are sentimental people. Taking sentiment out of the Navy would be like taking the sentiment from the American Flag; you'd be left with a fifty-cent strip of dyed cotton.

I'm not writing this letter just for myself; I'm simply saying what a lot of the boys here said (and thought) when they read your advertisement. Sometimes we grin to ourselves when we hear the radio programs tell us what marvelous heroes we are. We're just doing our job, and we want everyone else to do theirs.*

Speeches are wonderful, but we like to see results as well as hear them. One airplane is better than a million speeches. So when we see that your railroad and scores of others are backing us up, we feel swell, because we know that the railroads of America are America.

So thanks again for that little bit of mainland on newsprint. We like to think that it's not just another advertisement, but, instead, a very sincere message. A message as friendly as the engineer who used to wave at us at the little country crossing, as kindly as the conductor who pinched our noses as he punched our tickets, as anxious to help as your company used to be when you arranged our football specials. And as determined as the big black engines we used to go down and watch.

So anyway, thanks awfully,

Jack Salem

Yeo. 3c., R/S Personnel Office,
Pearl Harbor, T. H.

Letters like this make us railroad people even more determined to keep 'em rolling. We promise Jack Salem and all the other men in our armed forces that the railroads will not let them down. We are doing and will continue to do the greatest job in our history.

A. T. MERCIER, *President*

S·P

The Friendly Southern Pacific

* One job we all can do is to buy War Bonds.

The Chemists' War on Disease

(Continued from page 9)

In this way antibodies to several simple antigens and, we believe, to various proteins like egg albumin have been prepared. They behave much like the natural antibodies in many respects. Since one of our goals is the preparation of synthetic antisera, Dr. Dan Campbell has started a series of experiments on synthetic antibodies to various bacteria. He has chosen to start on the pneumococci, which are relatively easy to work with and are at the same time very important in medicine. The synthetic antibody produced will be tested for its ability to actually protect mice against pneumonia in the same way that the natural pneumonia antiserum now in common use is tested before being distributed for use.

The possibility of making synthetic antisera for treatment of disease is something to stir one's imagination, especially under the urgent needs of war-time conditions. Making them naturally has always been a slow and involved process. It may be that we can make them quickly and in large quantities in the vats of a chemical works. Also the synthetic antibodies should be relatively free from the foreign substances that occasionally cause serum sickness when the use of present day antisera is not carefully controlled. It is not unlikely that certain infectious diseases which cannot be handled by the classical methods will succumb to the synthetic treatment.

There has been some question as to whether the particular type of antibodies with which we have been working, namely precipitins, which precipitates antigens in solution, are the same as the agglutinins which cause bacteria and other cells to clump, tbus helping to render them harmless. Dr. David Pressman has performed some interesting experiments to add strength to evidence obtained in other laboratories that there is no essential difference between them. First he tested Pauling's postulate that an antibody or other molecule capable of combining with two bacterial cells could cause agglutination. Using diazotized benzidine which can link with two protein molecules, he simulated the agglutination of red blood cells. Then he caused the precipitin for egg albumin to agglutinate red cells simply by first coating the cells with albumin. Other workers have performed the converse experiment, showing that the antibody which agglutinates pneumococci will also precipitate the material which coats the organisms.

Reference was made in the introduction to a study of the kinectics of immunological reactions at The Institute. Ordinarily the first step in such a study would be to get pure materials and select a clean cut reaction that gives products of known and constant composition. That is not possible in immunology. Antiserum contains the normal components of blood as well as the antibodies of interest. Probably the antibody molecules to a particular antigen are quite inhomogeneous. Some have only one complementary combining region and others two or more. The resulting precipitate has a variable composition. In spite of these difficulties Dr. Pauling has derived rather complicated expressions relating the composition and amount of precipitate with the concentrations of antibody and antigen, the equilibrium constant for their combination, and the effects of inhibiting agents. Dr. Pressman and assistants have been testing these expressions in a series of experiments involving thousands of analyses. A great simplification was introduced when it was discovered that relatively simple organic dyes of known structure and high purity could be used for the antigen. Experiments of this type add greatly to our knowledge of the manner in which antibodies combine with various antigens.

A still more direct attack on the structure of antibodies is to be made this winter with the use of a new electrophoresis apparatus which I constructed last year. It is still a matter of conjecture as to how many places on an antibody can combine with the antigen molecules. In these new experiments the antibody will be allowed to form soluble complexes with very simple antigens. When an electric current is passed through the mixture the antibody molecules will separate into distinct layers. With the new apparatus it will be possible to measure the amount of antibody in each layer and also to test the uniformity of any particular layer. The material in each layer can be collected for further experiments.

It should be mentioned that these experiments on antibodies probably have a much broader significance than just their relationship to immunity. In all living matter there is a great variety of highly specific reactions. Enzyme action, the fertilization of eggs, certain steps in cell division, allergy, and the synthesis of proteins are but a few examples. It seems likely that the type of bonds involving complementary structure which have been discussed in this paper play a leading role in many of these life processes. In view of the excellent progress in immunochemistry made at the Institute last year and the increasing interest being shown, important results should appear during the next year.

Western War Minerals

(Continued from page 6)

for all our needs are readily obtained as a by-product from nickel mining in Ontario.

The demand for radio-sending and detection devices of all types in this war has increased tremendously the need for quartz crystals, which are a vital part of many such units either as a frequency control, a crystal detector, or because of the piezoelectrical properties. Miscellaneous uses of strategic interest include range-finders, instruments measuring pressures or detonation in gun barrels or airplane engines, in depth sounding and direction finding apparatus, and for sundry precision instruments such as chronometers, seismographs, periscopes, gun-sights and polariscopes. These quartz crystals must be free from flaws of all types, twinning, impurities, intergrowths and fractures. Most of it occurs in igneous rocks or veins from which it only can be separated by explosives which fracture the quartz. Our supplies normally are obtained almost entirely from Brazil, where the quartz crystals are found in clays resulting from the long-continued weathering of igneous rocks. By this process the matrix around the quartz is decomposed and the quartz liberated.

Our imports increased from about 10 tons in 1936 to 63 tons in 1940. There are one or two deposits in California where optical quartz can be mined. Weathering conditions throughout the west however, have not favored the liberation of optical quartz from our existing deposits.

Tin finds its greatest use in the ever-present tin can, which consumes about 40 per cent of our normal consumption. Another 20 per cent goes into solder and the balance of the tin consumed is spread through a very wide range of uses, of which babbitt, bronze, collapsible tubes, tinning, chemicals, type metals, tin oxide, and so on, are all important uses. We normally consume about 75,000 tons of tin a year, or equivalent to somewhat more than 40 per cent of the world's production. Our normal production of tin from primary sources is 25 tons, or less, a year. There are no known tin deposits of economic importance within the United States.

Tungsten is one of the ferroalloy materials which, although we consume only about 7,000 tons a year, is absolutely vital to both peace and war activity. Tungsten is added to ferroalloys to improve their resistance to heat, fatigue, abrasion and corrosion; the largest and most important use is in the manufacture of high-speed tool steels which retain their hardness at red heat. Self-hardening steels are another important use and the recent development of tungsten carbide and powdered tungsten in cutting tools makes them a potential substitute in many uses for industrial diamonds. Although the use of tungsten filaments in electric lights is very widespread, it accounts for only about 1½ per cent of the annual consumption of tungsten. Our domestic tungsten production, all from the western States, has increased from about 2,500 tons in 1939 to over 5,000 tons in 1940, and the rate of increase is still accelating. The exploration of scheelite deposits has been greatly aided by the fluorescent lamp. With the recent development of two or three new and potentially large western producers, we may become self-sufficient in tungsten and continue so after the war.

Vanadium is another important ferro alloy metal of which we normally produce less than half of our consumption. In 1939 the apparent consumption of vanadium was somewhat over 2,000 tons, mainly in steel alloys of special types. In part, vanadium is used in high-speed tool steels, in carbon vanadium steel and similar special steels which are noted for their hardness, tensile strength and unusual toughness. Our domestic production is all obtained from Colorado and Utah and our imports come mainly from Peru.

Among the metals not on the strategic or critical list but which at the present time appear of great importance in the war activity and which are becoming increasingly scarce, one should mention copper, zinc, lead and magnesium. In all all of these it is not so much a case of a shortage in our raw materials but a bottleneck in our productive capacity coupled with the fact that our proposed uses are far in excess of anything within our past experience. The accompanying figures show the distribution of the western production of the first three of these vital metals. The production there portrayed accounts for about 90 per cent of our domestic copper, 50 per cent of our lead, and 35 per cent of our zinc.

FUTURE TRENDS

During the past few years exploration and development of our mineral deposits has been more active than at any period since tbe last war and possibly even more active than then. Despite this activity, aided by recent technological improvements, it must be realized that the discoveries of new deposits have been disappointingly few in number and in importance. Practically all of our production, both from current producers and from new deposits now being brought to production, is from deposits known during the last war.

It must be realized that the surface of our western states has been rather thoroughly examined during the past fifty years of mining activity. There are very few districts in which a mineralized deposit of substantial size could be located and which had not been examined by one or more competent mining men. We no longer have great geologically unexplored and unexploited areas. Future discoveries will mostly be made either as extensions of known ore bodies or will be discovered by use of sub-surface methods, either geological or geophysical.

Our consumption of metals is on such a large scale that discoveries of new reserves must be made frequently and ore bodies of substantial size must be developed if we are going to maintain our present rate of consumption. It is evident that we have not done this during the past 25 years and during this emergency every effort is being made to stimulate production at the expense of exploration. Our rich deposits are rapidly being depleted and only the low grade ores left to compete with foreign producers. We must look elsewhere for an increasing proportion of our mineral supplies and also expect to pay more for those produced domestically. The effects of this trend will become increasingly apparent and important to the Southwest when the present emergency is past.

Maps reproduced from "Metalliferous Deposits of the Eleven Western States", written by Horace J. Fraser, and published by the Industrial West Foundation.

England: 1942

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However, absence of bone presented a problem to the glue industry. A Mid-westerner in our group was much concerned that we had sent considerable quantities of dried beans with no instructions for cooking them. The result was a filling but not a tasty dish. This, he claimed, was ruining the market for these beans in Britain. We had also sent over considerable quantities of salt pork. This was sliced and sold as bacon. Fried salt pork is hardly eatable. This soon became known as American bacon, and most Britishers were convinced that all American bacon is saturated with salt. I tried to do some good by convincing as many people as possible to soak this product before cooking it. These are just two mistakes in a very large program. American beef is earning itself a very good name. Prem, Spam, etc., are becoming well-known names.

Of all things sent to Britain from America by individuals, I believe that the dried fruits were most appreciated. The British are greatly amused by our tea bags, but rather like the idea. Tea is not too scarce, and could be had in any household any hour and in most factories.

The three years of war and the raids, as well as the stoppage in production of non-essential goods, have caused a very great shortage in most goods and services. So many barbers have been called into the service that ten minutes is all the time that can be given for an individual hair-cut. There is, also, considerable unofficial rationing by merchants to their customers.

Britain, in general, has many misconceptions as to what America is like, and the way Americans live. Some of the information given to the public by popular British authors is not based on a real knowledge of America. Our motion-pictures are having a great effect on the British. There are many who hope to rebuild along the lines of American towns as portrayed in our films. Children of people with a dialect, hardly understandable, talk American movie slang.

Except for the very optimistic or pessimistic reports American news channels seem to be giving a fair view of the situation in England.

Utilities in the War: Communications

(Continued from page 15)

When the several emergency services reach the scene of an incident the senior official present may become the Incident Officer and coordinate activities, or the Control Center Chief may send an Incident Officer to the scene from the Control Center. He establishes a field headquarters and message center serving all the defense units, usually at the nearest telephone which can be used for communication with the Control Center.

OTHER ACTIVITIES

In connection with civilian defense it is of interest that the Bell Telephone Laboratories at the request of the National Defense Research Council developed a high-volume air raid siren which was described by authorities testing it as the first "real" siren they had heard tested.

In addition to providing arrangements for aircraft warning and civilian defense networks as outlined, networks for many additional essential services are provided. The experience gained in using these from day to day suggests many changes and one of the important duties of the telephone companies is to make these changes and improvements as quickly as possible after they are requested. This keeps many employees busy, frequently long after regular working hours.

Many plans have been placed in effect by the telephone companies in order to make small supplies of critical materials serve as many telephones as possible. One interesting material-saving device is the new method of joining the sheaths of lead-covered cable where the cable conductors are spliced. Using the old method, the Bell System required annually 2,500,000 pounds of solder of which 40 per cent was tin. The new Victory Joint makes possible a saving of 600,000 pounds of tin annually at the usual rate of use of solder. Another instance of material saving is a recent job in Southern California, where 157,200 pounds of copper were saved by replacing 600 miles of .165 inch copper wire with .104 inch copper wire. This made possible the addition of 39 long distance circuits.

One of the greatest emergency demands on the telephone companies is for service to Army and Navy training stations where the concentrations of young men away from their homes mean many telephone calls. To handle these calls the companies, cooperating with the military authorities, provide booths at many points throughout the training areas and at one or two locations in each area attended pay stations are installed. One pay station built on a trailer and providing five attended booths has been in use at a Southern California Air Base. It is recognized that telephone service aids in maintaining morale and the military authorities have worked with the companies in providing telephones for the use of the men. The conditions to be met by the telephone facilities at training stations are frequently severe because of the usual necessary location of the stations at considerable distance from telephone offices. This sometimes makes it impossible for the telephone companies with the limited materials now at hand to provide as good service as they would like to, but the best possible under the circumstances is provided and users, understanding present obstacles, generally accept this good-naturedly.

When communication specialists are needed, the telephone companies are naturally turned to. Since this country began preparation for war, many specialists have been requested for both military duty and civilian duties connected with the war. In all, over 15,000 Bell System employees have entered the armed forces.

Most of the foregoing discussion has dealt with services being rendered directly to the war and defense effort. The telephone companies must, of course, in addition to providing such services, carry on other services in such a way as to contribute a full part to the nation's welfare under war conditions. That this may be done employees have been organized and equipped to protect and restore service, and buildings have been placed under increased guard and have been provided, where necessary, with additional protective equipment.

Although it is not deemed judicious to publish information regarding many of the steps taken to maintain service, it is true that the telephone companies have taken every precaution to insure calls going through.

Acknowledgement is made to the Bell Telephone Magazine for the use of illustrations and material.

The Second Front and a Global War

(Continued from page 18)

Japan. They are landing in England, and they will land in France."

Then, in the first week of June, as if to make good Sir Stafford's statement about bombing, the R.A.F. hammered at strategic objectives in enemy territory with unprecedented intensity. On six nights between May 30 and June 6 they sent more than 7,000 planes over Nazi Europe and dropped thousands of tons of bombs, 3,000 tons on Cologne alone. These bombings constituted at least a partial reply to the Russian and public demand for a second front. And there was evidence that more ambitious undertakings were afoot to meet fully the popular demand and relieve the increasing pressure on Russia.

In the second week of June it was announced that Britain and the United States had signed pacts with Russia concerning the prosecution and conduct of the war and that these powers had reached a full understanding "with regard to the urgent tasks of creating a second front in Europe in 1942." This language still left in doubt the nature of this second front, but that it envisaged a land front was read into an announcement made in Washington and emanating from Mr. Churchill and President Roosevelt. This announcement stated that there was agreement among the United Nations on action to be taken to curb submarine warfare, aid China, and "divert German strength from the attack on Russia." This latter point was emphasized by the further announcement that Major General Dwight D. Eisenhower was placed in command of American forces in the "theater of European operations," which, it was pointed out, differed from the "theater of European training" already established in the British Isles, and that this general was already in London.

But time would pass and work would have to be done before these pacts and appointments could be translated into desired action. It was one thing to recognize the urgency of a task, and another to carry it out. Meanwhile Germany was pushing toward the Caucasus and the Near East in a great pincer's movement. The northern arm of the movement reached eastward across Southern Russia, the south arm stretched across North Africa toward Suez. On May 23, the Germans captured Kerch and so possessed themselves of an important springboard into the Caucasus. This advantage was made secure by the capture of Sebastopol on July 5 after more than eight months of seige. By the end of July they had driven eastward from the line Orel-Kharkov-Taganrog deep into the big bend of the Don river and had occupied Rostov, northern gateway to the Caucasus. By mid-August they had reached the foothills of the Caucasus mountains, including the oil fields of Maikop, and, while maintaining pressure in this area, were mounting a shattering offensive toward Stalingrad on the Volga. Before the month was out they were hammering at the gates of that city still unchecked.

The southern arm of the pincers had fared less well. Field Marshall Rommel attacked the Allied forces in North Africa on the night of May 26-7. In the early days of the operation, the Afrika Korps suffered reverses and setbacks. But during the first week of June they regained the initiative and from then on surged forward, escaping from what was reported to be one British trap after another, until on June 20-21 they captured Tobruk with a large proportion of its garrison. Pressing his advantage, Rommel moved on toward Suez and was within sixty miles of the naval base at Alexandria before he was checked in the first week of July and subsequently forced to fall back to the Qahara Depression. Since the middle of July there has been a lull in the desert fighting as each side exerted itself to accumulate superior strength for the test which would certainly come. Rommel enjoys the advantage of comparative proximity to his main source of supply, although in North Africa itself Rommel's lines of communication are longer and more vulnerable than those of his enemy. And, while the northern arm of the pincers threatens to encircle Stalingrad, reports from Ankara tell of the movement of men, supplies and equipment to reinforce Rommel's armies. That the United Nations anticipate continued German attempts to extend the reach of both arms of the pincers, — toward Astrakan and deeper into the Caucasus as well as toward Suez and Syria, — is reflected in the replacement of General Auchinleck by General Sir Harold Alexander, and by the division of the Near Eastern command into two parts: the one under General Alexander to comprise in broad terms North Africa and the new one under General Sir Henry Maitland Wilson to embrace Syria, Iraq and Iran, the all important landbridge connecting Europe, Africa and Asia.

For generations German military leaders have been specialists in planning and executing campaigns, the objective of which was the destruction of the enemy's field army. To appreciate this, it is sufficient to recall the Franco-Prussian War of 1870 and its battle of Sedan, the von Schlieffen plan which was so nearly carried out in 1914, and more recently the Polish Campaign of September, 1939, and that of northern France in early summer, 1940. The length of the Russian front, opened in June 1941, made difficult the application of this strategy to the entire Russian army, and attempts to apply it piecemeal were frustrated by the stubborn, resourceful resistance of the Russian soldier and by excellent Russian staff work which managed to keep the Russian front intact in the face of desperate enemy onslaughts.

Germany's present campaign in Russia, that of 1942, may well have as its ultimate and traditional objective the "annihilation" of Russia's armies. It would appear, however, that Germany is preparing for the *coup de grace* by operations whose immediate objective is to cut off Russian armies from their sources of indispensable supply. Hence the advances in southern Russia at enormous cost to occupy important industrial areas and cut off Russian access to Caucasian oil; hence the steady defense of positions in the Baltic area from which the lines from Moscow to Murmansk can be cut; hence the attack on shipping in the Atlantic and especially on the northern route to Murmansk and Archangel; hence the preparations to renew the drive toward Suez. Should this drive materialize and develop successfully, and should the thrust toward Stalingrad carry to the Caspian Sea, Russia would be cut off, not only from her own southern resources, but also from allied supplies now brought in through the Persian Gulf. The Germans may reasonably expect another two and a half months of good campaigning weather: (it was the end of November, 1941, before the tide of battle turned against them around Rostov), that is to say as much good weather ahead of them as they have enjoyed since their offensive began, and they are now (August 26) much closer to Astrakan on the Caspian than they were to Stalingrad three months ago. In view of these circumstances, one may well wonder what transpired during the recent visit of Mr. Churchill and his associates to Moscow. Surely it was decided there whether to bring immediate aid to Russia by sending more supplies over long and dangerous routes, or to do so by establishing soon a second land front in Europe.

Whatever decision was made in Moscow, it could not have been unrelated to United Nations successes against Japan. Beginning with the battle of the Coral Sea, through the battle of Midway Island, to the struggle in the Solomon Islands, the Japanese have suffered a series of tactical and strategic reverses. At the moment, the initiative which Japan has enjoyed in the Pacific seems in jeopardy. Contemporaneously, increased air assistance to China has aided her armies to seize the initiative from Japan on the Asiatic mainland. Do these setbacks at sea and in China mean that Japan is experiencing the harsh consequences of having overtaxed her strength? Or do they mean that she is concentrating for an attack on India or on Eastern Siberia or on both? It is reported that a strong Japanese army, based on Burma, is ready to attack India after the monsoon season, which will have passed in another two months. Against such a threat General Wavell has been building up his military strength during the summer. If military resistance to any Japanese attack on India were not undermined by political action within India itself, it is probable that a Japanese invasion force could be successfully repelled; but with the political situation what it is, the moral and psychological factors both of which are incalculable, the military authorities may have reason to doubt their capacity simultaneously to maintain order in India and hold off the foreign enemy.

A Japanese attack on the Russian Far East was reported as imminent more than four months ago, yet has not occurred. It was assumed that Russia had been obliged so to weaken her defenses in that area, in order to hold off the Germans in the fall of 1941—that the Japanese could attack with prospect of victory. The disposition and strength of Russia's armed forces is, naturally, a closely guarded secret, but there is reason to believe that one of the most effective deterrents to a Japanese attack on Siberia has been a healthy and legitimate respect for Russian strength in that area. Relations between Russia and Japan are still governed by the neutrality pact of April 13, 1941, valid for five years. In the twelve months that followed the signing of this pact, Russia was attacked by Japan's ally and Japan attacked Russia's ally. Despite the strain of these developments both signatories stuck to the letter of their agreement. The first anniversary of the pact was celebrated amid rumors of Japanese preparations for a stab in Russia's back, and Russia saw fit to give what was regarded as a warning to Japan. *Pravda,* official organ of the Russian Communist Party, wrote on April 13, 1942, that the pact "was a result of prolonged evolution of Japanese-Soviet relations, a result of realization of the plain truth that the U.S.S.R does not belong to those countries whose interests may be violated with impunity." It recognized that the spread of hostilities had subjected the pact to a "serious trial." That the pact may continue to exist, it continued, Japan would have to show "the same attitude toward treaties as that displayed by the Soviet Union . . . It is necessary that the Japanese military and Fascist cliques whose heads have been turned by military successes realize that their prattle about an annexationist war in the north may cause damage, in the first place and most of all, to Japan herself."

If this warning represented not only Russia's determination to fight if attacked by Japan, but also her capacity to resist, then her Far Eastern strength, together with the apparently increased strength of the Chinese armies and the offensive power of the United Nations in the Southwestern Pacific may combine to turn the tide of battle against Japan in her chosen areas of conflict. Such a favorable situation in the Far East would make practicable additional emphasis on measures to aid hard-pressed Russia, by direct shipment of supplies or by the establishing of a second land front in Western Europe, or by both. But the point is, that they who must make the decision regarding the establishment of a second land front in Europe will have to consider the undertaking in terms of the global war. It is not simply a matter of preparing for the invasion of Western Europe by at least 750,000 men carried in and equipped from a minimum of 4,500,000 tons of merchant shipping appropriately convoyed by sea and air, or of sustaining and enlarging that front once established; it is also a matter of how such preparation would affect the flow of men, ships, planes and material to the extended Japanese front and to the embattled Russians.

PLACEMENT REPORT

ALUMNI PLACEMENT ACTIVITIES 1942 - 1943

By DONALD S. CLARK, *Director of Placements*

The annual report of the Alumni Placement Service for the year beginning July 1, 1941, and ending June 30, 1942, has just been issued. It presents a much different picture than the reports of previous years. The "shoe is on the other foot," so to speak — there are more jobs than men to take them. During the year, 251 Tech alumni, including ex-students, and 223 individuals, who had completed ESMDT courses or who were sponsored by faculty, registered with the service. The office received 973 requests for men as compared with 399 during the year 1940-1941. A total of 41 Tech men were placed during this period. The accompanying table shows the nature of requests and the action taken on each. This table includes Tech men and others.

While 41 Tech men registered with the office as unemployed during the year, only five were listed as unemployed on June 30, 1942. One may say that this situation is unnecessary in times like these, but each individual case must be considered, before drawing any conclusions. In each case there are extenuating circumstances which account for the condition.

The function of the Placement Service in times like these in which technical men are scarce is to assist industry to find men of particular qualifications who can be most effective in the war effort. In this work it is very important not to contribute to shifting personnel from one war industry to another. Of course, men should be utilized to the fullest extent of their training and experience.

It may interest the alumni that 99.5% of the candidates for degrees on June 5, 1942, were placed by June 30, 1942. Practically this same percentage was placed even before commencement. This was an all-time high. Interviewing activities have already begun for the coming year. Industrial concerns are making arrangements to be on the campus early in the Fall.

The activities of the Alumni Placement Service have been extended to include all placement work connected with alumni, candidates for degrees and undergraduate students. Formerly part-time jobs were cleared through the Cal Tech Y.M.C.A. Now all of this work is handled in the placement office which means year-round service.

YEARLY PLACEMENTS 1937 TO 1942

	1942	1941	1940	1939	1938	1937
Ae.	0	1	0	0	0	2
Ch. & Ch.E.	6	9	3	13	7	11
C.E.	3	11	9	27	24	13
E.E.	7	14	25	23	9	17
Ma.	0	0	1	3	1	2
M.E.	10	21	18	21	19	19
Ph.	5	9	5	5	9	3
Misc.	1	1	1	0	0	39
Graduates	4	2	26	21	27	15
Students	159	55	31	42	26	22
Ex Students	3	3	8	7	10	9
Others	5	20	6	2	2	0
ESMDT	18	—	—	—	—	—
Total	222	150	140	166	146	152

REQUESTS AND PLACEMENTS

July 1, 1941 - June 30, 1942

	Requests	Men Notified Bet.	Men Notified Unemp.	Filled Bet.	Filled Unemp.
Aeronautics	17	22	—	3	—
Biology	3	1	—	—	—
Chemistry	68	33	24	2	1
Chemical Engineering and Applied Chemistry	89	62	13	1	1
Civil Engineering	76	28	9	1	—
Electrical Engineering	149	51	14	3	1
Geology	3	—	—	—	—
Mathematics	1	—	—	—	—
Mechanical Engineering	113	52	5	9	2
Physics	80	28	9	1	1
General	111	47	34	6	1
Geophysics	2	3	—	—	—
Sales	22	11	6	2	—
Teaching	67	5	5	—	—
Time and Motion Study	4	1	6	—	—
Drafting	60	17	2	2	—
Metallurgy	13	10	—	2	—
Miscellaneous Non Technical	1	—	—	—	—
Industrial Engineering	84	49	4	5	—
Tool Design	1	—	—	—	—
Patent Law	1	—	1	—	—
Meteorolgy	1	—	1	—	—
Meteorolgy	1	—	1	—	1
Office	5	1	—	—	—
Women	2	2	—	—	1
Totals	973	423	133	37	9
Grand Totals		556		46	

REQUESTS FOR TEACHERS

Aeronautics	10	Science	2
Civil Engineering	3	Chemical Engineering	2
Electrical Engineering	1	Meteorolgy	1
General	20	Metallurgy	1
Mathematics	13	Geology	1
Mechanical Engineering	6		—
Physics	7		67

THE NAVY NEEDS ENGINEERS

(*Official Release, U. S. Navy*)

The Navy needs men whose engineering training and experience can be carried directly into the Service for work very similar to that which they are now doing. It also needs men whose engineering background gives promise that they can readily learn duties which are peculiar to the Navy. To candidates qualifying, the Navy offers compensation varying from $216 a month to $416 a month. Most officers who have been commissioned in recent months have accepted a definite reduction in income, finding their chief compensation in the fact that they are serving their country to their highest ability.

Before considering the various specific fields in which the Navy needs officers it might be well to point out that engineering training coupled with executive experience is sufficient in itself in many cases to qualify an individual for a commission, and also to indicate that hobbies such as an interest in aviation, practical experience in photography, knowledge of navigation, and many others will oftentimes make a man valuable to the Service.

Turning now to the specific fields of Naval activity in which engineers are being commissioned, the first is the classification which includes nearly all phases of aviation from aeronautical engineering through airport managers, meteorologists, pilots, and ground school instructors to men whose executive experience qualifies them for administrative positions in the ground organization. Men with engineering degrees who have had experience in any of these fields are, in most cases, eligible to make application. In addition, fliers and men having an expert knowledge of firearms may often apply even if they have not completed their formal education.

The Communications Classification offers commissions to men who are qualified in any form of communication operation such as radio, telegraph, telephone, underwater sound, various forms of visual signalling, traffic, cable operation, etc. Any engineering degree is acceptable. Men who have made a study or a hobby of cryptanalysis have an excellent chance of being accepted by the Navy.

The ship construction officers in the Navy are drawn almost entirely from men possessing a degree in Naval architecture but other engineers and architects who have had practical experience in shipyard work will also be considered.

The Civil Engineers Corps of the Navy covers a much wider range of activities than its name would imply. It designs and constructs docks, dry docks, railroads, air fields, hospitals, radio installations, and nearly all other structures used by the Navy with the exception of ships and ordnance. The primary need at this time is for civil engineering graduates who have had at least three years of practical experience but there are opportunities also for electrical, mechanical and architectural engineers.

Instructors of midshipmen are also needed. These men should be graduate engineers who have had experience as instructors in physics, chemistry, or Diesel, electrical, mechanical and radio engineering. A few mathematics instructors are also desired.

The most desirable background for the classification of security officers is considered to be an engineering degree and practical experience in the field of fire prevention. Men with related lines of experience, for example along the line of industrial plant inspection, are also eligible for commissions as security officers.

It goes without saying that engineers who have had practical experience in the operation of ship's machinery are very much in demand. The rank which they are given is dependent upon their age, their years of practical experience and the size of the vessels on which they have served. Engineers who are familiar with boilers, turbines, sound engineering, fuel oils, testing and welding, can often be used either in the field in which they have specialized or else, after a brief training period, in related types of engineering activity. Principal emphasis is on mechanical, electrical and Diesel engineering graduates but other engineering degrees are not overlooked. Men under thirty-five years of age are desired for this class.

Chemists and chemical engineers, especially those who have had some experience with explosives are commissioned in the Ordnance Bureau but they are being accepted only in limited numbers at the present time.

There is a very urgent need for men who can be trained to handle the Navy's ultra-high-frequency detection equipment. This program carries with it commissions in any one of a number of the specialized departments in the Navy and involves a training period three or four months in duration after the commission has been issued. Men having a degree in electrical, radio, or communications engineering are well qualified for this work, but men who have an engineering degree of any sort and some practical experience in radio and electrical work should have little difficulty in mastering the subject, and men who have not completed college or who perhaps have had no college training at all may, by virtue of extensive practical experience in the field of electricity or radio, be highly desirable candidates. In selecting this group the emphasis is placed on men who have built their own equipment or done other original work rather than upon those who have performed purely routine operations.

This brief outline covers the needs of the Navy at the present time. Quotas and requirements change, and any individual who is interested in placing his engineering training and experience at the service of his country may obtain more detailed information at the nearest office or branch office of the Director of Naval Officer Procurement of his particular Naval District. The Office of the Director for the Eleventh Naval District is located in Los Angeles at 850 Lilac Terrace, just south of the tunnels on North Figueroa Street. Branch offices are located in the Bank of America Building, San Diego; Heard Building, Phoenix, Arizona; and the Stadium Building, University of New Mexico, Albuquerque, New Mexico.

THE ARMY NEEDS ENGINEERS

(*Official Information, U. S. Army*)

It is noted that one of the recent developments of the Army calls for a considerable number of trained engineers and men learned in scientific fields.

The usual method provided for obtaining the services of these men, is through the adapted method of enlistment. Classification is made immediately following enlistment and any applicant who holds a degree can, when he finishes a course in basic training, be sent to the appropriate school for further training which eventually leads to a commision in the Army. However, maintenance and repair of the physical plant at all Army Posts is the responsibility of the Corps of Engineers. Due to the expansion in troop housing, the Army is in need of some 500 engineers with experience in road building, repair and maintenance of buildings, water supply, sewerage disposal, operation and maintenance of steam plants, domestic heating, or operation and maintenance of electric systems.

The engineers selected for organizing and directing the utilities duties outlined above will be commissioned as captains, first lieutenants or 2nd lieutenants in the Army of the United States, or in the Army Specialist Corps as Post Utilities Officers. As Post Utilities Officers and Assistant-Post Utilities Officers, they will direct the work of a staff of civilian engineers and operating personnel or of technical service troops at Army Posts.

The Office of the Chief of Engineers, War Department, Washington, D. C., will be glad to receive applications from qualified individuals. The name, address, age, principal field of education and experience record should be supplied. On receipt of this information, interviews will be arranged at convenient locations throughout the country. Engineers selected for commissions will be ordered to Washington, D. C., for two weeks' training before assignment to an Army Post.

Book *Review*

STORM
By George R. Stewart
(Random House, 1941—$2.50)
Book review by Paul E. Ruch, Instructor in Synoptic Meteorology

George R. Stewart's novel *Storm* might be the story of the New England hurricane of 1938 or any other devastating weather occurence, for the entire plot is based on the sequence of events accompanying or caused by intense cyclonic activity. Newspaper and radio accounts of the occurence of severe storms normally convey mater-of-fact information pertaining to destruction and damage, but in this book the experiences of many persons form an exciting and extremely interesting narrative.

Professional meteorologists could offer little criticism of the technical details of the author's presentation of the storm development. Obviously Stewart has spent considerable time in weather offices with the result that his account of the storm's formation, structure, and subsequent meteorological effects are technically correct. This is particularly refreshing after witnessing numerous motion picture presentations of airline or military aircraft operations that are far from even approximating actual conditions. Any engineer or scientist, although not directly associated with meteorology, could accept the author's presentation of the storm's activity as correct. Every meteorological feature of the storm is possible and certainly has occurred many times. No doubt some criticism has been made of *Storm* by those who are unfamiliar with weather developments as they are seen by the meteorologist, the airline dispatcher and pilot, the division superintendent of a state highway department, and others whose daily activities are basically dependent upon the weather. However, such criticism is not based on a true appreciation of fact.

Although the story centers around the activities of a violent weather disturbance on the west coast of the United States, the incipient storm is first discovered off the east coast of Asia by the junior meteorologist in the Bay Region office of the United States Weather Bureau as he constructs the synoptic weather chart. This new storm the junior meteorologist named Maria, as it was his custom to personalize each new storm appearing on the weather chart. As the storms moves eastward across the Pacific it intensifies, and finally, on reaching the mainland, brings to an end a month-long drought. The effect of the storm on the lives of thousands of persons is shown in detail. Entirely unrelated incidents are commonly affected by wind and rain. Highways are flooded, dams threatened, air transportation periled, and a train wreck narrowly averted. Rain in the coastal areas turns to a blizzard of snow over the Sierras. Through the whole story of the development of this one storm and the destruction it wrought Stewart has interwoven accounts of many different human activities. In each is a sharp climax.

For light reading with interest guaranteed, *Storm* is to be highly recommended.

From the Big T, 1942

CHAPTER NEWS

SAN FRANCISCO

The third annual Sports Day and Supper of the San Francisco Chapter of the Alumni Association was held at the home of Mr. and Mrs. Howard Vesper, on May 22nd. The Vesper home, "Cactus Rock" is situated in the hills of Oakland, and looks out upon a sweeping view of San Francisco Bay and San Francisco. While the ladies were enjoying the view, the game room, and the grounds, the "Early" and "Late" grads reluctantly left the comfortable chairs in the patio for the annual soft-ball game. The "Early" grads scored a winning game for the first time in three years.

A fine supper was served in the patio, and later the group gathered in the house for a "sing" with Mrs. Vesper at the piano. Howard showed some fine colored pictures taken on his trip to Hawaii last fall. As there were many camera enthusiasts present, a lively discussion took place. The party ended with a marshmallow toast at the outdoor fireplace. A group of fifty-two attended the party, and all agreed that the annual trip to Cactus Rock is a grand idea.

Louis Erb, the outgoing president, gave the report of the nominating committee, and the following officers were elected for the year 1942:

Donald F. Merrell, '24, President;
Elmer H. Fisher, '27, Vice-President;
Alex J. Hazzard, '30, Secretary-Treasurer.

Congratulations were extended to Louis Erb for his fine work last year.

An invitation is extended to any Caltech alumni who may come to the bay region to attend the luncheon held each Monday at twelve o'clock in the Fraternity Club Dining Room at the Palace Hotel, San Francisco.

NEW YORK CHAPTER

The annual meeting of the New York Chapter was held Friday, June 5. Harry St. Clair showed some color movies which he had made during his vacation travels, and several recordings made at the Annual Seminar in Pasadena were played. The following officers were elected for the coming year:

President, Chester Carlson;
Vice-President, James Davies;
Secretary-Treasurer, Lawrence Ferguson;
Director for two years, Charles Elmendorf;
Director for one year, Robert Custer.

A new Secretary-Treasurer will be elected, because Larry Ferguson received his commission as Lieutenant in the Navy.

During the past winter the club held two of the most successful meetings of its history, one at which Professor Gilbert spoke, and the other with Professor Royal W. Sorensen as speaker. Both meetings had a turnout of around fifty people, including Tech men and their wives.

Bev Frendendall, the past president, returned recently to New York after a year in Chicago where he was engaged in installing new studio equipment for the National Broadcasting Company.

BOARD OF DIRECTORS 1942-43
Alumni Association
California Institute of Technology

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. . . . . . OF INTEREST

WAR TIME ATHLETIC PROGRAM AT TECH

A thorough revision of the California Institute's athletic program to meet the special needs of war time has been announced by Institute authorities. Professor R. W. Sorensen, Chairman of the Division of Physical Education, stated that changes in the program are emergency measures, set up only for the school year of 1942-43, and subject to revision later as changing conditions may require.

Faculty discussions which led to recommendations for revision stressed the point that an adequate physical education program at the present time should provide the maximum benefit for the maximum number of students. As Professor Sorensen pointed out, "The Army and Navy have repeatedly urged the necessity of bringing the young men of the United States to the peak of physical fitness. These pronouncements emphasize the needs of the armed services. But young men who are preparing themselves for the battle of production, charged with the grave responsibility of increased industrial output for mechanized war, have an equally great need of getting themselves into the best possible physical condition. We must do everything we can to make sure that our students, whether they go into the armed services or into industry, will be physically fit to sustain their part in the national war effort."

To secure this result, the Institute's revised athletic program will place increased emphasis on intramural games and will include a greater variety of sports in intramural competition. The Faculty has approved revision of class schedules so that more and better time will be available for exercise and competitive sport. So that this general program can be carried out effectively by including every student, the Institute plans to add to its physical education facilities. The physical education staff will be enlarged so that supervision and coaching can be provided for the beginners in a variety of sports as well as for the men who are first or second team material; and where remedial exercise is needed, it will be carried on regularly under competent guidance.

Another important consideration in modifying the athletic program was the desire to follow official recommendations for civilian conduct in cooperation with the national war and defense effort. The two recommendations which most directly affect college athletic programs are those which urge the conservation of tires by every possible means, and the avoidance of any occasions for the congregation of crowds. As the intercollegiate football can hardly be reconciled with either of these, Tech's fall schedule of intercollegiate football games has been cancelled. Other intercollegiate sports remain on the calendar, but they will be carried on only in so far as they do not run counter to defense requirements.

Dr. Robert A. Millikan, in commenting on the revised athletic program, declared, "This is an experiment. The Institute is committed to it only for the next school year. Later we may find that we'll want to go back to our former procedure. But for the present, a physical education program designed to include effectively every student on the campus, and to function in the main on the campus, is the only sensible kind of program to adopt."

SUMMER COURSES, 1942

During the summer of 1942 the California Institute scheduled five full-time courses. These were all planned to supply trained personnel for various requirements of the national war program, and all were organized as a part of the Engineering, Science and Management Defense Training authorized by the United States Office of Education.

The courses given were Aeronautical Engineering, supervised by Professor Clark B. Millikan; Ultra-High Frequency Techniques, supervised by Professors R. W. Sorensen and W. H. Pickering; Basic Electric Circuits and Machinery, supervised by Professors R. W. Sorensen and F. W. Maxstadt; Aircraft Drafting, supervised by Professor H. N. Tyson; and Topographical Map Drafting, supervised by Professor W. W. Michael.

The great majority of the students in Aernonautical Engineering were Navy officers assigned to take this work at the Institute in preparation for duty as maintenance, service, and supply officers at naval air installations. Similarly, the class in Ultra-High Frequency Techniques was composed mainly of Army and Navy officers sent to the Institute for training in this field.

The two courses in drafting occasioned a good deal of comment, since they were misinterpreted as representing a change in Institute policy. Both courses were given mainly for women students, since there is an increasing demand for women trained in both map and aircraft drafting. A good many people assumed that the Institute was admitting women to its regular courses. As a result, letters began to come in. One group of writers protested violently against this breach of ancient tradition. Another group congratulated Institute authorities on finally abandoning their anti-feminist discrimination and prejudice.

To quiet any possible apprehensions on the part of alumni, it should be understood that women students were admitted only to these two special summer courses; that these courses were given as part of the ESMDT program, and do not carry Institute credit; and that when the Fall term opens, ancient tradition or anti-feminist discrimination and prejudice—as you like—will continue as before.

BRIDGE EXPERT IN LATIN-AMERICA

Neff E. Vasquez, '20, bridge and highway engineer with the Los Angeles County Road Department for 22 years, left recently for Central America to work on the Pan-American Highway. His knowledge of the Spanish language and customs of the Latin American people, and his brilliant record as an engineer, make Mr. Vasquez an excellent man for this job. Heading an advance guard of engineers, he will take the party into Mexico, as well as Central America.

One of Mr. Vasquez's outstanding feats during his career with the County Road Department was the construction of the spectacular Armstrong bridge on the Angeles Forest Highway. He had charge of excavations for the bridge and directed preliminary work for the footings when it was necessary to lead a crew of prison labor over a precipitous mountain trail. Later a tunnel was cut through the mountain and the highway pushed through to the bridge site. Mr. Vasquez remained as bridge engineer until the job was completed.

Mr. Vasquez has been active during the past year and a half in the County Road Department's fore-sighted plan of redesigning its structures for the use of wood, rather than steel. The Department will be ready to launch a large work program on this basis when the war is over and scarcity of steel will make use of woods imperative.

The annual Stag and Field Day was held Saturday, June 27th, at the Southern California Golf and Country Club in Monterey Park. The attendance was excellent, considering the fact that many of the alumni are in the armed forces and are stationed far away from the Southern California area, and many others are busily engaged in the war effort.

CHINESE SCHOLARS UNITED IN MARRIAGE

Dr. Chia Liu Yuan, research fellow at the California Institute of Technology, was married in June to Miss Chien-Shiung Wu, in the gardens of Dr. Robert A. Millikan. Mrs. Yuan, who also holds a Ph.D. degree, is the daughter of one of the chief engineers for the Burma Road. Dr. Yuan is the grandson of Yuan Shih-Kai, China's first President in 1911.

In the absence of the bride's parents, Dr. and Mrs. Millikan made all wedding arrangements and served as sponsors for the bride and bridegroom, in keeping with a Chinese custom. Dr. Millikan escorted the bride to the garden altar, and Dr. Yuan was accompanied by Mrs. Millikan.

Guayule, lately in the news as a possible solution to the rubber shortage, was dramatized by experts on the "Unlimited Horizons" program. This program was produced by N.B.C. with the co-operation of the California Institute of Technology, and revealed some of the latest developments and possibilites of guayule rubber.

PREHISTORIC ANIMALS BEING RESTORED AT CALTECH

Restoration of prehistoric animals is now underway at Caltech. William Otto, distinguished sculptor, has just completed restoration of a 100,000 year old capromeryx and a stockoceras, antelope of the pleistocene age. The stockoceras was named in honor of Dr. Chester Stock, eminent Caltech paleontologist, by Dr. Childs Frick, noted savant of the American Museum of Natural History, New York City. The remains of this animal was discovered in an ancient cave in Mexico. These Otto restorations will be used for classroom work, exhibition purposes, and for exchange with institutes and museums.

Dr. Linus Pauling was elected president of the Pacific Division of the American Association for the Advancement of Science at the annual convention in Salt Lake City. Dr. Pauling was described as "the outstanding theoretical chemist in the United States, and probably in the world."

The Class of 1942 presented the school with a new bulletin board to replace the old blackboard in Throop Hall.

The character, Mrs. Day Adams Morganstierne, mentioned in Leland Stowe's book "No Other Road to Freedom," is the wife of Calla Morgenstierne, '33. At the time of the invasion, Calla's father was the Norwegian representative in Washington, D. C.

Donald O'Melveny, treasurer of the California Institute of Technology Associates since its organization, died on August 28th following an illness of several months.

Mr. Frederick W. Williamson, a member of the California Institute of Technology Associates, passed away suddenly in July, after being stricken by a heart attack while in his Los Angeles office.

Mrs. James E. Bell, wife of James E. Bell, Professor of Chemistry at the California Institute of Technology, passed away in July.

Professor Royal W. Sorensen has been appointed to the engineering division of the National Research Council for a three year term. The appointment was made by Dr. F. B. Jewett, president of the council, and former president of the Bell Telephone Laboratories, Inc.

NEWS OF CLASSES

One of the greatest services which the Alumni Association may render is keeping old friends and acquaintances in touch with one another. The constant address changes of men in industry and the armed services causes difficulty in maintaining the records of the alumni office and in publishing correct news items about alumni, unless the Association is kept informed of these matters. Please let the alumni office know when you change your address, or, if that is not practicable, give us a permanent address through which you may always be reached.

Editor.

1918

Frank Capra has been promoted from Major to Lieutenant Colonel in the U. S. Army Signal Corps.

1921

Major Smith Lee stopped over in Los Angeles recently on his way to Salt Lake. He wishes to be remembered to all the "gang."

1922

Major Glen M. Webster paid a visit to former haunts at the Southern California Telephone Company on his way back to Corvallis, Oregon, where he commands the R.O.T.C. Glen has been east on a special training assignment for the summer.

1923

C. R. Owens has been appointed as Welding Specialist of the G. E. Pacific District. Mr. Owens has been with General Electric since graduation from Tech.

Loren E. Blakeley is now one of the Regional Waterworks Advisors with the State Board of Health in San Diego.

1924

Fred Groat recently entertained several Tech people at his home in Washington, D. C., including Major Larry Lynn, '29, and Captain Jean E. Joujon-Rouche, '28, both of whom are stationed at Fort Belvoir, Virginia.

Major W. Lawrence Hall is at Fort Hustus, Virginia, following a year with the Air Corps at Phoenix.

The offices of the Waugh Laboratory are now located in Pasadena under the supervision of **Emmett Irwin.**

1925

John Templeton, who was personnel director for Basic Magnesium at Las Vegas, is now in business for himself in Los Angeles.

Major Michael Brunner is with the Air Force in San Francisco.

1927

Mortimer Dick Darling is a Captain, U. S. A., stationed at Camp Haan, California.

Max Bower is now in the office of the Chief Signal Officer, General Development Branch, Material Division, at Washington, D. C. He is assistant officer in charge of the Wire Communication Development Section and finds the work very interesting.

Thurman Peterson is working for the Navy Department in Seattle.

Wayne Rodgers, Captain, U. S. Army, and **Bob Ross,** Lieutenant, U. S. Army, are roommates again, as they were in 1926-27. Wayne is assigned to the War Department General Staff in Washington, and Bob is in charge of some important personnel work. Bob recently visited the west coast.

1928

Joseph B. Ficklen has been serving as Consultant in Occupational Diseases for the City of Los Angeles Health Department and as Special Health Officer for the County of Los Angeles.

Moe W. Gerwertz is now a lieutenant in the U. S. Marine Corps.

Lt. Guy Chilberg has been with the Signal Corps at Fort Monmouth.

1929

Don Livingston was a visitor in Southern California the latter part of June, from New York City.

Captain Walter B. Grimes, stationed at Fort Belvoir, Virginia, since November, 1940, is director of the Mechanical Section, which consists of courses in mechanical equipment, welding, engine maintenance, water purification, searchlight repair and other allied subjects.

Captain Allen W. Dunn, stationed at Camp Claiborne, Louisiana, is now back in circulation again following a month spent in the station hospital with a case of yellow jaundice.

1930

Fred R. Groch has been appointed assistant to the vice-president of the Portland General Electric Company. He has been associated with electric utilities in California and Oregon since 1924, joining the Portland General Electric Company in 1940 as a statistical analyst.

1931

Aubrey Horn is the father of a girl, born July 11th.

Lt. Perry M. Boothe is now on duty with the Navy at Hartford, Connecticut, and is now making his home in that city since the arrival of his family early in August.

William F. Arndt is with the U. S. Navy Underwater Sound Laboratory at New London, Conn.

1932

Alvin J. Tickner has been appointed physicist in the Naval Ordnance Laboratory in Washington, D. C. For seven years after leaving Caltech, he was sound engineer at the M-G-M Studios, and more recently has served at the Walt Disney Studios as sound engineer, resigning that position to accept the call to government service. Mr. Tickner was married last December to Miss Rose L. Barkell of Hollywood.

Dr. Charles D. Coryell is now at the Metallurgical Laboratory of the University of Chicago.

Emmer J. Arnold recently became process engineer at North American Aviation, Inc. Emmer has two boys, two and four years of age.

Gordon E. Bowler has received the commision of Lieutenant, U.S.N.R.

Paul G. Parsons is in the engineering department of Vega Aircraft Corp.

Lieutenant William F. Schultz is battery executive and plans and training officer at Camp Callan.

Mr. and Mrs. John V. Chambers became the parents of a son, John Christopher, born May 16.

1933

Kenneth Warren is now working at the Filtrol Corporation in Los Angeles.

Robert R. Mead, who has been employed as an engineer for the Ethyl Corporation in the six northwestern states, was called into service recently at Fort Lewis, Washington. He is now stationed at Fort Douglas, Salt Lake City.

Fred H. Detmers is now with the U. S. Signal Corps in Missouri. He was enrolled in the ultra-high-frequency course at Tech, but responded to the call for service before completing it.

J. Stanley Keenan is a layout inspector for the Santa Monica plant of the Douglas Aircraft Company.

1934

The engagement of Miss Anne Morris and **David E. Cook** was announced in June. Lt. Cook is with the United States Signal Corps at Fort Monmouth, N. J.

George Van Osdol is a lieutenant (j. g.) in the U.S.N.R.

Duncan L. Hooper is now living at Port Arthur, Texas.

1935

Lt. (j. g.) Frederick Pehoushek has been stationed at the Navy Department Bureau of Ordnance since last June.

Mr. and Mrs. **Milo C. Kechum** are the parents of a girl, born June 24th in Pasadena.

Dr. Bert Ribner is an aerodynamicist for the N.A.C.A., Langley Field, Virginia.

Lt. Arthur Engelder is stationed at Camp Carson, Colorado.

An early summer wedding united Miss Dorothy Moore of Pasadena, and **James H. Jennison.** Among the ushers was **Robert L. Jones,** '36.

Henry W. Stoll, his wife and twin sons spent three weeks during August on the west coast. Mr. Stoll is with the Taylor Instrument Company at Rochester, N. Y.

N. L. Hallanger has been transferred back to the mainland temporarily by Pan American Airways, for whom he has been working in Honolulu.

Allan R. Scoville was transferred from the Lynn, Mass., factory of General Electric to the Cincinnati District Office of the same company last October.

John Ritter is now a lieutenant (j. g.) in the Navy.

1936

Stuart R. Ferguson and Betty Barnard White were married on June 20 in Beverly Hills. Mr. Ferguson is a production engineer at Vega.

Clarence F. Goodheart is now a member of the Tech contingent in Washington, D. C., working at the Naval Ordnance Laboratory.

Robert L. Jones is working as assistant project engineer for the contractors for the Santa Fe Dam.

Paul F. Jones is with the U. S. Engineers in foreign service.

Dale H. Van Riper and Miss Dorothy Cruse of Los Angeles were married last June. Mr. Van Riper is executive engineer at North Western Airplane factory in Inglewood.

Raymond H. F. Boothe, Ensign, U.S. N.R., is with the naval air forces in foreign service.

Hugo Meneghelli is an office engineer with the U.S.E.D. in San Jose, Costa Rica, working on the Inter-American Highway Survey.

Meral Hinshaw is now works manager for the Felker Manufacturing Company in Torrance.

1937

The wedding of **J. Ridgely Leggett** and Miss Betty Bailey of Sacramento took place on June 27th.

Boyd R. Hopkins is now with the Magnaflux Corp. in the Los Angeles office.

Claude B. Nolte recently accepted a position as design engineer with the Fluor Corporation, Los Angeles.

Lt. Hugh M. Gilmore, Jr. recently received his commission after attending Officer Candidate School at Camp Davis, N. C.

Robert D. Townsend, Jr., Ensign, U.S. N.R., was married last May to Miss Shirley Phyllis Smith, in San Diego.

Dr. Stanford W. Briggs is now with Merck and Company at Rahway, New Jersey.

Bruce Morgan is foreman in the electric shop of the Seattle-Tacoma Shipbuilding Corporation.

1938

Arthur C. Downing recently accepted a position with the General Electric Company in Ontario, California.

Recently commissioned, **Fred Llewellyn,** Ensign, U.S.N.R., is stationed at Boston for the present.

L. Bruce Kelly, who has been working in the engineering department of Byron Jackson, was called for active duty in the U. S. Naval Air Service. He is now teaching Radio Theory and Navigation at one of the distant air bases.

C. Norman Scully is now a captain in the U. S. Marine Corps.

Jack Johannessen recently was promoted to the position of design engineer for the Imperial Irrigation District, with headquarters at El Centro, California.

Russell Hayward is stationed at Bellows Field, Hawaii.

Robert J. Barry is now living at 5022 245th Street, Douglaston, Long Island, New York.

Michel Ambroff is now an engineer with the Pacific Railway Equipment Company in Los Angeles.

The wedding of **Frank B. Jewett, Jr.,** and Edar von Lengerke is to take place in Washington, D. C., on September 5.

William Twiss is president of the Twiss Heat Treating Company, formed around the first of the year.

1939

Late in June, **David E. Hoyt** and Miss Barbara Butz were married at St. Elizabeth's Church in Altadena. **Kenneth Bragg** acted as best man, and **Marcus Hall** and **Henry Goodin** were ushers. The Hoyts are now making their home in Westwood.

Charles Carstephen, who is working in the Production Division of the Puget Sound Navy Yard at Bremerton, Washington, recently was promoted to the rank of lieutenant (j.g.).

Carl Paul has been placed in the tank engine development division of Caterpillar Tractor and is working on various production phases for their new southern Illinois plant.

Fred Hoff was married June 14 to Miss Eleanor R. Hettinger of Freeport, Illinois. Fred is assistant engineer for Loading Plant Development atSavanna Ordnance Depot.

William M. Green is now a second lieutenant in the Army Air Force.

Frank McCreery is the father of a girl born early in June.

Dr. Edgar L. Armi is now with the Physics Department, Alabama Polytechnic Institute, at Auburn.

Harry Davis married Miss Constance Curtis on June 20. He is employed at Vega.

Ray V. D. Gerhardt and **Bert Roudebush** came to southern California for a vacation in July. They still prefer California, but find their work at Port Arthur, Texas, most interesting.

Lt. Paul Engelder has seen foreign service with the U. S. Marine Corps.

William R. Frampton has left the United States with one of the foreign contingents of the Douglas Aircraft Company.

Albert P. Green is working for the Aircraft Section of the Naval Research Laboratory at Washington, D. C.

Kenneth Bragg is working in the engineering department of the El Segundo Plant of Douglas Aircraft.

Roderick McClung was married March 16 to Miss Lorraine Bilhorn of Savanna, Illinois. Rod is in the engineering division at the Savanna Ordnance Depot.

1940

Alexander Brewer is now with the Sperry Gyroscope Company at Garden City, New York.

Kit and **Chuck Payne** have sent out blue ribbons imprinted as follows: "Our First Prize — Stephen Charles, 6 lbs., 8 ozs., June 13, 1942."

Robert B. Glassco left the employment of Lockheed Aircraft last September to go to Cornell University on a scholarship. He obtained the degree of M.S. in engineering in May, and is now back at Lockheed as a research engineer.

James M. Watkins, Jr., was married in April to Miss Betty Emerson of Altadena, and is now in Washington, D. C., as ensign with the Naval Reserve Ordnance Office.

Al Guillen is the father of a daughter, Nancy Ann, born in May. He is now in foreign service for the Air Corps.

George Todd, Ensign, U.S.N.R., is now stationed at one of the east coast shipyards. He was married July 18 at Warrenton, N. C., to Miss Laura Pettway Ellis. They are making their home in New Jersey.

Donald Kupfer worked this summer as a ranger-naturalist at Mesa Verde National Park. He received his M.A. in geology from U.C.L.A. in June, and will start work for his Ph.D. at Columbia this month.

David Varnes is working for U.S.G.S. at Ophir, Colorado.

Gordon Weir, Lieutenant, U.S.A., has been teaching meteorology at Stockton Field. California.

Robert Ray came to California in July with Ray Gerhardt and Bert Roudebush. He is working in Galveston, Texas.

Howard Baller will attend the conference of teachers in ultra-high-frequency technique to be held at M.I.T. August 31 to September 6.

Lieutenant (j.g.) Charles C. Wilbur, who is in the submarine service, recently visited family and friends in Pasadena.

1941

C. Victor Sturdevant III and his bride, the former Miss Margaret Louise Keith, are now making their home in Santa Monica. They were married August 15.

John D. Spikes and Miss Elizabeth A. Dorland were married in July. They will reside in Ojai, where Mr. Spikes is employed in the high school.

Frank R. Hicks is now employed at the Cherry Rivet Company, Burbank, as a metallurgist.

Al Schaff was married August 21 to Miss Cecile Mary Booker in Lima, Peru. Al is now superintendent of maintenatnce of Aero Boliviano.

Quentin Elliott recently started work as a research engineer for the Texas Company at Port Arthur, Texas.

Homer Jacobson worked at the American Potash and Chemical Company, Trona, this summer.

Joe Rominger worked for the U.S.G.S. at Teluride, Colorado, this summer, but will return to Northwestern University this fall.

Grant Ewald is working at the West Virginia Ordnance Works. He is living in Gallipolis, Ohio.

Robert F. Myers, former president of the student body and captain of the basketball team, was married in June to Miss Mary Jane Myler of Manhattan Beach.

1942

The engagement of Miss Margery Martin to **Fred M. Ashbrook** was announced this summer. Mr. Ashbrook is research assistant at the Massachusetts Institute of Technology.

Roy C. Van Orden and Betty Margaret Wagner will be married sometime in September. Mr. Van Orden is employed by Douglas Aircraft at Long Beach.

George Osborne is now an ensign, U.S. N.A., stationed at Harvard University, Cambridge, Mass., for training.

Merle Smallberg is an assistant project engineer with Sperry Gyroscope Company, Garden City, N. Y.

Carter Hunt, Ensign, U.S.N.R., is stationed at the Puget Sound Navy Yard, Bremerton, Washington.

Gene McDaniel is working on design, development and construction of electronic instruments at the Physicists Research Company, Ann Arbor, Michigan.

Wilbur Crater was married in June to Miss Katherine Virginia Miller of Pasadena. They are at home in Erie, Penn.

Forrest Clingan and **Richard Latter,** Ensigns, U.S.N.R., have been stationed at Cornell University, Ithaca, New York.

Layton True, Ensign, U.S.N.R., reported in July for temporary duty for instruction at Dartmouth College.

Melvin J. Skinner was married in June to Miss June Charlotte Carson of Pasadena. They are now living in Berkeley.

John Rubel, employed by General Electric at Schnectady, was married early in June to Miss Dorothy Rosencranz of Beverly Hills. Mr. Rubel was associate editor of the April and June issues of the Alumni Review.

Roger Brandt, working for the Sylvania Corporation in Emporium, Pennsylvania, is already firmly entranched in the community as scoutmaster of the local Boy Scout troop.

Warren Hall, Ensign, U.S.N.R., was married in June to Miss Betty Nickerson of Pasadena.

Thomas Curtis is in San Jose, Costa Rica. with the U.S.E.D., as a computer-draftsman on the Inter-American Highway Survey.

Thomas Elliott, football and track star, recently was married to Miss Barbara Ritchie of Rockford, Illinois.

Howard Martens is now a research assistant at Caltech, and has been given a leave of absence from Ingersoll Rand.

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